

**UNISYS**

**A Series**

**ALGOL**

**Programming  
Reference Manual**

**Volume 1: Basic  
Implementation**

Release 3.9.0

September 1991

Priced Item

U S America  
8600 0098-000

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# About This Manual

## Purpose

This language reference manual provides the programmer with information on the language components, declarations, statements, expressions, and program units of Unisys Extended ALGOL.

Unisys Extended ALGOL is a high-level, structured programming language designed for A Series systems. Unisys Extended ALGOL has provisions for communication between programs and input/output (I/O) devices, the editing of data, and the implementation of diagnostic facilities for program debugging.

The fundamental constituents of ALGOL are the language components. These are the building blocks of the language and include, among other things, letters, digits, and special characters such as the semicolon (;).

At a level of complexity higher than language components are declarations, statements, and expressions. These are the building blocks of ALGOL programs. A declaration associates identifiers with specific properties. For example, an identifier can be associated with the properties of a real number. A statement indicates an operation to be performed, such as the assignment of a numerical value to an array element or the transfer of program flow to a location in the program out of the normal sequence. An expression describes operations that are performed on specified quantities and return a value. For example, the expression *SQRT(100)* returns 10.0, the square root of 100.

At the highest level are program units. A program unit is any group of ALGOL constructs that can be compiled as a whole by the ALGOL compiler. An ALGOL program is, by definition, a program unit.

## Scope

To assist application programmers in using ALGOL, the programming reference material is divided into two volumes. Volume 1 contains the Unisys Extended ALGOL developed for general use. Volume 2 contains extensions to ALGOL that are intended for specific products.

## Audience

This manual is intended for the applications programmer or systems analyst who is experienced in developing, maintaining, and reading ALGOL programs.

## Prerequisites

To use this manual, a programmer should be familiar with the general concepts of ALGOL programming or of another high-level structured programming language, such as Pascal.

## How to Use This Manual

This manual contains reference information for each ALGOL feature, which can be accessed either through the index or the table of contents. Cross references are provided within each section. Declarations, statements, expressions, functions, and compiler control options are each presented in alphabetical order within their sections.

This manual also describes the language components and programs units of Unisys Extended ALGOL. Unless otherwise stated, the word ALGOL refers to Unisys Extended ALGOL.

## Organization

The earlier sections describe the fundamentals of ALGOL: the structure of programs and the basic components of the language. The middle chapters describe the major constructs of ALGOL: declarations, statements, and expressions. The later chapters describe topics related to compiling ALGOL programs, and interfaces between ALGOL and other facilities such as libraries. The appendixes contain reference information about reserved words and about the format used internally to store data.

The manual contains the following sections and appendixes, supplemented by a glossary, a bibliography, and an index.

### **Section 1. Program Structure**

This section defines the basic structure of an ALGOL program and the scope of variables.

### **Section 2. Language Components**

This section defines the most elemental constructs in the ALGOL language.

### **Section 3. Declarations**

This section defines the constructs that establish data structures in an ALGOL program and associate identifiers with those data structures. These constructs are ordered alphabetically by declaration name.

### **Section 4. Statements**

This section defines the constructs that describe operations to be performed in an ALGOL program. These constructs are ordered alphabetically by statement name.

## **Section 5. Expressions and Functions**

This section defines the constructs used to describe operations that are performed on specified quantities and return a value. The first part of the section describes the types of expressions. These types are ordered alphabetically by expression name. The second part of the section describes functions that are intrinsic to ALGOL. These functions are ordered alphabetically by their names.

## **Section 6. Compiling Programs**

This section describes the various input and output files used by the ALGOL compiler and the compiler control options that control the compiler's processing of ALGOL source input.

## **Section 7. Compile-Time Facility**

This section describes how ALGOL source data can be compiled conditionally and iteratively.

## **Section 8. Library Facility**

This section describes library creation, use, sharing, and initiation.

## **Section 9. Internationalization**

This section includes a general introduction to internationalization concepts and a summary of CENTRALSUPPORT library procedures. Each internationalization function entry point, with its parameters and results, is presented in alphabetical order. A list of error messages and values ends the section.

## **Appendix A. Run-Time Format-Error Messages**

This appendix interprets the error numbers given at run time when an error occurs in a READ or WRITE statement.

## **Appendix B. Reserved Words**

This appendix lists the identifiers that need not be declared in an ALGOL program before they are used, if they appear in recognized contexts.

## **Appendix C. Data Representation**

This appendix describes the internal form of the various operands, the descriptor, the pointer, and the various character sets.

## **Appendix D. Understanding Railroad Diagrams**

This appendix describes how to read and understand the various elements of railroad, or syntax, diagrams that appear in the manual.



## Related Product Information

***A Series ALGOL Programming Reference Manual, Volume 2: Product Interfaces (form 8600 0734)***

This manual describes the extensions to the Extended ALGOL language that allow application programs to use the Advanced Data Dictionary System (ADDS), the Communications Management System (COMS), the Data Management System II (DMSII), the Screen Design Facility Plus (SDF Plus), or the Semantic Information Manager (SIM). This manual is written for programmers who are familiar with Extended ALGOL programming language concepts and terms.

***A Series ALGOL Test and Debug System (TADS) Programming Guide (form 1169539)***

This guide describes the features of ALGOL TADS, an interactive tool used for testing and debugging ALGOL programs and libraries. ALGOL TADS allows the programmer to monitor and control the execution of programs under test and examine the data at any given point during program execution. This guide is written for programmers who are familiar with ALGOL programming language concepts and terms.

***A Series Binder Programming Reference Manual (form 8600 0304)***

This manual describes the functions and applications of the Binder, an efficiency tool that reduces the need to recompile an entire program when only a portion of the program has been modified. This manual is written for programmers who are familiar with programming language concepts and terms.

***A Series CANDE Operations Reference Manual (form 8600 1500)***

This manual describes how CANDE operates to allow generalized file preparation and updating in an interactive, terminal-oriented environment. This manual is written for a wide range of computer users who work with text and program files.

***A Series Distributed Systems Service (DSS) Operations Guide (form 8600 0122)***

This guide describes the capabilities and features of DSS Services. It is intended for system operators, system administrators, and general computer users.

***A Series Editor Operations Guide (form 8600 0551)***

This guide describes the operation of the Editor, an interactive tool for creating and modifying text and program files. This guide is written for experienced and inexperienced users who are responsible for creating and maintaining text and program files.

***A Series File Attributes Programming Reference Manual (form 8600 0064). Formerly A Series I/O Subsystem Programming Reference Manual***

This manual contains information about each file attribute and each direct I/O buffer attribute. The manual is written for programmers and operations personnel who need to understand the functionality of a given attribute. The *A Series I/O Subsystem Programming Guide* is a companion manual.

***A Series I/O Subsystem Programming Guide (form 8600 0056). Formerly A Series I/O Subsystem Programming Reference Manual***

This guide contains information about how to program for various types of peripheral files and how to program for interprocess communication, using port files. This guide is written for programmers who need to understand how to describe the characteristics of a file in a program. The *A Series File Attributes Programming Reference Manual* is a companion manual.

***A Series Menu-Assisted Resource Control (MARC) Operations Guide (form 8600 0403)***

This guide provides an overview of MARC, a description of the menu structure, and information on how to use help text, commands, security features, and Communications Management System (COMS) windows from MARC. The guide also explains how to run programs from MARC, how to customize MARC to meet user needs, and how to use MARC in a multinational environment. This guide is written for a wide audience, ranging from experienced system administrators to end users with no previous knowledge of MARC or A Series systems.

***A Series Message Translation Utility (MSGTRANS) Operations Guide (form 8600 0106). Formerly A Series Message Translation Utility Operations Guide***

This guide describes how to use the Message Translation Utility (MSGTRANS) to translate compiled program messages from any natural language to any other natural language. It provides complete instructions for running and using the screen and batch interfaces of MSGTRANS. This guide is written for programmers and translators who create and translate program messages in a Multilingual System (MLS) environment.

***A Series MultiLingual System (MLS) Administration, Operations, and Programming Guide (form 8600 0288)***

This guide describes how to use the MLS environment, which encompasses many Unisys products. The MLS environment includes a collection of operating system features, productivity tools, utilities, and compiler extensions. The guide explains how these products are used to create application systems tailored to meet the needs of users in a multilingual or multicultural business environment. It explains, for example, the procedures for translating system and application output messages, help text, and user interface screens from one natural language to one or more other languages; for instance, from English to French and Spanish. This guide is written for international vendors, branch systems personnel, system managers, programmers, and customers who wish to create customized application systems.

***A Series System Architecture Reference Manual, Volume 2 (form 5014954)***

This manual describes and defines the architecture used in A Series data processing system products. It describes operating system concepts and requirements. It is written for personnel developing programs to run on A Series systems.

***A Series System Commands Operations Reference Manual (form 8600 0395)***

This manual gives a complete description of the system commands used to control system resources and work flow. This manual is written for systems operators and administrators.

## About This Manual

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### ***A Series System Software Utilities Operations Reference Manual (form 8600 0460)***

This manual provides information on the system utilities, such as DCSTATUS, FILECOPY, and DUMPALL. This manual is written for applications programmers and operators.

### ***A Series Task Attributes Programming Reference Manual (form 8600 0502)***

This manual describes all the task attributes available on A Series systems. It also gives examples of statements for reading and assigning task attributes in various programming languages.

### ***A Series Work Flow Language (WFL) Programming Reference Manual (form 8600 1047)***

This manual presents the complete syntax and semantics of WFL. WFL is used to construct jobs that compile or run programs written in other languages and that perform library maintenance such as copying files. This manual is written for individuals who have some experience with programming in a block-structured language such as ALGOL and who know how to create and edit files using CANDE or the Editor.

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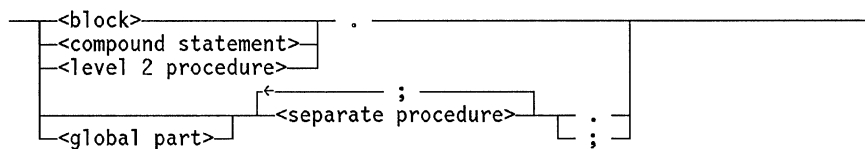
# Section 1

## Program Structure

### Program Unit

A program unit is a group of ALGOL constructs that can be compiled as a whole. The following diagram shows the elements that can be included in an ALGOL program.

**<program unit>**



**<block>**

— BEGIN —<declaration list>— ; —<statement list>— END —————|

**<declaration list>**

— [ —<declaration> ; — ] —————|

**<statement list>**

— [ —<statement> ; — ] —————|

**<compound statement>**

— BEGIN —<statement list>— END —————|

**<level 2 procedure>**

—<procedure declaration>—————|

**<global part>**

— [ —<declaration list>— ] —————|

**<separate procedure>**

—<procedure declaration>—————|

# Elements of an ALGOL Program

The simplest valid ALGOL program is a BEGIN/END pair. The BEGIN/END pair can enclose a list of declarations, a list of modules, or a list of statements. If the BEGIN/END pair is preceded by a procedure heading, the entire program is a procedure, which can be typed or untyped and can have one or more parameters.

Program units can be blocks, compound statements, level 2 procedures, or separate procedures that have a lexical (lex) level of three or greater and that can have global declarations.

A block is a statement that groups one or more declarations and statements into a logical unit by using a BEGIN/END pair. A compound statement is a statement that groups one or more statements into a logical unit by using a BEGIN/END pair. A compound statement is a block without any declarations.

The definitions of a compound statement and a block are recursive: both compound statements and blocks are made, in part, of statements. A statement can itself be a compound statement or a block.

The structures of compound statements and blocks are illustrated in the following:

### Compound Statements

```
BEGIN
  <statement>;
  <statement>;
  .
  .
  .
  <statement>;
END
```

```
BEGIN
  <statement>;
  <statement>;
  BEGIN
    <declaration>;
    BEGIN
      <statement>;
      <statement>;
    END;
  END;
  <statement>;
END
```

## Blocks

```

BEGIN
  <declaration>;
  <declaration>;
  .
  .
  <declaration>;
  <statement>;
  <statement>;
  .
  .
  <statement>;
END

BEGIN
  <declaration>;
  <declaration>;
  <statement>;
  BEGIN
    <declaration>;
    <statement>;
  END;
  BEGIN
    <statement>;
    <statement>;
    <statement>;
  END;
END

```

A program unit that is a separate procedure is typically bound to a host program to produce a more complete program.

The <global part> construct allows global identifiers to be referenced within a separate procedure. Any program unit that has a global part is valid only for binding to a host.

A program unit can be preceded, but not followed, by a remark.

A compound statement is executed in-line and does not require a procedure entrance and exit. A block, however, is executed like a procedure and requires a procedure entrance and exit. Entering a block requires extra processor resources; entering a compound statement does not.

## Examples

### Compound Statement

```

BEGIN
  DISPLAY("HI THERE");
  DISPLAY("THAT'S ALL FOLKS");
END.

```

### Block

```

BEGIN
  REAL X;
  X := 100;
END.

```



### Level 2 Procedure

```
PROCEDURE S;  
BEGIN  
  REAL X;  
  X := SQRT(4956);  
END.
```

### Separate Procedure with Global Part

```
[REAL S;  
  ARRAY B[0:255];  
  FILE LINE;]  
REAL PROCEDURE Q;  
BEGIN  
  Q := S*B[4];  
  WRITE(LINE,/, "DONE");  
END.
```

According to the syntax, the last statement of a block or compound statement is not followed by a semicolon (;). However, in the above examples (and throughout this manual), the last statement is always followed by a semicolon. This is valid because the statement before the END is the null statement.

## Scope

The scope of an identifier is the portion of an ALGOL program in which the identifier can successfully be used to denote its corresponding values and characteristics.

In one part of an ALGOL program, an identifier can be used to denote one set of values and characteristics, while in another part of the program, the same identifier can be used to denote a different set of values and characteristics.

For example, in one block the identifier `EXAMPLE_IDENT` can be declared as a `REAL` variable. That is, the identifier can be used to store single-precision, floating-point arithmetic values. Such an identifier could be assigned the value 3.14159. In another block of the same program, `EXAMPLE_IDENT` can be declared as a `STRING` variable. In this block, `EXAMPLE_IDENT` could be assigned the value *ALGOL IS A HIGH-LEVEL, BLOCK-STRUCTURED LANGUAGE*.

Although `EXAMPLE_IDENT` can be of type real and of type string in the same program, within a specific block `EXAMPLE_IDENT` has only one type associated with it. In general, the scope of an identifier is always such that within a given block, the identifier has associated with it at most one set of values and characteristics.

The scope of an identifier is described by rules that define which parts of the program are included by the scope, which parts of the program are excluded by the scope, and the requirements for uniqueness placed on the choice of identifiers. These general rules are described as follows.

## Local Identifiers

An identifier that is declared within a block is referred to as local to that block. The value or values associated with that identifier inside the block are not associated with that identifier outside the block. In other words, on entry to a block, the values of local identifiers are undefined; on exit from the block, the values of local identifiers are lost. An identifier that is local to a block is global to blocks occurring within the block. When a block is exited, identifiers that are global to that block do not lose the values associated with them. The properties of global identifiers are described more completely below.

## Global Identifiers

An identifier that appears within a block and that is not declared within the block, but is declared in an outer block, is referred to as global to that block. A global identifier retains its values and characteristics as the blocks to which it is global are entered and exited.

As the following program illustrates, an identifier can be local to one block but global to another block.

```

BEGIN
  FILE PRTR(KIND = PRINTER);
  REAL A;
  A := 4.2 @ -1; % FIRST STATEMENT OF OUTER BLOCK
  BEGIN
    LIST L1 (A);
    INTEGER A;
    LIST L2 (A);
    A := 3; % FIRST STATEMENT OF INNER BLOCK
    WRITE (PRTR, */ , L1);
    WRITE (PRTR, */ , L2);
  END; % OF INNER BLOCK
  A := A*A;
  WRITE (PRTR, */ , A);
END. % OF PROGRAM

```

In the preceding example, the identifier A that is declared REAL is global to the inner block. The A declared as type INTEGER in the inner block is local to the inner block, so when the inner block is exited, the integer A and its value, 3, are lost. Within the scope of integer A, a reference to A is a reference to the integer A, not to the global, real A. At the time the declaration for list L1 is compiled, the declaration for local A has not been seen, so list L1 contains the global, real A. However, the list L2 contains the local, integer A. The A referenced in the outer block is the A that was declared REAL and assigned the value 4.2 @ -1. The result of the first WRITE statement is A=0.42. The result of the second WRITE statement is A=3. The result of the third WRITE statement is A=0.1764, which equals 4.2 @ -1 \* 4.2 @ -1.

Global identifiers are used in inner blocks for the following reasons:

- To carry values that have been calculated in an outer block into the inner block
- To carry a value calculated inside the block to an outer block

## Program Structure

---

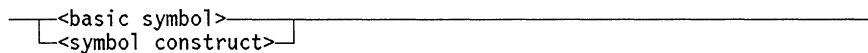
- To preserve a value calculated within a block for use in a later entry to the same block
- To transmit a value from one block to another block that does not contain and is not contained by the first block

# Section 2

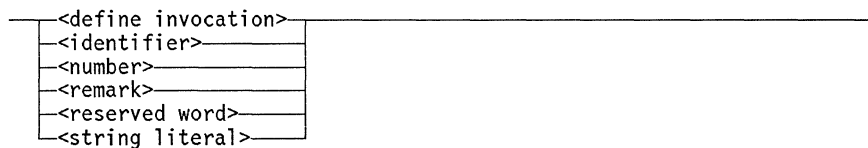
## Language Components

Language components are the building blocks of ALGOL. They consist of basic symbols, such as digits and letters, and symbol constructs, which are those groups of basic symbols that are recognized by the ALGOL compiler.

**<language component>**



**<symbol construct>**



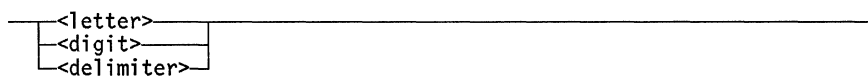
Basic symbols, identifiers, numbers, remarks, and string literals are described under separate headings in this section.

Because the define invocation is closely linked to the DEFINE declaration, the define invocation is explained under “DEFINE Declaration” in Section 3, “Declarations.”

Reserved words are described and listed in Appendix B, “Reserved Words.”

## Basic Symbol

**<basic symbol>**



**<letter>**

Any one of the uppercase (capital) letters A through Z.

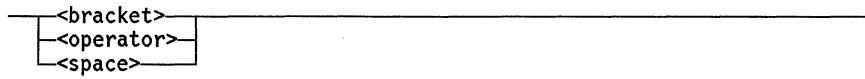
**<digit>**

Any one of the Arabic numerals 0 through 9.

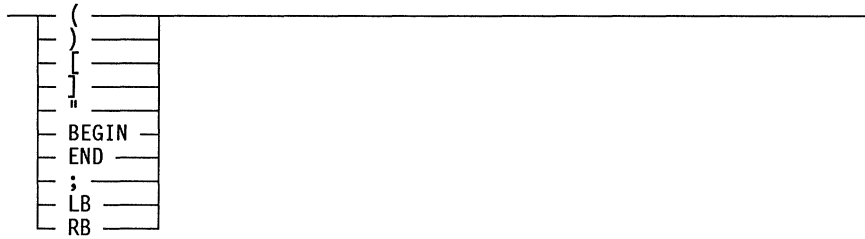
# Language Components

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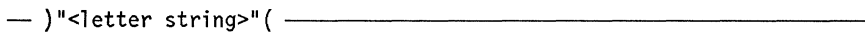
## <delimiter>



## <bracket>



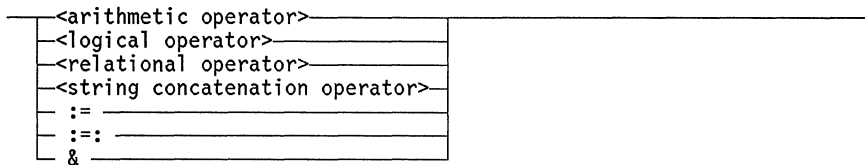
## <parameter delimiter>



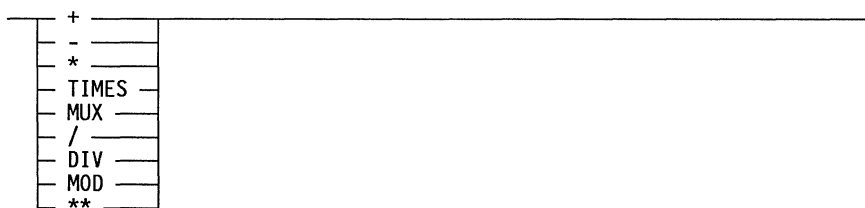
## <letter string>

Any character string not containing a quotation mark (").

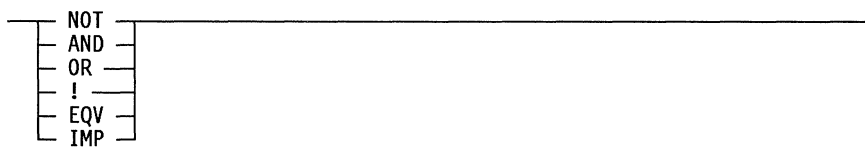
## <operator>



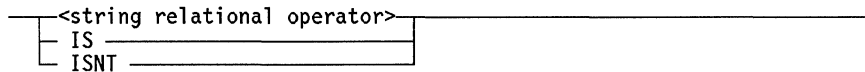
## <arithmetic operator>



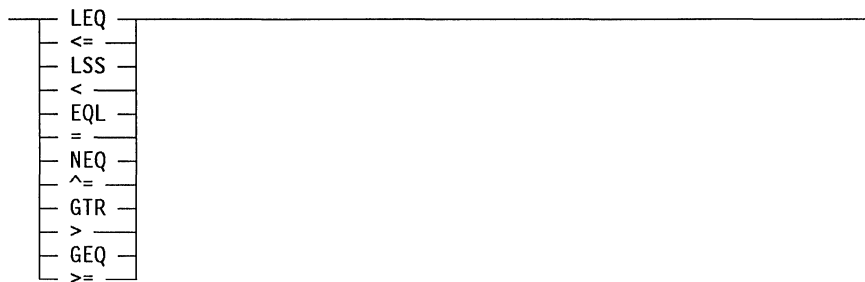
## <logical operator>



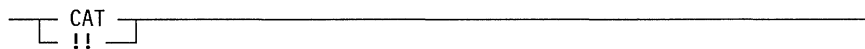
**<relational operator>**



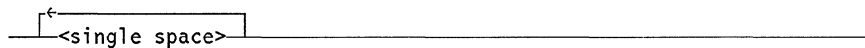
**<string relational operator>**



**<string concatenation operator>**



**<space>**



**<single space>**

One blank character.

Only uppercase letters are permitted. Lowercase letters are specifically disallowed. Individual letters do not have particular meanings except as used in pictures and formats.

Digits are used to form numbers, identifiers, and string literals.

Delimiters include operators, spaces, and brackets. An important function of these elements is to delimit the various entities that make up a program. Each delimiter has a fixed meaning, which, if not obvious, is explained in this manual in the syntax of appropriate constructs. Basic symbols that are words, such as some delimiters and operators, are reserved for specific use in the language. A complete list of these words, called reserved words, and details of the applicable restrictions are given in Appendix B, "Reserved Words."

Reserved words and basic symbols are used, together with variables and numbers, to form expressions, statements, and declarations. Because some of these constructs place programmer-defined identifiers next to delimiters composed of letters, these identifiers and delimiters must be separated. Therefore, a space must separate any two language components of the following forms:

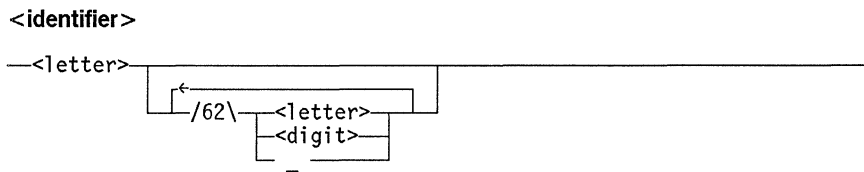
## Language Components

---

- Delimiter composed of letters
- Identifier
- Boolean value
- Unsigned number

Aside from these requirements, the use of a space between any two language components is optional. The meanings of the two language components are not affected by the presence or absence of the space.

## Identifier



Identifiers have no intrinsic meaning. They are names for variables, arrays, procedures, and so forth. An identifier must start with a letter, which can be followed by any combination of letters, digits, and underscore characters (`_`).

The scopes of identifiers are described in Section 1, “Program Structure.”

### Examples

#### Valid Identifiers

A  
I  
B5  
YSQUARE  
EQUITY  
RETURN\_RATE  
D2R271GL  
TEST\_1

#### Invalid Identifiers

1776

2BAD

\$

X-Y

NET GAINS

NO.

\_TEST

BEGIN

#### Reason

Does not begin with a letter.

Does not begin with a letter.

\$ is not an allowed character.

“-” is not an allowed character.

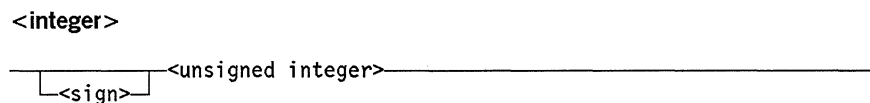
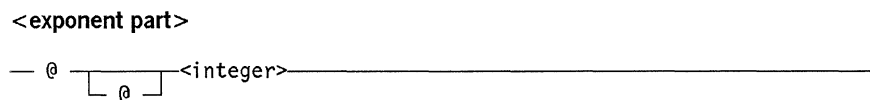
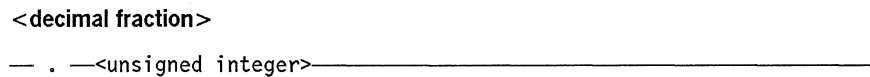
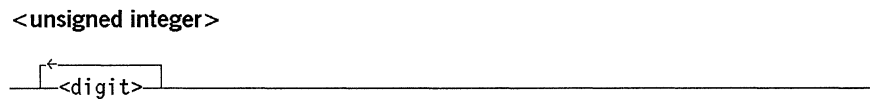
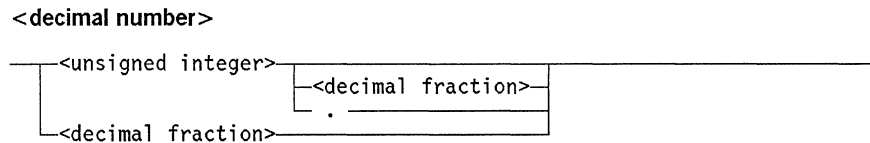
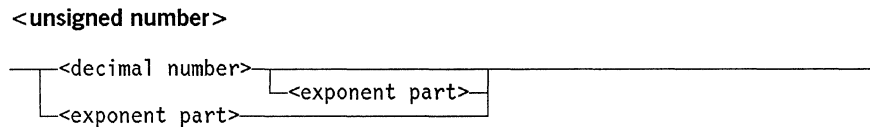
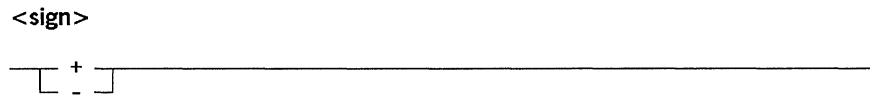
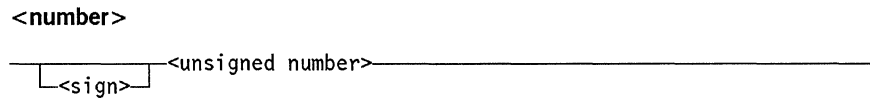
Blank spaces are not allowed.

“.” is not an allowed character.

Does not begin with a letter.

Reserved word.

# Number



No space can appear within a decimal number. All numbers that do not contain the double-precision exponent delimiter “@@” are considered to be single-precision numbers.

## Examples

Unsigned Integers	Decimal Fractions	Decimal Numbers
5	.5	69.
69	.69	.546

*continued*



## Language Components

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*continued*

Unsigned Integers	Decimal Fractions	Decimal Numbers
	.013	3.98
		25
Integers	Exponent Parts	Unsigned Numbers
1776	@8	99.44
-62256	@-06	@-11
+548	@+54	1354.543@48
	@@16	.1864@4

### Valid Numbers

∅  
+545627657893  
1.75@-46  
-4.31468  
-@2  
.375

### Invalid Numbers

50 00.5@8 8  
1,505,278  
@63.4  
1.667E-01 0

### Reason

Blank spaces are not allowed.  
Commas are not allowed.  
Exponent part must be an integer.  
E is not allowed for exponent part.

## Number Ranges

The sets of numbers that can be represented in ALGOL are symmetrical with respect to zero; that is, the negative number corresponding to any valid positive number can also be expressed in the language and the object program.

The largest and smallest integers and numbers that can be represented are as follows (decimal versions are approximate):

- Any integer between plus and minus  $549755813887 = 8^{**13} - 1 = 4^{**007FFFFFFFF}$ , inclusive, can be represented in integer form.
- For single-precision numbers:
  - The largest, positive, normalized, single-precision number that can be represented is  $4.31359146674@68 = (8^{**13} - 1) * 8^{**63} = 4^{**1FFFFFFFF}$ .
  - The smallest, positive, normalized, single-precision number that can be represented is  $8.75811540204@-47 = 8^{**(-51)} = 4^{**3F9000000000}$ .
- Zero and numbers with absolute values between the largest and smallest values given above can be represented as single-precision real numbers.

- For double-precision numbers:
  - The largest, positive, normalized, double-precision number that can be represented is  $1.94882838205028079124467@@29603 = (8^{**13} - 8^{**(-13)}) * 8^{**32767} = 4"1FFFFFFFFFFFFFFFFFFFFFFFFF"$ .
  - The smallest, positive, normalized, double-precision number that can be represented is  $1.9385458571375858335564@@-29581 = 8^{**(-32755)} = 4"3F900000000FF800000000"$ .
- Zero and numbers with absolute values between the largest and smallest values given above can be represented as double-precision numbers.

## Compiler Number Conversion

The ALGOL compiler can convert into internal format a maximum of 24 significant decimal digits of mantissa in double precision. The effective exponent, which is the explicit exponent value following the “@@” sign minus the number of digits to the right of the decimal point, must be less than 29604 in absolute value. For example, the final fractional zero cannot be specified in the smallest, positive, normalized, double-precision number shown above:  $-29581 - (23 \text{ fractional digits}) = -29604$ . Leading zeros are not counted in determining the number of significant digits. For example, 0.0002 has one significant digit, but 1.0002 has five significant digits.

The compiler accepts any value that can be represented in double precision (not more than 24 significant decimal digits) as an unsigned number. If this unsigned number does not contain an exponent part with “@@” (specifying a double-precision value), then the single-precision representation of that value is used. If the value represented by the significant digits of such an unsigned number, when disregarding the placement of the decimal point, is greater than 549755813887, then some precision is lost if the unsigned number is converted to single precision.

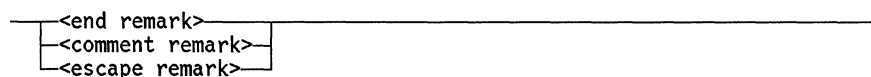
## Exponents

The exponent part is a scale factor expressed as an integer power of 10. The exponent part  $@@ <integer>$  signifies that the entire number is a double-precision value.

If the form of the unsigned number used includes only an exponent part, a decimal number of 1 is assumed. For example,  $@-11$  is interpreted as  $1@-11$ .

## Remark

`<remark>`



## Language Components

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### <end remark>

Any sequence of letters, digits, and spaces not containing the reserved words END, ELSE, or UNTIL.

### <comment remark>

— COMMENT —<comment characters>— ; —————|

### <comment characters>

Any sequence of EBCDIC characters not containing a semicolon (;).

### <escape remark>

— % —<escape text>—————|

### <escape text>

Any sequence of EBCDIC characters.

Remarks are provided as methods of inserting program documentation throughout an ALGOL source file.

The end remark can follow the language component END. The compiler recognizes the termination of the end remark when it encounters one of the reserved words END, ELSE, or UNTIL, or any nonalphabetic, nonnumeric EBCDIC character. Defines are not expanded within an end remark.

The comment remark is delimited by the word COMMENT at the beginning and a semicolon (;) at the end. The comment remark can appear between any two language components except within editing specifications.

Because remarks, string literals, and define invocations are language components, a comment remark is not recognized within a string literal, a define invocation, or another remark. Comment remarks can contain the dollar sign (\$), but the comment remark must not contain a dollar sign as the first nonblank character on a source record. If a dollar sign is the first nonblank character on a source record, the compiler interprets the source record as a compiler control record.

The percent sign (%) preceding escape text in an escape remark can follow any language component that is not contained in editing specifications. The escape remark begins with the percent sign and extends to the beginning of the sequence number field of the record. The compiler does not examine the escape remark. When the percent sign that precedes an escape remark is encountered, the compiler skips immediately to the next record of the source file before continuing the compilation.

### Examples

The following program illustrates some syntactically correct uses of the remark.

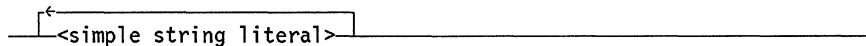
```
BEGIN
  FILE F(KIND=PRINTER COMMENT;);
  FORMAT COMMENT; FMT COMMENT; (A4,I6);
  PROCEDURE P(X,COMMENT;Y,Z);
    REAL X,Y COMMENT; ,Z;      % PERCENT SIGN CAN BE USED HERE
    X := Y + COMMENT; Z;      % HERE TOO
  IF COMMENT; 7 > 5 THEN
    WRITE(F,<"OK">);
  IF 4 COMMENT; > 2 THEN
    WRITE(F,<"OK">);
  IF 8 > 5 THEN
    WRITE COMMENT;(F,<"OK">);
END OF PROGRAM.
```

The following program illustrates some invalid uses of the remark.

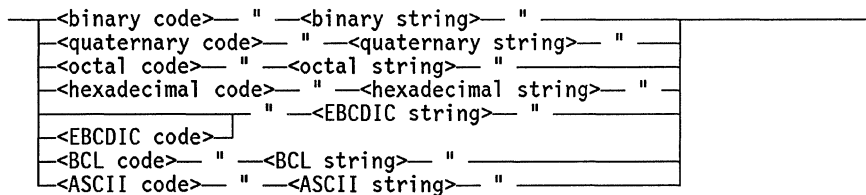
```
BEGIN
  FILE F(KIND=PRINTER);
  FORMAT FMT(13,F10.3 COMMENT; ,A4);
  ARRAY A[0:99];
  REAL X;
  FORMAT ("ABC", % CANNOT BE USED. "DEE");
  WRITE(F,<"INVALID USE" COMMENT;>);
  REPLACE POINTER(A) BY "ABCD COMMENT;EFGHIJ";
  X := "AB,COMMENT;C";
  COMMENT CANNOT BE USED HERE COMMENT; EITHER;
END.
```

## String Literal

<string literal>



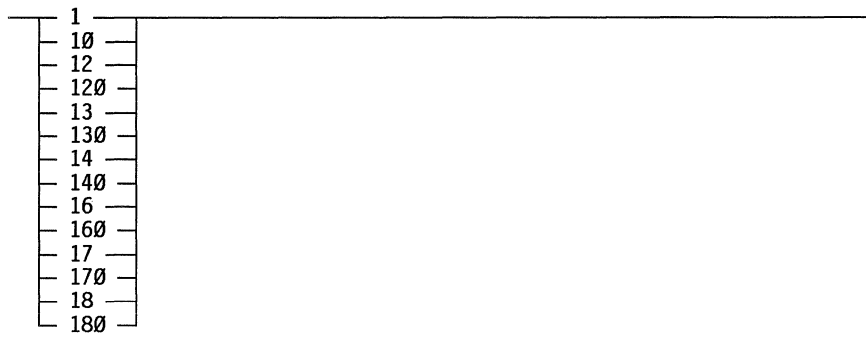
<simple string literal>



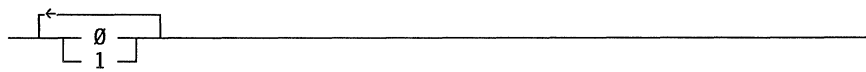
## Language Components

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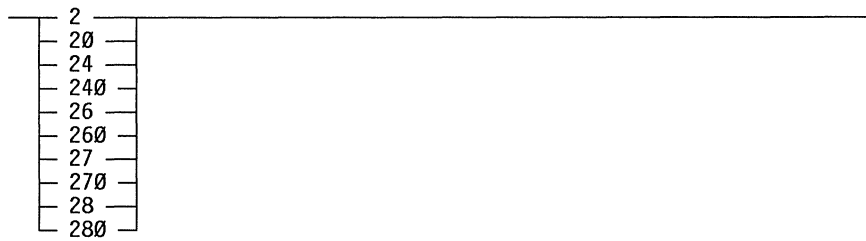
**<binary code>**



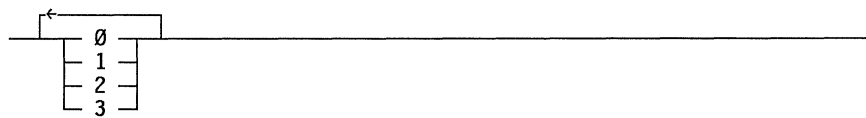
**<binary string>**



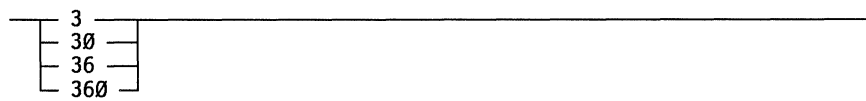
**<quaternary code>**



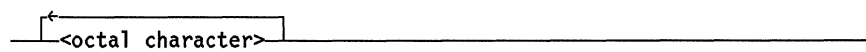
**<quaternary string>**



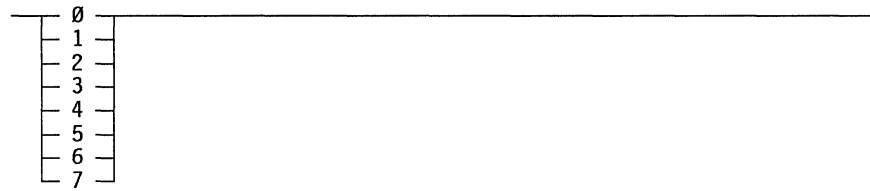
**<octal code>**



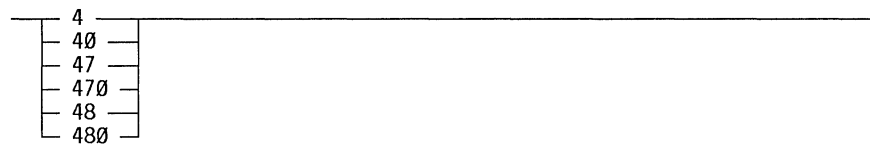
**<octal string>**



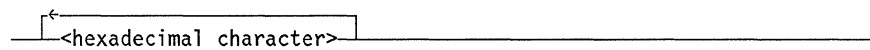
**<octal character>**



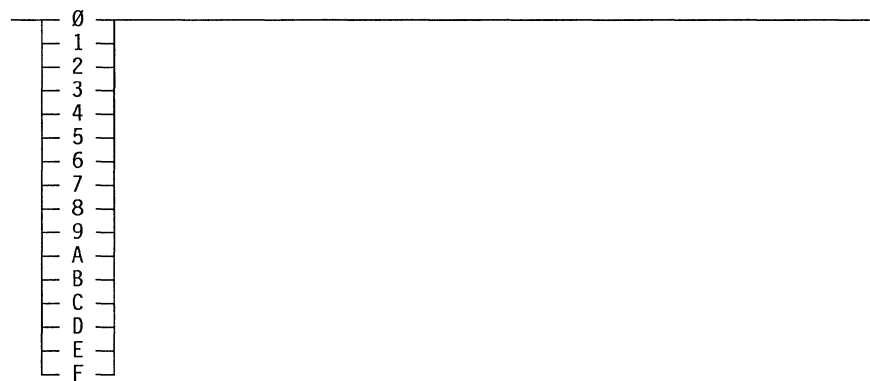
**<hexadecimal code>**



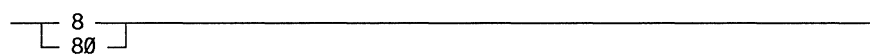
**<hexadecimal string>**



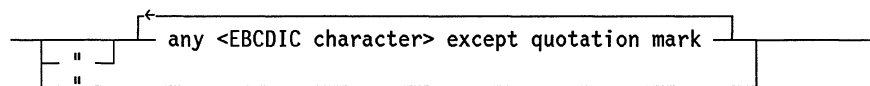
**<hexadecimal character>**



**<EBCDIC code>**



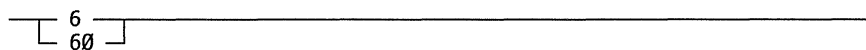
**<EBCDIC string>**



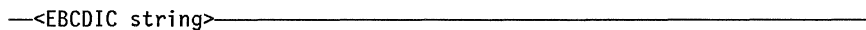
**<EBCDIC character>**

Any one of the 256 possible EBCDIC characters.

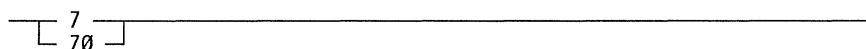
<BCL code>



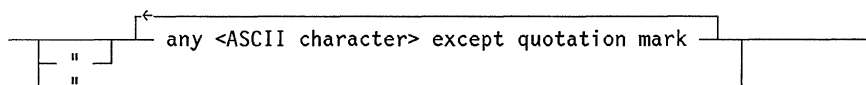
<BCL string>



<ASCII code>



<ASCII string>



<ASCII character>

Any one of the 128 possible ASCII characters.

## Character Size

Strings can be composed of binary (1-bit) characters, quaternary (2-bit) characters, octal (3-bit) characters, hexadecimal (4-bit) characters, BCL (6-bit) characters, ASCII (7-bit in 8-bit format) characters, or EBCDIC (8-bit) characters. The word formats of various character types are described under “Character Representation” in Appendix C “Data Representation.”

## String Code

The string code determines the interpretation of the characters between the quotation marks (") of a string literal. The string code specifies the character set and, for strings of less than 48 bits, the justification. The first digit of the string code specifies the character set in which the source string is written. The next nonzero digit (if any) specifies the internal character size of the string to be created by the compiler. If no nonzero digit is specified, the internal size is the same as the source size. If the internal size is different from the source size, the length of the string must be an integral number of internal characters. For example, the string literal 48"C1C2C3C4" is an EBCDIC string expressed in terms of hexadecimal characters.

If the string literal contains fewer than 48 bits, a trailing zero in the string code specifies that the string literal is to be left-justified within the word and that trailing zeros are to fill out the remainder of the word.

If the string literal contains fewer than 48 bits, the absence of a trailing zero in the string code specifies that the string literal is to be right-justified within the word and that leading zeros are to fill out the remainder of the word.

If the string literal contains 48 or more bits, the presence or absence of a trailing zero in the string code has no effect.

If the string code is not specified, the source string and the internal representation of the string are of the default character type. For more information, refer to “Default Character Type” in Appendix C, “Data Representation.”

## String Length

The maximum length permitted for a simple string literal is 256 characters; the maximum length permitted for a string literal is 4095 characters. However, when a string literal is used as an arithmetic primary, it must not exceed 48 bits in length.

Internally, a string literal of 48 bits or less is represented in the object code as an 8-bit, 16-bit, or 48-bit literal. A string literal more than 48 bits long is stored in a pool array created by the compiler. An internal pointer carries the character size and address of the string within the pool array.

## BCL Strings

BCL strings can contain any EBCDIC character. However, any EBCDIC character that does not have a BCL equivalent is translated by the compiler into a BCL question mark (36"14").

*Note: The BCL data type is not supported on all A Series systems. The appearance of a BCL construct that can cause the creation of a BCL descriptor, such as a BCL string literal more than 96 bits long, causes the program to get a compile-time warning message.*

## ASCII Strings

The ASCII string code can be used only with ASCII strings composed entirely of characters that have corresponding EBCDIC graphics. This is because the compiler recognizes only ASCII characters that have corresponding EBCDIC graphics.

The compiler translates each ASCII character into an 8-bit character. The rightmost seven bits are the ASCII representation of that character; the leftmost bit is 0.

ASCII characters that are not in the EBCDIC character set must be written as a hexadecimal string in which each pair of hexadecimal characters represents the internal code of one ASCII character, right-justified with a leading 0 bit.

## Quotation Mark

The quotation mark (") can appear only as the first character of a simple string literal. Strings with internal quotation marks must be broken into separate simple strings by using three quotation marks in succession. For example, the string literal ""ABC" represents the string "ABC, and the string literal "A""BC" represents the string A"BC.



### Dollar Sign

String literals can contain the dollar sign (\$). The dollar sign must not be the first nonblank character on a source record. If a dollar sign is the first nonblank character on a source record, the compiler interprets the source record as a compiler control record.

# Section 3

## Declarations

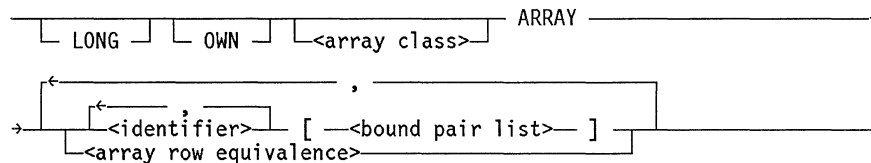
A declaration associates certain characteristics and structures with an identifier. In an ALGOL program, every identifier must be declared before it is used. The compiler ensures that subsequent usage of an identifier in a program is consistent with its declaration.

In this section, the ALGOL declarations are listed and discussed in alphabetical order. In many cases, the entire syntax diagram for a declaration is divided into smaller segments, and each segment is discussed in turn. Each declaration is accompanied by examples of its use.

### ARRAY Declaration

An ARRAY declaration declares one or more identifiers to represent arrays of specified fixed dimensions. After an array has been declared in an ARRAY declaration, values can be stored in and retrieved from the elements of the array by the use of subscripted variables, which contain the array identifier and a subscript list.

<array declaration>



### LONG Arrays

The LONG specification affects only array rows. It specifies that the array is not to be paged regardless of its length. The length of most LONG arrays is limited by the length of an overlay row that the operating system has been configured to use. Attempting to allocate, or to use the RESIZE statement to create, an array larger than the limit causes termination of the program at run time.

Normally, an array row longer than a certain threshold is automatically subdivided, or segmented, at run time into pages. Each page is of a fixed length, except the last, which can be shorter. The page size is a property of the machine on which the program is run; it is always a power of two and is never less than 256 words. The paging threshold is maintained by the operating system on which the program is run. The operating system enforces a limit on the size of a LONG array; the maximum length of an array is  $2^{20}-1$  words, and it is never less than  $\max(\text{page\_size}, 1024)$  words.

The array size at which an array row is automatically paged can be changed with the system command SEGARRAYSTART. For more information on the SEGARRAYSTART

## Declarations

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command, see the *A Series System Commands Operations Reference Manual*. Arrays smaller than 1024 words are never paged.

When `LONG` specification is designated, the maximum size of an array row is determined by the overlay row size of the system, which is specified at cold-start time.

## OWN Arrays

If an OWN array is declared, the array and its contents are retained on exit from the block in which the array is declared and are available on subsequent reentry into the block.

OWN arrays are allocated only once, regardless of the number of times entry is made into the block in which the array is declared. If the OWN array is declared with variable bounds, these bounds are evaluated once when the array is allocated, and the affected dimension retains these bounds for the remainder of the program execution. For information on resizing the array, refer to “RESIZE Statement” in Section 4, “Statements.”

An OWN array remains unreferenced from the time the program begins execution until the first execution of a statement that references the array is encountered. Once such a statement is encountered, the array is referenced, or *touched* for the remainder of the program execution.

An array that is not an OWN array remains unreferenced from the time the program enters the block in which the array is declared until the first execution of a statement that refers to the array. Once such a statement is encountered, the array is touched until the program exits the block.

Arrays not declared as OWN arrays are deallocated on exit from the block in which they are declared and are reallocated on every entry into the block in which the arrays are declared.

## Identifiers

**<array identifier>**

An identifier that is associated with an array in an ARRAY declaration.

**<character array identifier>**

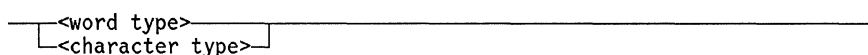
An array identifier, array reference identifier, direct array identifier, or value array identifier that is declared with a character type.

**<word array identifier>**

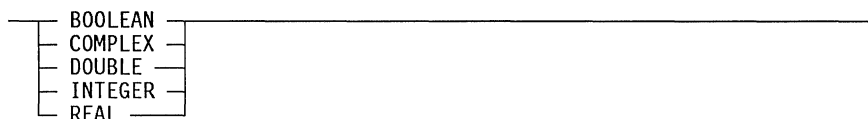
An array identifier, array reference identifier, direct array identifier, or value array identifier that is declared with a word type.

## Array Class

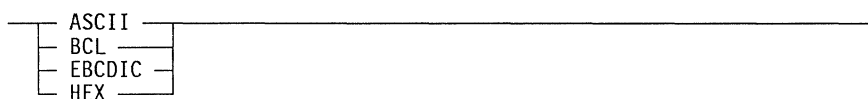
<array class>



<word type>



<character type>



Arrays declared in the same ARRAY declaration are of the same array class. If the array class is omitted, a REAL array is assumed. Arrays not declared with a character type are called word arrays. Arrays declared with a character type are called character arrays. Word and character arrays can be passed as parameters and used as array rows. Character arrays can be used as simple pointer expressions.

For character arrays, the actual storage area allocated is the number of whole words sufficient to contain the specified number of characters. The last portion of the last word in the storage area can be referenced by using pointer operations, even if this portion is beyond the valid subscript range. For example, if array A is declared *EBCDIC ARRAY A[0:3]*, the characters corresponding to A[4] and A[5] can be referenced by using a pointer operation.

**Note:** *The BCL character type is not supported on all A Series systems. The appearance of a BCL construct that can cause the creation of a BCL descriptor, such as a BCL array, causes the program to get a compile-time warning message.*

### Element Width

The element width of an array is the number of bits used to contain each element of the array. The element width is determined by the array class, as follows:

Array Class	Element Width
DOUBLE, COMPLEX	96 bits (double word)
INTEGER, REAL, BOOLEAN	48 bits (single word)
EBCDIC, ASCII	8 bits (6 characters per word)
BCL	6 bits (8 characters per word)
HEX	4 bits (12 characters per word)

## Declarations

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Within the operating system, arrays are manipulated by means of descriptors; each descriptor specifies an element width appropriate to the array class. Single-word and double-word descriptors are used for word arrays; 4-bit, 6-bit, and 8-bit descriptors are used for character arrays.

*Note: 6-bit descriptors (BCL) are not currently supported.*

Because complex and double array elements are composed of two 48-bit words, the two words are allocated contiguously. The layout of a complex array is as follows: the real part of the first element, the imaginary part of the first element, the real part of the second element, the imaginary part of the second element, and so on. Similarly, the layout of a double array is as follows: the first word of the first element, the second word of the first element, the first word of the second element, the second word of the second element, and so on.

For information on the internal representation of double and complex operands, refer to “Two-Word Operand” in Appendix C, “Data Representation.”

## Bound Pair List

<bound pair list>

┌───┐  
└─<bound pair>───┘

<bound pair>

—<lower bound>— : —<upper bound>───┘

<lower bound>

—<arithmetic expression>───┘

<upper bound>

—<arithmetic expression>───┘

The subscript bounds for an array are given in the first bound pair list following the array identifier. The bound pair list gives the lower and upper bounds of all dimensions, in order from left to right. In all cases, upper bounds must not be less than their associated lower bounds.

Arithmetic expressions used as array dimension bounds are evaluated once (from left to right) on entering the block in which the array is declared. These expressions can depend only on values that are global to that block or passed in as actual parameters. The results of the arithmetic expressions are evaluated as integers. Arrays declared in the outermost block must use constant bounds or constant expression bounds.

The maximum value of lower bound is 131,071; the minimum value of lower bound is -131,071.

## Original and Referred Arrays

Every array identifier that is declared with a bound pair list is an original array, which is distinct from all other original arrays.

There are three other ways to associate an identifier with an array: array row equivalence, array reference assignment, and array specification in a PROCEDURE declaration. In each of these cases, the identifier refers to the same data as an original array. Such an identifier is called a referred array. An array row equivalence or array reference assignment can cause an array identifier of one array class to refer to data in an original array of another array class.

## Dimensionality

The dimensionality (number of dimensions) of an original array is the number of bound pairs in the bound pair list with which the array is declared. Arrays cannot have more than 16 dimensions.

The size (number of elements) of each dimension of an array declared with a particular bound pair is given by the following expression:

$$\langle \text{upper bound} \rangle - \langle \text{lower bound} \rangle + 1$$

The maximum size of a dimension is  $2^{20}-1$  elements.

## Array Row Equivalence

**<array row equivalence>**

—<identifier>— [ —<lower bound>— ] — = —<array row>—————|

An array row equivalence causes the declared array identifier to refer to the same data as the specified array row. That array row can be an original array or another referred array. The declared identifier is an equivalent array.

The size of the declared array is determined by the size and element width of the array row and the element width for the array class of this declaration. For example, assume that  $S_a$  and  $W_a$  are the size and element width of the array row, and that  $W_e$  is the element width for the equivalent array. The size of the equivalent array,  $S_e$ , is then the following:

$$S_e := (S_a * W_a) \text{ DIV } W_e$$

Because of the truncation implicit in the DIV operation,  $S_e * W_e$  might be less than  $S_a * W_a$ . In this case, indexing the equivalent array by  $S_e + \langle \text{lower bound} \rangle$  causes an invalid index fault. Nevertheless, pointer operations that use the equivalent array can access the entire area of memory allocated to the original array to which the array identifier ultimately refers; the memory area can hold more than  $S_e$  elements of width  $W_e$ .

# Declarations

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The array row equivalence enables the program to reference the same array row with two or more identifiers. Each identifier can reference the same data with different type, character type, or lower bound specifications. For example, in the following program, both I[2] and R[0] contain the value 25.0 after the assignment I[2] := 25.234 is executed. However, after the assignment R[0] := 25.234 is executed, both I[2] and R[0] contain the value 25.234.

```
BEGIN
  REAL ARRAY R[0:9];
  INTEGER ARRAY I[2] = R; % Array row equivalence. The INTEGER
                          % array I refers to the same data as
                          % the REAL array R.

  I[2] := 25.234;
  R[0] := 25.234;
END.
```

The array row equivalence part cannot appear in an ARRAY declaration that declares an OWN array. For example, the following declaration is invalid:

```
OWN ARRAY A[0] = B
```

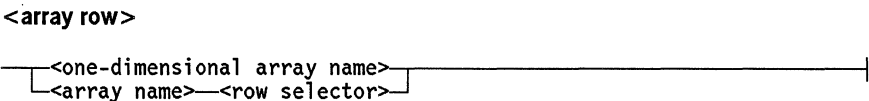
An array declared with an array row equivalence part is an OWN array if and only if the array to which it is equated is an OWN array.

*Note: There are subtle restrictions on the correct declaration and use of an array row equivalence in which the array row of the declaration is a row of an array reference, because the default state of an array reference variable is uninitialized.*

If the array reference is one-dimensional and has the same element width as the new array, then the two identifiers become synonyms. Whenever the array reference variable is assigned a value, the equivalent array describes the same data.

If the array reference is multidimensional and/or has a different element width than the new array, the array row equivalence is established from the value of the array reference variable at the time the program enters the block containing the array row equivalence declaration. Later assignments to the array reference variable do not affect the array row equivalence. Therefore, in order for the declaration to be useful, the array reference variable must have been declared and initialized in a scope global to the block declaring the array row equivalence.

## Array Row

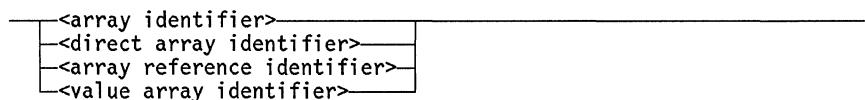


An array row is a one-dimensional array designator.

**<one-dimensional array name>**

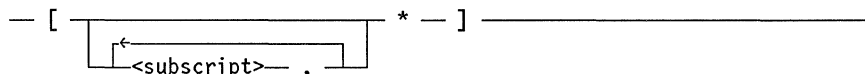
An <array name> whose identifier was declared with one dimension.

**<array name>**

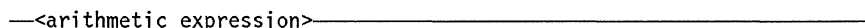


## Row Selector

**<row selector>**



**<subscript>**



A row selector is the limiting case of a subarray selector, with only one asterisk.

## Examples of ARRAY Declarations

The following example declares DOG, a four-dimensional array made up of  $6 * 26 * 7 * 13 = 14196$  integer elements:

```
INTEGER ARRAY DOG[0:5,0:25,1:7,4:16]
```

The following example declares STUB, a one-dimensional OWN array made up of 10 real elements:

```
OWN REAL ARRAY STUB[0:9]
```

The following example declares two real arrays: GROUP\_REAL, which is a one-dimensional array, and CAD, which is a two-dimensional array:

```
REAL ARRAY GROUP_REAL[0:17], CAD[400:500,1:50]
```

The following example declares the EBCDIC array GROUP\_EBCDIC. Array row equivalence causes GROUP\_EBCDIC to refer to the same data as the previously declared real array GROUP\_REAL. Note that the element width of GROUP\_REAL is 48 bits, whereas the element width of GROUP\_EBCDIC is 8 bits. This means that a reference to a single element in GROUP\_REAL refers to 48 bits, and a reference to a single element in GROUP\_EBCDIC refers to 8 bits.

```
EBCDIC ARRAY GROUP_EBCDIC[0] = GROUP_REAL[*]
```



## Declarations

---

The following example declares XRAY, a one-dimensional array. Because no array class is specified, the array class XRAY is of type REAL. The lower bound is the integerized value of  $X + Y + Z$ , and the upper bound is the integerized value of  $3 * A + B$ .

```
ARRAY XRAY[X+Y+Z:3*A+B]
```

The following example declares BIG\_ARRAY, a one-dimensional array made up of 10,000 Boolean elements. Because BIG\_ARRAY is declared a LONG array, the array is not paged (segmented). Because it is not paged, the array occupies 10,000 contiguous words in memory.

```
LONG BOOLEAN ARRAY BIG_ARRAY[0:9999]
```

The following example declares SEGARRAY, a one-dimensional array made up of 50,001 real elements. Because SEGARRAY is not declared a LONG array and the array row is longer than 1024 words, SEGARRAY is automatically divided at run time into segments that are 256 words long.

```
ARRAY SEGARRAY[0:50000]
```

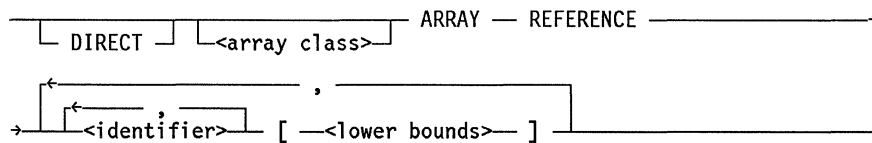
The following example declares C, a two-dimensional array made up of  $3 * 61 = 183$  complex elements. Note that the element width of a complex array is 96 bits (two words).

```
COMPLEX ARRAY C[0:2,0:60]
```

## ARRAY REFERENCE Declaration

An ARRAY REFERENCE declaration is used to establish an array reference variable. The array reference assignment statement can then be used to assign an array or part of an array to this variable.

<array reference declaration>



Following an array reference assignment, any subsequent use of the array reference identifier acts as a reference to the array assigned to it. For more information on array reference assignment, see “Array Reference Assignment” in Section 4, “Statements.”

If the array class is not specified as COMPLEX, the array reference variable can be declared as DIRECT. This declaration enables the array reference variable to be used in direct I/O operations.

**Note:** *The BCL data type is not supported on all A Series systems. The appearance of a BCL construct that can cause the creation of a BCL descriptor, such as a BCL array reference, causes the program to get a compile-time warning message.*

If an array class is not specified, a REAL array is assumed.

## Identifiers

**<array reference identifier>**

An identifier that is associated with an array reference in an ARRAY REFERENCE declaration.

**<direct array reference identifier>**

An identifier that is associated with an array reference that is declared as DIRECT in an ARRAY REFERENCE declaration.

## Lower Bounds

**<lower bounds>**

← `<constant arithmetic expression>` |

The number of dimensions of the array reference variable is determined by the number of lower bounds in its declaration. No more than 16 dimensions are allowed. For more information on lower bounds, see “ARRAY Declaration” earlier in this section.

The initial state of an array reference variable is uninitialized. Any attempt to use an uninitialized array reference variable as an array results in a fault at run time.

## Examples of ARRAY REFERENCE Declarations

The following example declares REFARRAY, an array reference variable with a lower bound of 3. Because an array class is not specified, REFARRAY is a real array reference variable.

```
ARRAY REFERENCE REFARRAY[3]
```

The following example declares DIRREFARRAY, a direct, real array reference variable with a lower bound equal to the value of N. Because this array reference variable is declared to be DIRECT, it can be used in direct I/O operations.

```
DIRECT ARRAY REFERENCE DIRREFARRAY[N]
```

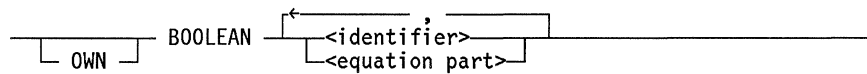
The following example declares two complex array reference variables. CREF1 is a one-dimensional array reference variable with a lower bound of 0 (zero), and CREF2 is three-dimensional with lower bounds of 0, 10, and 10.

```
COMPLEX ARRAY REFERENCE CREF1[0], CREF2[0,10,10]
```

### BOOLEAN Declaration

A BOOLEAN declaration declares simple variables that can have Boolean values of TRUE or FALSE.

<Boolean declaration>



A simple variable declared with the OWN specification retains its value when the program exits the block in which the variable is declared. The value of that variable is again available when the program reenters the block in which the variable is declared.

<Boolean identifier>

An identifier that is associated with the BOOLEAN data type in a BOOLEAN declaration.

### Equation Part

<equation part>



The equation part causes the simple variable being declared to have the same address as the simple variable associated with the second identifier. This action is called *address equation*. An identifier can be address-equated only to a previously declared local identifier or to a global identifier. The first identifier must not have been previously declared within the block of the equation part. An equation part is not allowed in the global part of a program.

Address equation is allowed only among INTEGER, REAL, and BOOLEAN variables. Because both identifiers of the equation part have the same address, altering the value of either variable affects the value of both variables. For more information, see "Type Coercion of One-Word and Two-Word Operands" in Appendix C, "Data Representation."

The OWN specification has no effect on an address-equated identifier. The first identifier of an equation part is declared with the OWN specification only if the second identifier of the equation part is also declared with the OWN specification.

### Boolean Simple Variable Values

The TRUE or FALSE value of a Boolean simple variable and the value of any other Boolean operand depend only on the low-order bit (bit zero) of the word. Each of the 48 bits of a Boolean simple variable contains a Boolean value that can be interrogated or altered by using the partial word part or concatenation.

When a Boolean simple variable is allocated, it is initialized to FALSE, a 48-bit word with all bits equal to 0 (zero).

Refer to Appendix C, “Data Representation,” for additional information on the internal structure of a Boolean operand as implemented on A Series systems.

## Examples of BOOLEAN Declarations

The following example declares `BOOL` as a Boolean simple variable.

```
BOOLEAN BOOL
```

The following example declares `DONE` and `ENDOFIT` as Boolean simple variables. Because they are declared as `OWN`, these simple variables retain their values when the program exits the block in which the simple variables are declared.

```
OWN BOOLEAN DONE, ENDOFIT
```

The following example declares `FLAG` and `BINT` as Boolean simple variables, and address-equates `BINT` to the previously declared simple variable `INTGR`. The variables `BINT` and `INTGR` share the same address.

```
BOOLEAN FLAG, BINT = INTGR
```

## COMPLEX Declaration

A `COMPLEX` declaration declares a simple variable that can have complex values.

<complex declaration>

```
┌──┴──┐
└──┬──┘  OWN  COMPLEX  ┌──┴──┐
                               <identifier>
```

<complex identifier>

An <identifier> that is associated with the `COMPLEX` data type in a `COMPLEX` declaration.

## Complex Variables

Complex variables allow for the storage and manipulation of complex values in a program. The interpretation of complex values is the usual mathematical one. The real and imaginary parts of complex values are always stored separately as single-precision real values.

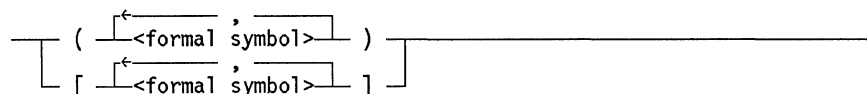
Because a real value is a complex value with an imaginary part equal to 0 (zero), the set of real values is a subset of the set of complex values. Therefore, arithmetic values can be assigned to complex variables, but complex values cannot be assigned to arithmetic variables.



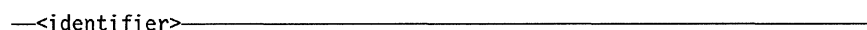
Compiler control records occurring within the text are processed normally if the dollar sign (\$) is in column 1 or 2. If the dollar sign is in column 3 or beyond, a syntax error is generated whenever the define is invoked.

## Formal Symbol Part

**<formal symbol part>**



**<formal symbol>**



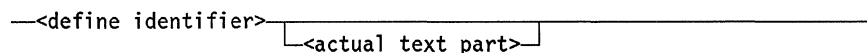
A define has two forms: simple and parametric. These forms are readily differentiated because parametric defines have a series of parameters (called formal symbols) enclosed in matching parentheses or brackets. The parentheses and the brackets have identical meanings.

The formal symbols constitute the essential part of a parametric define. Formal symbols function similarly to the formal parameters of a PROCEDURE declaration. When a parametric define is invoked, wherever formal symbols appear in the text, a substitution of the corresponding closed text of the define invocation is made before that part of the text is compiled. References to formal symbols cannot appear outside the text of the corresponding parametric define. No more than nine formal symbols are allowed in a parametric define.

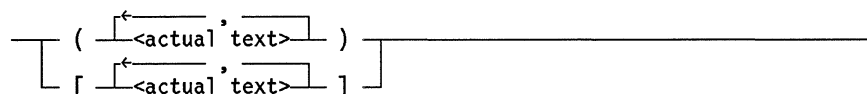
## Define Invocation

A define invocation causes a define identifier to be replaced by the text associated with the define identifier.

**<define invocation>**



**<actual text part>**



The parentheses and the brackets have identical meanings. These symbols are used when a parametric define is invoked.

## Declarations

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<actual text>

Program text that cannot contain mismatched or unmatched parentheses, brackets, or quotation marks, or any comma outside of these bracketing symbols.

The invocation of a parametric define causes the actual text to be substituted into the positions in the text designated by the proper formal symbol.

The actual text need not be simple. As an example, assume you are using the following DEFINE declaration:

```
DEFINE FORJ(A,B,C) = FOR J := A STEP B UNTIL C #
```

For this declaration, the following applies:

Define Invocation	Expands to
FORJ(0,B*3,MAX(X,Y,Z))	FOR J := 0 STEP B*3 UNTIL MAX(X,Y,Z)

The actual text can be empty in a define invocation. In this case, all occurrences of the corresponding formal symbol in the text are replaced by no text. For example, assume you are using the following DEFINE declaration:

```
DEFINE F(M, N) = M + N #
```

For this declaration, the following applies:

Define Invocation	Expands to	Syntactically Correct
R := F(, 1);	R := +1;	Yes
R:=F(2,);	R:=2+;	No

A define identifier cannot be invoked as a part, rather than the whole, of a language component such as a string literal or a number. For example, assume you are using the following declarations:

```
EBCDIC STRING S;  
DEFINE EBCDIC_STR = 8 #;
```

For these declarations, the following two statements are not interpreted by the compiler to be equivalent:

Statement	Syntactically Correct
S := EBCDIC_STR"ABC";	No
S := 8"ABC";	Yes

The invocation of define EBCDIC\_STR is interpreted by the compiler as a whole language component, specifically a number, and not as an EBCDIC code preceding a quoted EBCDIC string. Thus, it appears that a number is being assigned to a string variable, which is illegal, and the compiler flags the statement with a syntax error.

As a further example, assume you are using the following declarations:

```
REAL R;
DEFINE ITEM = 15 #;
```

For these declarations, the following applies:

Statement	Legal
R := ITEM;	Yes
R := ITEM.30;	No, because it is equal to $R := (15).30$ ;, which is illegal.

In the following instances, the appearance of a define identifier does not cause the define to be expanded:

- Defines are not expanded in an end remark, a comment remark, or an escape remark.
- Defines are not expanded within quoted strings. For example, assume you are using the following declaration:

```
DEFINE ONE = THE FIRST #;
```

For this declaration, the string ONE WEEK is not equivalent to the string THE FIRST WEEK.

- Defines are not expanded within identifiers. For example, assume you are using the following declaration:

```
DEFINE A = PREFIX #;
```

For this declaration, the identifiers A\_B and ABC are not expanded to PREFIX\_B and PREFIXBC.

- Define identifiers are not always expanded when they occur in declarations. If the define identifier occurs in a position where an identifier can appear, the define identifier is not expanded. If the define identifier occurs in a position where an identifier is not expected, the define identifier is expanded. The following examples illustrate this rule:

```
DEFINE A = ARRAY #;
A B[0:10];           % A is expanded.
REAL A B[0:10];     % A can be interpreted as an identifier
                    % in a REAL declaration. A is not
                    % expanded. A syntax error results.
EBCDIC A B[0:10];  % A is expanded.
```

- A define identifier is not expanded either in the format part of a FORMAT declaration or in the editing specifications of a READ statement or WRITE statement. Furthermore, if a FORMAT declaration or editing specifications are located within the text of a parametric define, they cannot reference the formal symbols of that define.



## Declarations

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- A define identifier is not expanded when used in place of a file or task attribute mnemonic. Refer to the *A Series File Attributes Programming Reference Manual* for file attribute mnemonics and the *A Series Work Flow Language (WFL) Programming Reference Manual* for task attribute mnemonics. In the following example, the define identifiers are not expanded in the FILE declaration or in the VALUE function:

```
DEFINE NEVERUSED = NEWTASK #,  
        PRINTER = REMOTE #;  
  
FILE F(KIND = PRINTER);      % INTERPRETED AS PRINTER,  
                             % NOT REMOTE  
  
T.STATUS := VALUE(NEVERUSED); % INTERPRETED AS NEVERUSED,  
                             % NOT NEWTASK
```

If the ALGOL compiler encounters a syntax error while compiling the combination of the text, actual text part, and formal symbol part at the occurrence of a define invocation, some or all of the expanded define is given along with the appropriate error message.

To avoid problems with expanding a define, particularly when an expression is passed in as actual text, each occurrence of a formal symbol in the text of a parametric define should be enclosed in parentheses. For example, consider the following program:

```
BEGIN  
  BOOLEAN BOOL;  
  DEFINE  
    LOGIC1(A,B) = A AND B #,  
    LOGIC2(A,B) = (A) AND (B) #;  
  BOOL := LOGIC1(TRUE OR TRUE, FALSE); % INVOCATION OF LOGIC1  
  BOOL := LOGIC2(TRUE OR TRUE, FALSE); % INVOCATION OF LOGIC2  
END.
```

The assignment of a value to `BOOL` differs, depending on whether you invoke `LOGIC1` or `LOGIC2`, as shown in the following table:

Invocation	Evaluates As	Value Assigned to <code>BOOL</code>
<code>LOGIC1</code>	<code>BOOL := TRUE OR (TRUE AND FALSE);</code>	TRUE
<code>LOGIC2</code>	<code>BOOL := (TRUE OR TRUE) AND (FALSE);</code>	FALSE

Passing an updating expression to a parametric define should be done cautiously. Multiple uses of the corresponding formal symbol cause multiple updates. For example, assume you are using the following `DEFINE` declaration:

```
DEFINE Q(E) = E + 2 * E #
```

For this declaration, the following applies:

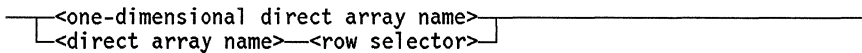
Define Invocation	Expands to
<code>Q(X := X + 1)</code>	<code>X := X + 1 + 2 * X := X + 1</code>



## Declarations

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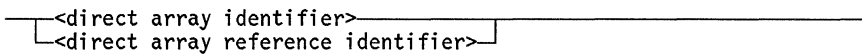
<direct array row>



<one-dimensional direct array name>

A direct array name whose identifier is declared with one dimension.

<direct array name>



## Declaring Direct Arrays

A direct array can be a word array or a character array. Direct arrays of type COMPLEX are not allowed.

**Note:** *The BCL character type is not supported on all A Series systems. The appearance of a BCL construct that can cause the creation of a BCL descriptor, such as a direct BCL array, causes the program to get a compile-time warning message.*

A direct array can be used in any way that a nondirect array can be used. However, arbitrary use of direct arrays instead of normal arrays can seriously degrade overall system efficiency.

The dimensionality of a direct array is the number of bound pairs in its declaration. No more than 16 dimensions are allowed.

**Note:** *There are subtle restrictions on the correct declaration and use of a direct array row equivalence in which the array row of the declaration is a row of an array reference, because the default state of a direct array reference variable is uninitialized.*

For more information on the OWN specification, array class, bound pair list, lower bound, and row selector, see “ARRAY Declaration” earlier in this section. For information on the direct array reference identifier, see “ARRAY REFERENCE Declaration” earlier in this section.

A direct array has attributes that can be programmatically interrogated and altered before, during, and after an actual I/O operation that uses the array.

Because a direct array can be used in performing direct I/O operations, a direct array is automatically unpagged (nonsegmented). For more information on direct I/O operations, see “I/O Statement” in Section 4, “Statements.”

## Examples of DIRECT ARRAY Declarations

The following example declares DIRARY, a one-dimensional direct array. Because no array class is specified, the array class of DIRARY is of type REAL.

```
DIRECT ARRAY DIRARY[0:29]
```

The following example declares the direct integer array DIREQVARAY. Array row equivalence causes the array DIREQVARAY to refer to the same data as the previously declared direct real array DIRARY.

```
DIRECT INTEGER ARRAY DIREQVARAY[5] = DIRARY
```

## DOUBLE Declaration

A DOUBLE declaration declares simple variables that can have double-precision values (that is, 96-bit arithmetic entities).

<double declaration>

```

┌───┐
│   │ DOUBLE ┌───┐
│   │         │ <identifier> │
└───┘         └───┘
    OWN
  
```

<double identifier>

An identifier that is associated with the DOUBLE data type in a DOUBLE declaration.

## Declaration of Simple Variables

A simple variable declared to be OWN retains its value when the program exits the block in which the variable is declared. That value is again available when the program reenters the block in which the variable is declared.

When a double-precision simple variable is allocated, it is initialized to a double-precision 0 (zero), which is two 48-bit words with all bits equal to zero. Refer to Appendix C, "Data Representation," for additional information on the internal structure of a double-precision operand as implemented on A Series systems.

## Examples of DOUBLE Declarations

The following example declares DUBL, a double-precision simple variable.

```
DOUBLE DUBL
```

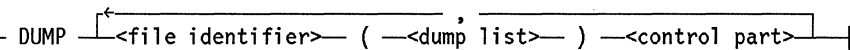
The following example declares three double-precision variables: BIGNUMBER, GIGUNDOUS, and DUBLPRECISION.

```
DOUBLE BIGNUMBER, GIGUNDOUS, DUBLPRECISION
```

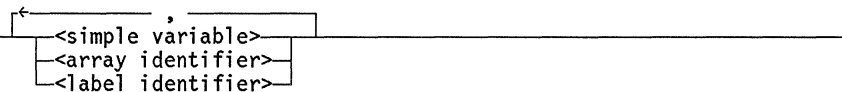
## DUMP Declaration

The DUMP declaration allows the display of the values of selected items during the execution of a program.

### <dump declaration>

— DUMP —  —>

### <dump list>

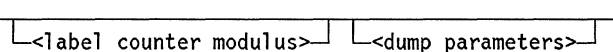
 —>

The file identifier specifies the name of the file to which the displayed information is to be written, and the dump list specifies the items whose values are to be displayed. The following types of variables and arrays must not appear in the dump list:

- Arrays with multiple dimensions
- Character arrays
- String variables
- String arrays

## Control Part

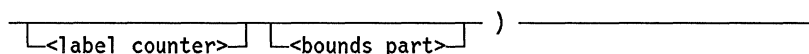
### <control part>

—<label identifier> —  —>

### <label counter modulus>

— : —<unsigned integer> —>

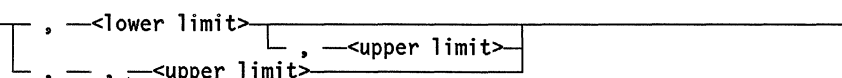
### <dump parameters>

— ( —  ) —>

### <label counter>

—<simple variable> —>

### <bounds part>

 —>

**<lower limit>**

—<arithmetic expression>—————|

**<upper limit>**

—<arithmetic expression>—————|

The control part determines when the items are to be displayed. The control part can be just a label identifier or it can have a combination of components.

### Label Identifier

If the control part is simply a label identifier, the items in the dump list are dumped each time program execution encounters the statement labeled by the specified label identifier.

### Label Identifier with Label Counter Modulus

If a label counter modulus appears, the items in the dump list are dumped every <label counter modulus> times that the statement labeled by the label identifier is encountered. For example, if  $N$  is the label counter modulus and  $E$  is the number of times that the labeled statement has been encountered, then the items in the dump list are dumped whenever  $E \text{ MOD } N$  is equal to 0 (zero).

### Label Identifier with Dump Parameters

Dump parameters are used to restrict the dumping to a specified range of encounters. All three parameters (the label counter, the lower limit, and the upper limit) are optional.

If a label counter is given, this variable is used to count the number of times that the labeled statement has been encountered. The specified variable is incremented automatically each time the labeled statement is encountered; changing the value of this variable elsewhere in the program affects the dumping process.

The items in the dump list are dumped when the number of times the labeled statement is encountered (or the value of the label counter variable, if specified) is greater than or equal to the lower limit and less than or equal to the upper limit. If the lower limit is not specified, it has a default value of 0 (zero). If the upper limit is not specified, it has a default value of infinity (no limit).

### Label Identifiers with Label Counter Modulus and Dump Parameters

When both a label counter modulus and dump parameters are specified, both the modulus check and the range check are performed. The items in the dump list are dumped when all the following conditions are true for the number of times that the labeled statement has been encountered (or the value of the label counter variable, if specified):

## Declarations

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- The number is greater than or equal to the lower limit and less than or equal to the upper limit.
- The number is evenly divisible by the label counter modulus.

## Form of Output

The information produced when a dump occurs depends on the declared types of the items to be dumped. When a dump occurs, the 1-character to 6-character symbolic name of each item in the dump list is produced, along with the following information:

For dumped simple variables,

- If the simple variable is of type REAL or DOUBLE, a real value is printed - for example,  $R = .1000000000$  or  $DUBL = 0.0$ .
- If the simple variable is of type INTEGER, an integer value is printed - for example,  $I = 2$ .
- If the simple variable is of type BOOLEAN, the Boolean value is printed - for example,  $BOOL = .FALSE.$ .
- If the simple variable is of type COMPLEX, it is printed as a pair of numbers. The format consists of a left parenthesis, the real part in REAL format, a comma, the imaginary part in REAL format, and a right parenthesis - for example,  $COMP = (3.000000000, 5.000000000)$ .

For dumped arrays,

- If the array is of type REAL, each element is printed as if the value were operated on by an R editing phrase. For more information, see "FORMAT Declaration."
- If the array is of type BOOLEAN, the value of each element is shown as *.TRUE.* or *.FALSE.*
- If the array is of type INTEGER, each element is printed as an integer value.
- If the array is of type COMPLEX, each element is printed in the form used for complex variables - for example,  $CA = (2.000000000, 3.000000000), (5.000000000, 7.000000000)$ .

A dumped label shows the number of times execution control has passed the specified label - for example,  $L2 = 3$ .

## Examples of DUMP Declarations

The following example dumps the value of variable A to a file named FYLE each time the statement labeled LBL is encountered during execution of the program.

```
DUMP FYLE (A) LBL
```

The following example dumps the values of I, INFO, and INDX to a file named PRNTR when the statement labeled NEXT is encountered. A label counter, DMPCOUNT, counts the number of times the statement labeled NEXT is encountered. Dumps occur

until the value of DMPCOUNT exceeds DPHIGH. Note that when a label counter is specified, the counter can also be altered elsewhere in the program.

```
DUMP PRNTR (I,INFO,INDX) NEXT (DMPCOUNT, ,DPHIGH)
```

The following example dumps the values of X, Y, ARRAYV, and COUNTER to a file named FID. Because a label counter modulus of 3 is specified, a dump of these items occurs only every third time the label LOUP is encountered during execution of the program.

```
DUMP FID (X,Y,ARRAYV,COUNTER) LOUP : 3
```

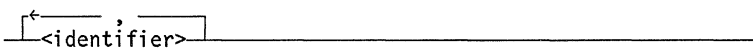
The following example dumps the values of A, B, LBL1, and ARRAYV to a file named LP. Because a label counter modulus of 5 is specified, a dump of these items occurs only every fifth time the label AGAIN is encountered during execution of the program. Dumps are further restricted to those times when the label counter TALY has a value between 20 and 50, inclusive. Because the dump occurs each time  $TALY \text{ MOD } 5 = 0$ , dumps occur when TALY has the values 20, 25, 30, 35, 40, 45, and 50. Note that TALY can be altered elsewhere in the program.

```
DUMP LP (A,B,LBL1,ARRAYV) AGAIN : 5 (TALY,20,50)
```

## EVENT and EVENT ARRAY Declarations

An event provides a means to synchronize simultaneously executing processes. An event can be used either to indicate the completion of an activity (for example, the completion of a direct I/O read or write operation) or as an interlock between participating programs over the use of a shared resource.

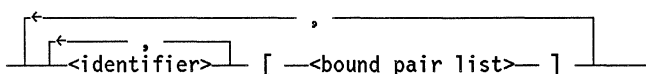
**<event declaration>**

```
— EVENT — 
```

**<event identifier>**

An identifier that is associated with an event in an EVENT declaration.

**<event array declaration>**

```
— EVENT — ARRAY 
```

**<event array identifier>**

An identifier that is associated with an event array in an EVENT ARRAY declaration.

An event array is an array whose elements are events. An event array can have no more than 16 dimensions.



## Declarations

---

Events can be used synchronously by explicitly testing the state of an event at various programmer-defined points during execution, or the events can be used asynchronously by using the software interrupt facility.

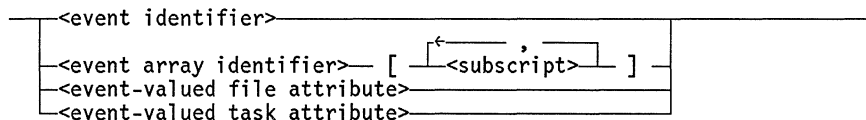
Events have two Boolean characteristics, happened and available. Each characteristic can be either TRUE or FALSE. Language constructs such as the SET, RESET, and CAUSE statements can be used to change the happened state of an event. The HAPPENED function returns the value of the happened state of an event. The FIX, FREE, and LIBERATE statements can be used to change the available state of an event. The AVAILABLE function returns the available state of an event.

The initial available state of an event is TRUE (available), and the initial happened state of an event is FALSE (not happened). For more information on events, refer to “Event Statement” in Section 4, “Statements.” For more information on interrupts, refer to “INTERRUPT Declaration” later in this section. For more information on the AVAILABLE function and the HAPPENED function, see Section 5, “Expressions and Functions.”

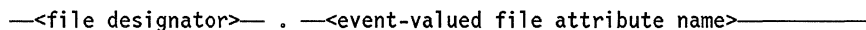
## Event Designator

An event designator represents a single event. An event array designator represents an array of events.

**<event designator>**



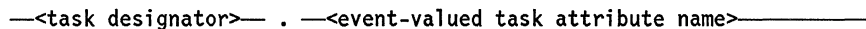
**<event-valued file attribute>**



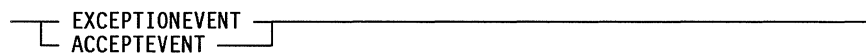
**<event-valued file attribute name>**

ALGOL supports all file attributes and file attribute values described in the *A Series File Attributes Programming Reference Manual*.

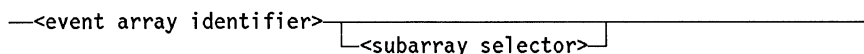
**<event-valued task attribute>**



**<event-valued task attribute name>**



**<event array designator>**



**Examples of EVENT and EVENT ARRAY Declarations**

The following example declares an event, FILEA.

```
EVENT FILEA
```

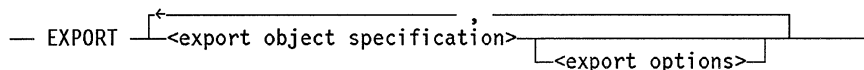
The following example declares an event array, SWAPPEE, which can store up to six events.

```
EVENT ARRAY SWAPPEE[0:5]
```

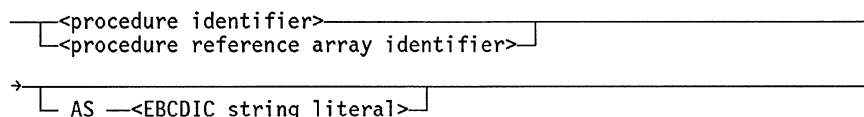
**EXPORT Declaration**

The EXPORT declaration declares procedures in a library program to be entry points into that library. A procedure that is declared as an entry point into a library can be accessed by programs external to the library.

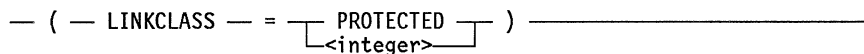
**<export declaration>**



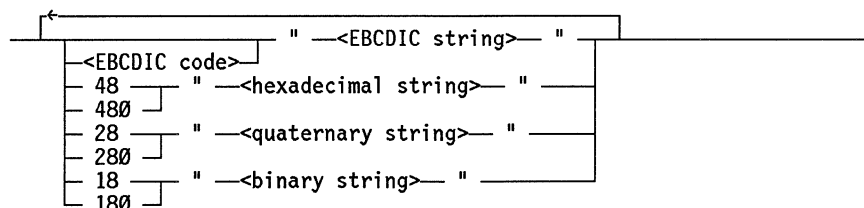
**<export object specification>**



**<export options>**



**<EBCDIC string literal>**



All procedures to be exported must be declared before the appearance of the EXPORT declaration and must be declared in the same block as the EXPORT declaration.

## Declarations

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To provide a library object with a security level, the object can be exported with a linkage class assigned to it. The linkage class of the user program, which is assigned by the system, is matched to the linkage class of the exported object on a per object basis to determine if visibility is allowed to the calling program. The PROTECTED linkage class provides the highest level of security. The values 0 through 15 can be assigned. The default linkage class is 0, which provides the lowest level of security.

A procedure reference array can be exported. Any type or parameters allowed for an exported procedure can be reference by an exported procedure reference array.

A program becomes a library by exporting procedures and then executing a FREEZE statement. The code file for that program contains a structure called a library directory, which describes the library and its entry points. The directory's description of an entry point includes the entry point's name, a description of the procedure's type, if any, and descriptions of its parameters.

When a program calls a library entry point, the description of the entry point in the library template of the calling program is compared to the description of the entry point of the same name in the library directory of the library. If the called entry point does not exist in the library or if the two entry point descriptions are not compatible, a run-time error is given and the calling program is terminated.

The name given to an exported entry point in a library directory is the procedure identifier from the EXPORT declaration, unless an AS clause appears, in which case the name is given by the EBCDIC string literal.

The EBCDIC string literal in the AS clause cannot contain any leading, trailing, or embedded blanks and must be a valid identifier. A valid identifier is defined to be any sequence of characters beginning with a letter and consisting of letters, digits, hyphens (-), and underscores (\_).

## Library Entry Point Types and Parameters

A library entry point can be any of the following:

- ASCII string procedure
- Boolean procedure
- Complex procedure
- Double procedure
- EBCDIC string procedure
- Hexadecimal string procedure
- Integer procedure
- Real procedure
- Untyped procedure

The parameters to a library entry point can be any of the following types:

- ASCII character array
- ASCII string variable or array
- Boolean variable or array
- Complex variable or array
- Double variable or array
- EBCDIC character array
- EBCDIC string variable or array
- Event variable or array
- File
- Hexadecimal character array
- Hexadecimal string variable or array
- Integer variable or array
- Pointer
- Real variable or array
- Task variable or array

A parameter to a library entry point can also be a formal procedure with the above restrictions on its type and parameters. The formal procedure must be fully specified, that is, the `<formal parameter specifier>` construct of the `PROCEDURE` declaration must be used.

### Conditions in Which Errors Can Occur

A library can export a procedure that is declared to be an entry point in yet another library. When a program calls this entry point, the template of the library to which the procedure is declared to belong is searched for an entry point with the same name as that of the called entry point in the directory for this library. For example, assume the following declarations have been compiled:

```
LIBRARY L;  
PROCEDURE LIBPROC; LIBRARY L;  
EXPORT LIBPROC;
```

When another program calls entry point `LIBPROC` of this library, the template for library `L` is searched for an entry point named `LIBPROC`. When found, the entry point `LIBPROC` of library `L` is then called.

On the other hand, assume the following declarations have been compiled:

```
LIBRARY L;  
PROCEDURE LIBPROC; LIBRARY L;  
EXPORT LIBPROC AS "P";
```

Another program calls entry point `P` of this library, and the template for library `L` is searched for an entry point named `P`. If it is found, that entry point is called. If that

## Declarations

---

entry point is not found, a run-time error is given and the calling program is terminated. In either case, procedure LIBPROC of library L is not executed. For more information on libraries, refer to Section 8, "Library Facility."

A library entry point must not declare any OWN arrays. An attempt to execute a library entry point that declares an OWN array results in a run-time error.

If a library exports a procedure reference array, a program importing that procedure reference array can access the procedures in that library. A program cannot assign into an element of an imported procedure reference array. If such an assignment is attempted, a compile-time or run-time error occurs.

Programs that export procedure reference arrays cannot be used for binding.

## Examples of EXPORT Declarations

The following example declares the procedure EXPROC as an entry point in a library program.

```
EXPORT EXPROC
```

The following example declares the procedure PROC1 as an entry point in a library program.

The name exported for this procedure is LIBPROC3; consequently, a program calls PROC1 in this library by using the name LIBPROC3.

```
EXPORT PROC1 AS "LIBPROC3"
```

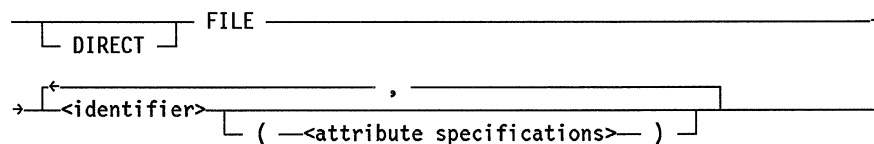
The following example declares the procedure reference arrays PRA1 and PRA2 and the procedure PROCID as entry points in a library program. The procedure reference array PRA2 is exported with the name PROCREF; consequently, a program must use the name PROCREF to call PRA2.

```
EXPORT PRA1, PROCID, PRA2 AS "PROCREF"
```

## FILE Declaration

A FILE declaration associates a file identifier with a file and assigns values to the file attributes of the file.

<file declaration>





## Declarations

---

<arithmetic-valued file attribute name>  
<Boolean-valued file attribute name>  
<pointer-valued file attribute name>  
<translate-table-valued file attribute name>  
<mnemonic file attribute value>

ALGOL supports all file attributes and file attribute values described in the *A Series File Attributes Programming Reference Manual*.

The attributes for a particular file need not be specified in the FILE declaration. Attributes can be assigned values by using an appropriate assignment statement, the multiple attribute assignment statement, a compile-time or run-time file equation, or the I/O subsystem, which is the default option. Refer to the *A Series Work Flow Language (WFL) Programming Reference Manual* for the file equation syntax.

Although the syntax allows more than one file identifier to precede the optional attribute specifications, only the identifier immediately before the attribute specifications is assigned the specified file attribute values. The other identifiers are assigned default file attribute values.

For example, the result of the following declaration is that the KIND attribute of file C is assigned the value DISK, and the KIND attributes of files A and B are assigned the default value for the KIND attribute, which might or might not be the value DISK.

```
FILE A,B,C(KIND=DISK)
```

For more information on file attributes and their default values, refer to the *A Series File Attributes Programming Reference Manual*.

A Boolean-valued file attribute whose name appears in a Boolean attribute specification without the = <Boolean expression > part is assigned the value TRUE.

A translate table identifier assigned to a translate-table-valued file attribute name must have been declared previously and must reference the first (or only) translate table declared in that particular TRANSLATETABLE declaration.

Attribute parameters are allowed in FILE declarations and MULTIPLE ATTRIBUTE ASSIGNMENT statements. In a FILE declaration, the attribute specifications cannot reference the file identifier of the file being declared. For example, the following is not valid:

```
FILE F(MAXRECSIZE=90, BLOCKSIZE=F.MAXRECSIZE*10)
```

## Examples of FILE Declarations

The following example declares a file named F.

```
FILE F
```

The following example declares a file named NEWFILE. This FILE declaration is the first step in creating a new disk file with the title DATA on a pack named PACK. Synchronized output, which is useful for auditing and recovery, will be performed.

```
FILE NEWFILE(KIND=DISK, MAXRECSIZE=14, BLOCKSIZE=420, NEWFILE,
             FILEUSE=OUT, AREAS=20, AREASIZE=450, SYNCHRONIZE=OUT,
             TITLE="DATA ON PACK.");
```

The following example declares a file, SCREEN\_OUTPUT, to be a remote file. Typically, using this declaration in conjunction with a WRITE statement allows a program to write to a computer terminal.

```
FILE SCREEN_OUTPUT(KIND=REMOTE)
```

## FORMAT Declaration

A FORMAT declaration associates a format identifier with a set of editing specifications. These editing specifications can then be used in READ and WRITE statements.

**<format declaration>**

```
-- FORMAT --<in-out part> { <format part> }
```

### In-Out Part

The in-out part affects the processing of simple string literals appearing in the editing specifications. If the in-out part of a FORMAT declaration is designated as OUT or unspecified (in which case OUT is assumed), simple string literals appearing in the editing specifications of the format are read-only. If the in-out part is designated as IN, such simple string literals are read-write. For more information, refer to "Simple String Literal" later in this section.

**<in-out part>**

```
[ IN ]
[ OUT ]
```

### Format Part

**<format part>**

```
--<identifier> [ ( --<editing specifications> ) ]
                [ < --<editing specifications> > ]
```

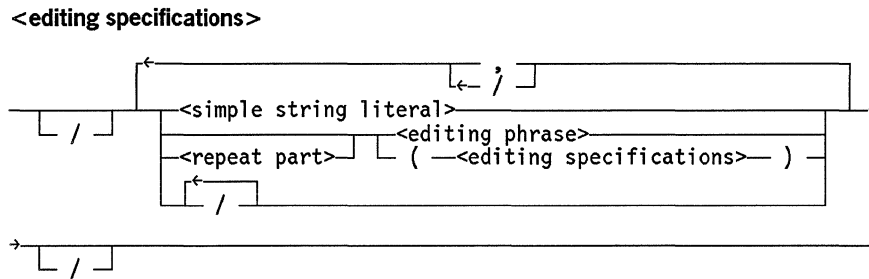
**<format identifier>**

An identifier associated with a set of editing specifications in a FORMAT declaration.

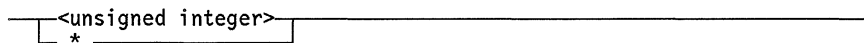


## Declarations

---



### **<repeat part>**



The editing specifications that appear in FORMAT declarations can be used in READ and WRITE statements to format, respectively, the input and output data.

Define identifiers, remarks, and formal symbols of parametric defines cannot be used in formats.

A format identifier can be referenced in a READ statement, WRITE statement, or SWITCH FORMAT declaration. In general, a list is referenced in READ and WRITE statements to indicate a series of data items, specified by the list, along with the formatting action, specified by the format, to be performed on each of the data items.

Editing phrases in the editing specifications are separated by a comma (,), a slash (/), or a series of slashes. A slash indicates the end of a record. On input, any remaining characters in the current record are ignored when a slash is encountered in the editing specifications. On output, the construction of the current record is terminated and any subsequent output is placed in the next output record when a slash is found in the editing specifications. Multiple slashes can be used to skip several records of input or to generate several blank records on output. The final right parenthesis or right angle bracket (>) of the editing specifications also indicates the end of the current record.

A carriage control action occurs each time a slash appears in the editing specifications. If a core-to-core part is specified in the file part of a READ statement, a slash is ignored.

### **Example of Editing Specifications**

```
BEGIN
  FILE READER (KIND=READER),
    LINE (KIND=PRINTER);
  REAL A,B;
  FORMAT FMT(I2,/,I2);
  READ(READER,FMT,A,B);
  WRITE(LINE,FMT,A,B);
  WRITE(LINE [SKIP 1],FMT,A,B);
END.
```

Assume that the following two input records are used:

```
1234
5678
```

Using these two input records, this program produces the following output:

```
12
56
12
.
.
. [skip to channel 1]
56
```

If all editing specifications have been used before the list of data items is exhausted, a carriage control action occurs, and the editing specifications are reused. If the list of data items is exhausted before all the editing specifications have been used, the I/O operation is complete and the remaining editing specifications are ignored.

### Simple String Literal

The presence of a simple string literal in the editing specifications indicates that the characters enclosed in quotation marks are to be used as the data. A simple string literal does not require a corresponding list element.

To enable more efficient handling of string literals in formats, 1-bit, 2-bit, and 7-bit strings are not allowed. The lengths of 3-bit and 4-bit strings must be a multiple of 2, to facilitate packing into 6-bit or 8-bit characters, respectively. BCL string literals are encoded as BCL characters, not as EBCDIC characters.

If no string code appears in a string literal, the default character type is used. The default character type can be designated by the compiler control options ASCII and BCL. If no such compiler control option is used, the default character type is EBCDIC. For more information, refer to “Default Character Type” in Appendix C, “Data Representation.”

## Declarations

---

### Example of Simple String Literal

Assume you are using the following statements:

```
.  
.
WRITE(LINE,<4"C1C2",8"ABC">);
$ SET BCL
WRITE(LINE,<3"646566",6"HIJ">);
.  
.
```

These statements produce the following output:

```
ABABC
UVWHIJ
```

When a simple string literal appears in editing specifications, only the first digit of the string code is used; if a second or third digit appears, a warning is given at compilation time.

Simple string literals appearing in editing specifications can be read-only or read/write, depending on the in-out part specified in the FORMAT declaration. If the in-out part is IN, simple string literals appearing in the editing specifications are read-write, and the format can be used in both READ statements and WRITE statements. When a format used in a READ statement is declared with an in-out part of IN and contains a simple string literal in the editing specifications, then data is read into the memory location of the simple string literal over the original value.

The number of characters read always equals the length of the simple string literal as it is defined in the FORMAT declaration. When the format is used in a subsequent WRITE statement, the new data is written to the output record. If the in-out part is OUT or unspecified (in which case OUT is assumed), any simple string literals appearing in the editing specifications are read-only. Any attempt to change the value of a read-only simple string literal by using that format in a READ statement results in a run-time error.

### Repeat Part

The repeat part indicates the number of times an editing phrase or editing specifications are repeated. If the repeat part is unspecified, a value of 1 is assumed. A repeat part value greater than 4029 results in a syntax error.

Editing specifications and their corresponding repeat parts can be nested. For example, assume you are using the following WRITE statement:

```
WRITE(F,<2(2(2I3))>,INT1,INT2,INT3,INT4,INT5,INT6,INT7,INT8)
```

The first repeat part indicates that the editing specifications (2(2I3)) are to be repeated twice, the second repeat part indicates that the editing specifications (2I3) are to be repeated twice, and the third repeat part specifies that the editing phrase I3 is to be repeated twice, causing the editing phrase I3 to be used a total of eight times.

The following examples show the correct syntax of repeat parts:

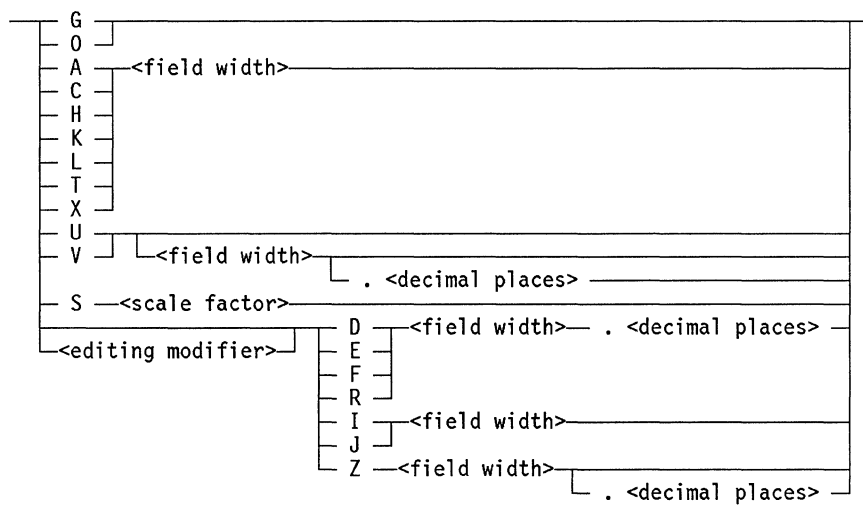
3F10.4

3(A6/)

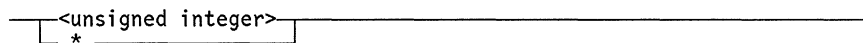
3(3A6,3(/I12)/)

## Editing Phrases

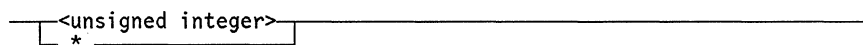
<editing phrase>



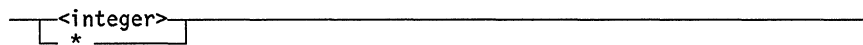
<field width>



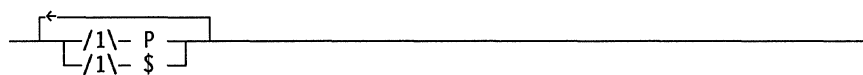
<decimal places>



<scale factor>



<editing modifier>



### Field Width

The field width specifies, in characters, the width of the field to be read or written. Because the field width specifies the entire length of the field to be used, if the `< decimal places >` variable is also specified, the field width value must allow for the number of decimal places requested plus one for the decimal point. Any field width value greater than 4029 results in a syntax error. Field width is covered further in the discussions of the individual editing phrase letters.

### Decimal Places

The decimal places value specifies the number of characters following the decimal point in the field that are to be read or written. On input, the `< decimal places >` variable can be overridden by an explicit decimal point. A decimal places value greater than 4029 results in a syntax error. The decimal places value is covered further in the discussions of the individual editing phrase letters.

## Variable Editing Phrases

A variable editing phrase is one that is not fully specified at compilation time. The format is processed from left to right at run time. If the letter V is encountered in an editing phrase, the next list element is accessed to provide an editing phrase letter. For more information, refer to “V Editing Phrase Letter” later in this section. If an asterisk (\*) is encountered as the repeat part, field width, decimal places, or scale factor, then the next list element is accessed to provide an integer value for that specification. In addition to the list elements to be read or written, the I/O list must contain one list element for each V editing phrase letter and asterisk encountered in the editing specifications. The WRITE statements in the following examples use asterisks as both repeat parts and field widths to produce varying I editing phrases.

### Examples of Variable Editing Phrases

```
WRITE(F, <I*>, IWIDTH, A);  
WRITE(F, <3I*>, IWIDTH, A, B, C);  
WRITE(F, <3(I*)>, IWIDTH1, A, IWIDTH2, B, IWIDTH3, C);  
  
IREPEAT1 := 1;  
IREPEAT2 := 2;  
WRITE(F, <2(X1,*I*)>, IREPEAT1, IWIDTH1, A,  
IREPEAT2, IWIDTH2, B, C);
```

When an asterisk is used as the repeat part, the number of repetitions performed depends on the value supplied by the list element. If the value of the list element is greater than 0 (zero), that number of repetitions is performed; if the value is equal to 0, an unlimited number of repetitions are performed. If the value is less than 0, no repetitions are performed, and control passes to the next editing phrase.

When an asterisk is used for the field width of an editing phrase, the actual width of the field depends on the value supplied by the list element. If the value of the list element is greater than 0 (zero), that value is used as the width of the field. If the value of the list element is less than or equal to 0, no editing is performed, the list elements

corresponding to the editing phrase are skipped, and control passes to the next editing phrase.

## Editing Phrase Letters

Every valid path through the editing phrase syntax requires an editing phrase letter that specifies how the data being read or written is to be edited. The editing phrase letters are as follows: A, C, D, E, F, G, H, I, J, K, L, O, R, S, T, U, V, X, or Z. An editing phrase that contains the editing phrase letter A is called an A editing phrase, an editing phrase that contains the editing phrase letter C is called a C editing phrase, and so on. Descriptions of the editing specified by each editing phrase letter are arranged in alphabetical order in the following paragraphs.

For ease of explanation, lowercase letters are used hereafter to refer to the values for the repeat part, field width, and decimal places as follows:

Letter	Meaning
r	<repeat part>
w	<field width>
d	<decimal places>

A list element of type COMPLEX is always edited as if it were two list elements of type REAL.

In the examples in the following sections, the lowercase letter *b* is used to denote a blank character.

## A and C Editing Phrase Letters

The editing phrase letters A and C are used when reading or writing alphanumeric data. Valid list elements are of type INTEGER, REAL, DOUBLE, COMPLEX, BOOLEAN, POINTER, and STRING.

When A is used, characters are read from, or written to, the word starting at the rightmost position. If C is used, the starting character position is the leftmost one.

The default character type applies to list elements other than pointers. For more information, refer to “Default Character Type” in Appendix C, “Data Representation.” The default character type allows BCL data to be read from or written to an EBCDIC file (and vice versa) with any translation necessary to preserve character data.

For example, assume you are using the following program:

```
BEGIN
  FILE F(KIND=PRINTER, INTMODE=EBCDIC);
  WRITE(F, <A3>, 8"ABC");
  $ SET BCL
  WRITE(F, <A3>, 6"ABC");
END.
```

## Declarations

---

This program produces the following output:

ABC  
ABC

In the explanations of the editing phrase letters A and C, the letter Q is used.

The value of Q is derived from the following table:

	Default Character Type	
	BCL	EBCDIC
Single Precision	8	6
Double Precision	16	12

If the list element is of the following form, then the value of the arithmetic expression is used as the value of Q:

<pointer expression> FOR <arithmetic expression>

On input,  $w$  characters are transferred from the input record to the pointer-designated location or string variable. On output,  $w$  characters are transferred from the pointer-designated location or string variable to the output record. The character size used is that of the pointer or string variable.

### Input

On input, the editing phrase letters A and C specify that  $w$  characters of data are to be read from the input record and assigned to the corresponding list element.

For the editing phrase letter A, if  $w$  is greater than or equal to Q, the rightmost Q characters of the input field are transferred to the list element. If  $w$  is less than Q, then  $w$  characters of the input field are transferred right-justified to the list element. The unused high-order bits of the list element are set to 0 (zero).

The action specified by the editing phrase letter C is identical to that specified by the editing phrase letter A except that characters are read to the leftmost portion of the word.

The following are input examples for the A and C editing phrase letters:

Default Character Type	External String	Editing Phrase	Internal Value
8-bit	ABCDEFGHJKLM	A9	8"DEFGHI"
6-bit	ABCDEFGHJKLM	A9	6"BCDEFGHI"
8-bit	AbCbEbGblbK	A4	4"0000"8"AbCb"
6-bit	ABCDEFGHJKLM	A4	6"0000ABCD"
6-bit or 8-bit	ABCDEFGHJKLM	A12	ABCDEFGHJKLM (pointer as list element)
8-bit	ABCDEFGHJKLM	A12	4"0000"8"ABCDEFGHJKLM" (8-bit pointer FOR 14)
6-bit	ABCDEFGHJKLM	A12	6"JKL" (6-bit pointer FOR 3)
8-bit	ABCDEFGHJKLM	C9	8"DEFGHI"
6-bit	ABCDEFGHJKLM	C9	6"BCDEFGHI"
8-bit	ABCD	C4	8"ABCD"4"0000"
6-bit	ABCDEFGHJKLM	C4	6"ABCD0000"
8-bit	ABCDEFGHJKLM	C12	8"ABCDEFGHJKLM"4"0000" (8-bit pointer FOR 14)
6-bit	ABCDEFGHJKLM	C12	6"JKL" (6-bit pointer FOR 3)

The editing phrase letters A and C do not round values before assigning them to a list element. Therefore, a list element of type INTEGER is not necessarily assigned an integer value. If  $w$  is greater than 4, the exponent field of the list element is affected; the result can be a noninteger value. The data representations of real and integer operands are discussed in Appendix C, "Data Representation."

### Output

On output, the editing phrase letters A and C specify that the value of the corresponding list element is to be written as a character string to an output field that is  $w$  characters wide.

For the editing phrase letter A, if  $w$  is greater than or equal to  $Q$  and the list element is not a pointer expression, the  $Q$  characters of the list element are written right-justified with blank fill to the output field. If  $w$  is less than  $Q$ , the rightmost  $w$  characters of the list element are written to the output field. If the character size is 8 bits and any of the character fields in the word contain bit patterns that do not correspond to an EBCDIC graphic, then question marks (?) are written to those positions.

The action specified by the editing phrase letter C is identical to that specified by the editing phrase letter A except that characters are written from the leftmost portion of the list element.



## Declarations

The following are output examples for the A and C editing phrase letters:

Default Character Type	External String	Editing Phrase	Internal Value
8-bit	8"DEFGHI"	A9	bbbDEFGHI
6-bit	6"BCDEFGHI"	A9	bBCDEFGHI
8-bit	4"000000000"8"A"	A4	??A
6-bit	6"0000ABCD"	A4	ABCD
8-bit	8"ABCDEFGH" (8-bit pointer FOR 7)	A11	bbbbABCDEFGH
6-bit	6"ABCDEFGH" (6-bit pointer FOR 7)	A4	DEFG
8-bit	8"DEFGHI"	C9	bbbDEFGHI
6-bit	6"BCDEFGHI"	C9	bBCDEFGHI
8-bit	8"ABCD"4"0000"	C5	ABCD?
6-bit	6"ABCD0000"	C4	ABCD
8-bit	8"ABCDEFGH" (8-bit pointer FOR 7)	C11	bbbbABCDEFGH
6-bit	6"ABCDEFGH" (6-bit pointer FOR 7)	C4	ABCD

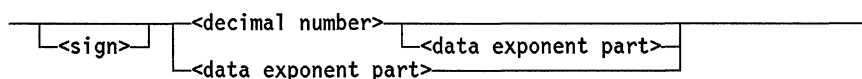
### D Editing Phrase Letter

The editing phrase letter D is used for reading or writing floating-point values. Valid list elements are of type INTEGER, REAL, DOUBLE, COMPLEX, and BOOLEAN.

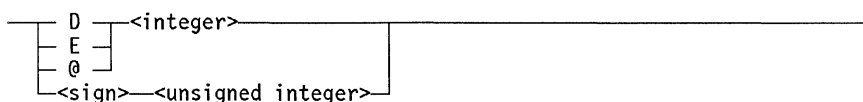
#### Input

The editing phrase letter D specifies that  $w$  characters of input data are to be read, converted to a real value, and assigned to the corresponding list element. The input data must be in the form of a data number; otherwise, a data error is returned. A data number is defined syntactically as follows:

<data number>



<data exponent part>



The position of the decimal point in the internal value is determined by its position in the input data or by the value of *d*. If a decimal point appears in the input data, that position is used for the internal value. If no decimal point appears in the input data, one is assumed to be *d* places to the left of the D, E, at sign (@), plus sign (+), or minus sign (-) indicating the beginning of the exponent field. If no decimal point appears in the input data and an exponent is not present, a decimal point is assumed to be *d* places to the left of the right edge of the input field.

For example, if the editing phrase D7.2 is used to read the data number 10005.0, the resulting internal value is 10005.0. However, if the same editing phrase is used to read the data number 10005, the resulting internal value is 100.05.

The value of *w* must be greater than or equal to the value of *d*. Blanks are interpreted as zeros.

The following are input examples for the D editing phrase letter:

External String	Editing Phrase	Internal Value
bbbbbb25046	D11.4	+2.5046
bbbb25.046	D11.4	+25.046
-bb25046E-3	D11.4	-0.0025046
-bbb25046-3	D11.4	-0.0025046
bb250.46D-3	D11.4	+0.25046
bbb250.46-3	D11.4	+0.25046
b-b25.04678	D11.4	-25.04678

**Output**

On output, the editing phrase letter D specifies that the value of the corresponding list element is to be converted to a string of characters that expresses the value in exponential notation. The string is written right-justified with blank fill to a field *w* characters wide. The value of the mantissa is rounded to the number of decimal places specified by *d* before it is written.

The value of *w* must be greater than or equal to *d* + 7. This width allows for a 4-character exponent part, a decimal point, a digit preceding the decimal point, and a sign. If *w* is less than *d* + 7, the field is filled with asterisks (\*).

The editing phrase letter D always uses four or seven characters to represent the exponent of the list element being written. The magnitude of the exponent determines in which syntactic form the exponent is expressed:

## Declarations

---

Magnitude of Exponent	Form
4-character	D+xx or D-XX (where $ABS(XX) \leq 99$ )
4-character	+XXX or -XXX (where $100 \leq ABS(XXX) \leq 999$ )
7-character	D+XXXXX or D-XXXXX (where $1000 \leq ABS(XXXXX) \leq 99999$ )

The following are output examples for the D editing phrase letter:

Internal Value	Editing Phrase	External String
+36.7929	D13.5	bb3.67929D+01
-36.7929	D12.5	-3.67929D+01
-36.7929	D11.5	*****
+36.7929	D10.5	*****
1.234@@-73	D14.5	bbb1.23400D-73
-789@@1234	D15.3	bb-7.890D+01236
6.54@@321	D9.2	b6.54+321

### E Editing Phrase Letter

The action specified by the editing phrase letter E is identical to that specified by the editing phrase letter D except that the letter E, when used for output, indicates the beginning of the exponent in the output string.

The following are output examples for the E editing phrase letter:

Internal Value	Editing Phrase	External String
+36.7929	E13.5	bb3.67929Eb01
-36.7929	E12.5	-3.67929Eb01

### F Editing Phrase Letter

The editing phrase letter F is used when reading or writing floating-point values. Valid list elements are of type INTEGER, REAL, DOUBLE, COMPLEX, and BOOLEAN.

#### Input

On input, the action specified by the editing phrase letter F is identical to that specified by the editing phrase letter D.

### Output

On output, the editing phrase letter F specifies that the value of the corresponding list element is to be converted to a string of characters that expresses the value in simple decimal notation. The string is written right-justified with blank fill to a field  $w$  characters wide. The value of the list element is rounded to the number of decimal places specified by  $d$  before it is written.

The value of  $w$  must be greater than or equal to  $d + 1$ . When a program writes negative values,  $w$  must also allow for the minus sign (-). The field contains asterisks (\*) if the value to be written requires a field wider than  $w$  characters.

The following are output examples for the F editing phrase letter:

Internal Value	Editing Phrase	External String
+36.7929	F7.3	b36.793
+36.7934	F9.3	bbb36.793
-0.0316	F6.3	-0.032
0.0	F6.4	0.0000
0.0	F6.2	bb0.00
+579.645	F6.2	579.65
+579.645	F4.2	****
-579.645	F6.2	*****

### G Editing Phrase Letter

If used to read a BCL file, the editing phrase letter G specifies that eight 6-bit characters of the input data are to be skipped. If used to write to a BCL file, the editing phrase letter G specifies that eight BCL zeros are to be written to the output record.

If used to read an EBCDIC file, the editing phrase letter G specifies that six 8-bit characters of the input data are to be skipped. If used to write to an EBCDIC file, the editing phrase letter G specifies that six EBCDIC zeros are to be written to the output record.

### H and K Editing Phrase Letters

The editing phrase letters H and K are used when reading or writing hexadecimal and octal values, respectively. Valid list elements are of type INTEGER, REAL, DOUBLE, COMPLEX, and BOOLEAN.

In the following explanation of the H and K editing phrase letters, the letter Q is used. The value of Q is derived from the following table:

## Declarations

---

	Editing Phrase Letter	
	H	K
Single Precision	12	16
Double Precision	24	32

### Input

The editing phrase letter H specifies that  $w$  characters of input data are to be read, converted to a hexadecimal value, and assigned to the corresponding list element. The editing phrase letter K specifies that  $w$  characters of input data are to be read, converted to an octal value, and assigned to the corresponding list element. When the letter H is specified, the input data must consist of only characters from the set of hexadecimal characters, the blank, or the minus sign (-). When K is specified, the input data must consist of only characters from the set of octal characters, the blank, or the minus sign (-). If other characters are used, a data error is returned. Leading, trailing, and embedded blanks are interpreted as zeros. If a minus sign appears in the input string, the value 1 is assigned to bit 46 of the list element (bit 46 of the first word of a double-precision list element).

If  $w$  is less than or equal to  $Q$ , the value is stored right-justified in the storage location. Both words of a double-precision variable are included. Unused high-order bits are set to 0 (zero). If  $w$  is greater than  $Q$ , the leftmost  $w - Q$  characters must be blanks, zeros, or minus signs; otherwise, a data error is returned.

The following are input examples for the H and K editing phrase letters:

External String	Editing Phrase	Internal Value
6F	H2	4"00000000006F"
1FFFFFFFFF	H12	4"1FFFFFFFFF"
-16	H3	4"400000000016"
1234b568	H8	4"000012340568"
FFCb	H4	4"00000000FFC0"
00C1C2C3C4C5C6	H14	4"C1C2C3C4C5C6"
-ABCD	H5	4"40000000000000000000ABCD" (double precision)
123456789ABCDEF	H15	4"00000000123456789ABCDEF" (double precision)

continued

continued

External String	Editing Phrase	Internal Value
16	K2	3"0000000000000016"
1777777777777777	K16	3"1777777777777777"
-16	K3	3"2000000000000016"
1234b56	K7	3"0000000001234056"
77b	K3	3"0000000000000770"
-567	K4	3"200000000000000000000000000000567" (double precision)
1234567654321234567	K19	3"00000000000001234567654321234567" (double precision)

**Output**

On output, the editing phrase letter H specifies that the value of the corresponding list element is to be converted to a string of hexadecimal characters. The editing phrase letter K specifies that the value of the corresponding list element is to be converted to a string of octal characters. The output string is written right-justified with blank fill to a field  $w$  characters wide. If  $w$  is less than  $Q$ , only the contents of the rightmost  $w * 4$  bits (when H is used) or  $w * 3$  bits (when K is used) of the list element are converted. A double-precision list element is treated as 96 contiguous bits. The output string does not contain an explicit sign.

The following are output examples for the H and K editing phrase letters:

Internal Value	Editing Phrase	External Value
4"0000E5551010"	H5	51010
4"0000E5551010"	H12	0000E5551010
4"0000E5551010"	H16	bbbb0000E5551010
8"123456"	H12	F1F2F3F4F5F6
4"000000000000000012345678 (double precision)	H4	5678
8"123456789bbb" (double precision)	H24	F1F2F3F4F5F6F7F8F9404040
3"0005677701234445"	K5	34445

continued



If the value of the list element requires a field larger than  $w$ , then  $w$  asterisks (\*) are written.

The following are output examples for the I editing phrase letter:

Internal Value	Editing Phrase	External String
+23	I4	bb23
-79	I4	b-79
+67486	I5	67486
-67486	I5	*****
+978	I1	*
0	I3	bb0
+3.6	I2	b4

### J Editing Phrase Letter

The editing phrase letter J is used when reading or writing integer values. Valid list elements are of type INTEGER, REAL, DOUBLE, COMPLEX, and BOOLEAN.

#### Input

On input, the action specified by the editing phrase letter J is identical to that specified by the editing phrase letter I.

#### Output

On output, the editing phrase letter J specifies that the value of the corresponding list element is to be converted to a character string in the form of an ALGOL integer. The string is written to a field equal in width to the length of the string. The value of the list element is rounded to an integer before it is written.

Negative values are written with a minus sign (-); nonnegative values are written without a sign.

If  $w$  is less than the number of characters required to express the value of the list element,  $w$  asterisks (\*) are written.

The following are output examples for the J editing phrase letter:



## Declarations

---

Internal Value	Editing Phrase	External String
+23	J5	23
-23	J5	-23
+233	J3	233
-233	J3	***
0	J3	0
3.14, -12	2J10	3-12

### L Editing Phrase Letter

The editing phrase letter L is used when reading or writing Boolean values. Valid list elements are of type INTEGER, REAL, DOUBLE, COMPLEX, and BOOLEAN.

#### Input

The editing phrase letter L specifies that  $w$  characters of input data are to be read, converted to one of the Boolean values TRUE or FALSE, and assigned to the corresponding list element. If the first nonblank character of the input data is the letter T, then bit 0 (zero) of the list element is assigned the value 1; otherwise, bit 0 is assigned the value 0 (zero). All other bits in the list element are assigned the value 0 (zero). An all-blank field yields the value FALSE. If the list element is a double-precision variable, the first word is assigned a value according to the rules just described, and the second word is set to 0 (zero).

The following are input examples for the L editing phrase letter:

External String	Editing Phrase	Internal Value
T	L1	TRUE (4"000000000001")
bbF	L3	FALSE (4"000000000000")
bbbTRU	L6	TRUE (4"000000000001")
b	L1	FALSE (4"000000000000")
T	L1	TRUE (4"0000000000010000000000") (double precision)

#### Output

On output, the editing phrase letter L specifies that TRUE is to be written to the output record if bit 0 (zero) of the corresponding list element equals 1, and the letter L specifies that FALSE is to be written if bit 0 (zero) of the corresponding list element equals the

number 0. If  $w$  is less than 5, the first  $w$  characters of TRUE or FALSE are written. If  $w$  is greater than 4, TRUE or FALSE is written right-justified with blank fill.

The following are output examples for the L editing phrase letter:

Internal Value	Editing Phrase	External String
0	L6	bFALSE
1	L5	bTRUE
2	L4	FALS
3	L3	TRU
4	L2	FA

### O Editing Phrase Letter

The editing phrase letter O is used when data is to be read or written without editing. Valid list elements are of type INTEGER, REAL, DOUBLE, COMPLEX, BOOLEAN, and POINTER.

In the following explanation of the editing phrase letter O, the letter Q is used. The value of Q is derived from the following table:

	Precision			Pointers		
	Single	Double	4-bit	6-bit	8-bit	
BCL	8	16	12	8	6	
EBCDIC	6	12	12	8	6	

### Input

The editing phrase letter O specifies that the input data is to be assigned to the corresponding list element without editing. Q characters of input data are read, unless the corresponding list element is of the following form:

<pointer expression> FOR <arithmetic expression>

When the list element is of this form, the value of Q and the value of the arithmetic expression are compared, and the lesser value is the number of characters read.

## Declarations

---

### Output

On output, the editing phrase letter O writes the value of the list element as an unedited string of characters. Q characters are written to the output record unless the corresponding list element is of the following form:

```
<pointer expression> FOR <arithmetic expression>
```

When the list element is of this form, the value of Q and the value of the arithmetic expression are compared, and the lesser value is the number of characters written.

### Example of Input and Output

The following example shows the use of the editing phrase letter O:

```
BEGIN
  FILE TD(KIND=REMOTE,MYUSE=IO);
  REAL R;
  READ(TD, <O>, R);
  WRITE(TD, <O>, R);
END.
```

Input and output data for this example are as follows:

Input	Output
A	A
ABCDEFGH	ABCDEF

### R Editing Phrase Letter

The editing phrase letter R is used when reading or writing real values and can be used with the editing phrase letter S. Valid list elements are of type INTEGER, REAL, DOUBLE, COMPLEX, and BOOLEAN.

#### Input

On input, the action specified by the editing phrase letter R is identical to that specified by the editing phrase letter D except when the letter R is immediately preceded by an S editing phrase.

#### Output

On output, the editing phrase letter R specifies that the value of the corresponding list element is to be converted to a string that expresses the value in either simple decimal or exponential notation.

In general, if  $w$  is greater than or equal to the number of characters required to express the value of the list element using simple decimal notation, then simple decimal notation is used. If  $w$  is less than the number of characters required to express the value using simple decimal notation and greater than or equal to the number of characters required

to express the value using exponential notation, then exponential notation is used. If  $w$  is less than the number of characters required to express the value using exponential notation, the field is filled with asterisks (\*).

**Examples of Input and Output**

External Input String	List Element Type	Editing Phrase	External Output String
-.333333bb	REAL	R10.4	bbb-0.3333
-.333333bb	DOUBLE	R10.4	bbb-0.3333
-.333333bb	INTEGER	R10.4	bbbb0.0000
3333.333E2	DOUBLE	R10.4	3.3333D+05
3333.333E2	INTEGER	R10.4	3.3333E+05
-.333bbbbb	REAL	R10.9	*****
-.333bbbbb	INTEGER	R10.9	.00000000
333.333E2b	DOUBLE	R10.4	3.3333D+22
bbbbbbbbbb1.23D12	REAL	R20.4	bb123000000000.0000
bbbbbbbbbb1.23D12345	DOUBLE	R20.4	bbbbbb1.2300D+12345
bbb4.3@68	REAL	R10.4	4.3000E+68

**S Editing Phrase Letter**

The editing phrase letter S is used with an R editing phrase to provide a scale factor.

If the next editing phrase in the editing specifications does not contain the editing phrase letter R, the S editing phrase is ignored. When more than one S editing phrase appears in the editing specifications, each subsequent S editing phrase takes precedence over the preceding one.

**Input**

On input, the value of the input data corresponding to the subsequent R editing phrase is divided by the following number before the input data value is assigned to the list element:

`10 ** <scale factor>`

The following are input examples for the S editing phrase letter:

## Declarations

---

External String	Editing Specifications	Internal Value
bbbb10000.	S2,R10.2	100.0
bbbbbb5.41	S1,R10.2	0.541
bbbbbb05.5	S1,R10.2	0.55
bbb5.01521	S-1,R10.2	50.1521
bbbbbb541	S1,R10.2	0.541

### Output

On output, the value of the list element corresponding to the subsequent R editing phrase is multiplied by the following number before the list element value is written to the output field:

1Ø \*\* <scale factor>

The following are output examples for the S editing phrase letter:

Internal Value	Editing Specifications	External String
100.0	S2,R10.2	bb10000.00
0.54	S1,R10.2	bbbbbb5.40
0.0056	S1,R10.2	bbbbbb0.06
1.55	S-1,R10.2	bbbbbb0.16

### T Editing Phrase Letter

The editing phrase letter T specifies that the buffer pointer is to be moved to character position  $w$  of the input or output record. The value of  $w$  must be greater than 0 (zero); if  $w$  is equal to 0, the buffer pointer is moved to the first character position in the record. No list element corresponds to this editing phrase letter.

### Input Examples

External String	Editing Specifications	Internal Value
012345678910111213	T13,I3	111
012345678910111213	T1,I4	123

continued

continued

External String	Editing Specifications	Internal Value
012345678910111213	T15,I4	1213
ABCDEFGHIJKLMNQPQR	T8,A6	HIJKLM

### Output Example

```
BEGIN
  FILE DCOM(KIND=REMOTE,MYUSE=IO);
  ARRAY A[0:9];
  WRITE(DCOM, <T11,I3,T1,I3>, 123, 456); % WRITE STATEMENT 1
  WRITE(DCOM, <T4,A3,T1,A2>, "ABC", "DE"); % WRITE STATEMENT 2
END.
```

This program produces the following output:

```
WRITE statement 1: b456bbbbbb123
WRITE statement 2: DEbABC
```

### U Editing Phrase Letter

The editing phrase letter U specifies that output data is to be edited as best suits the type of the corresponding list element. Valid list elements are of type INTEGER, REAL, DOUBLE, COMPLEX, and BOOLEAN, STRING, POINTER.

#### Input

The editing phrase letter U is not implemented for input.

#### Output

On output, real, integer, and double-precision list elements are written using a format that combines readability with maximum numerical significance. Boolean values are written as *T* or *F* and occupy one character position in the record. String literals are treated as real values. If the number of characters required to express the list element is greater than the number left in the current record, the output is placed in the next record.

If *w* is specified and the number of characters required to express the list element is greater than *w*, the field is filled with asterisks (\*).

If *d* is specified and *d* is greater than *w*, then *d* - *w* leading blanks are inserted in the value that is written to the list element before the field is written.

## Declarations

---

Thus, when the editing phrase letter U is used, the number of characters actually written cannot be less than  $d$  and can be greater than  $w$ .

The following are output examples for the U editing phrase letter:

Internal Value	Editing Phrase	External String
-123.4567	U	-123.4567
789	U	789
1.5@@275	U10	1.5D+275
1234567	U5	1.2+6
1	U10.4	bbb1
123.456	U10.4	123.456
1	U5.8	bbbbbbb1
123.456	U5.8	bbb123.5

### V Editing Phrase Letter

The editing phrase letter V allows the type of editing to be specified at run time. The rightmost character of the first word of the next list element (or, if the list element is a pointer, the character pointed at) provides the editing phrase letter to be used to edit the data. Valid list elements are of type INTEGER, REAL, DOUBLE, COMPLEX, BOOLEAN, and POINTER.

The editing phrase letter extracted from the list element is a 6-bit character if the default character type is BCL; otherwise, the letter is an 8-bit character.

#### Example of V Editing Phrase Letter

In the following program, FMT1 in the first READ statement evaluates to R8.2 and corresponds to the list element A; FMT2 in the WRITE statement evaluates to 2A6 and corresponds to the list elements A and I; and FMT3 in the second READ statement evaluates to 2E10.4 and corresponds to the list elements A and B.

```

      .
      .
      .
REAL A,B;
INTEGER I;

      .
      .
      .
FORMAT FMT1(V8.2),
       FMT2(2V*),
       FMT3(*V*.*) ;
      .
      .
      .
READ(KARD,FMT1,"R",A);
B := 4"C1";
WRITE(LINE,FMT2,B,6,A,I);
I := 4"C5";
READ(KARD,FMT3,2,I,1Ø,4,A,B);
      .
      .
      .

```

For more information, see “Variable Editing Phrases” earlier in this section.

### X Editing Phrase Letter

On input, the editing phrase letter X specifies that  $w$  characters of input are to be skipped. On output, the editing phrase letter X specifies that  $w$  blanks are to be written. No list element corresponds to this editing phrase letter.

### Z Editing Phrase Letter

The editing phrase letter Z is used when reading or writing real values. Valid list elements are of type INTEGER, REAL, DOUBLE, COMPLEX, and BOOLEAN.

#### Input

On input, the editing phrase letter Z selects one of the editing phrase letters D, I, or L to specify the editing action, depending on the type of the corresponding list element, as shown in the following table:

Type	Editing Phrase
REAL or DOUBLE	Dw.d
INTEGER	Iw
BOOLEAN	Lw

#### Output

The output string has a length of  $w$  characters regardless of the value or type of the list element being written. For Boolean list elements,  $Lw$  is used. For integer list elements,



## Declarations

---

*Iw* is used. For real or double-precision list elements, editing with D, E, or F editing phrase letters is performed depending on the type of the list element and the magnitude of its value.

The following are output examples for the Z editing phrase letter:

Internal Value	Editing Phrase	External String
1.23@@250	Z12.6	1.230000+250
1	Z5.1	bbbb1
12345	Z5.1	12345
12	Z8.7	bbbbbb12
12345.678	Z10.4	1.2346E+04
12	Z10.4	bbbbbbbb12
12345678	Z6	*****
1234	Z6	bb1234

## Editing Modifiers

Editing modifiers can be used to modify the editing performed by the editing phrase letters D, E, F, I, J, R, and Z. Editing modifiers are valid only for output.

### P Editing Modifier

The P editing modifier specifies that a comma (,) is to be inserted immediately to the left of every third digit left of the decimal point.

### \$ Editing Modifier

The \$ editing modifier specifies that a dollar sign (\$) is to be inserted immediately to the left of the output string.

### Examples of P and \$ Editing Modifiers

Internal Value	Editing Phrase	External String
17.347	\$F10.2	bbbb\$17.35
-1234567	PI10	-1,234,567
-1234567	P\$Z15.2	bbbb\$-1,234,567
1234567.11111	PF15.5	1,234,567.11111

continued



## Declarations

---

<forward interrupt declaration>

```
— INTERRUPT —<interrupt identifier>— ; — FORWARD ——————|
```

<forward procedure declaration>

```
—————| PROCEDURE —<procedure heading>— ; ——————>  
|<procedure type>|  
→- FORWARD ——————|
```

<forward switch label declaration>

```
— SWITCH —<switch label identifier>— FORWARD ——————|
```

## Order of Referencing

Assume two procedures, PROC\_ONE and PROC\_TWO, make references to each other, and PROC\_ONE appears before PROC\_TWO in the source code. Before PROC\_ONE is declared, the following FORWARD REFERENCE declaration must appear:

```
PROCEDURE PROC_TWO; FORWARD
```

When PROC\_ONE calls PROC\_TWO, the compiler recognizes the second procedure. Later in the program, the second procedure, PROC\_TWO, is declared in full.

Similar methods are used for mutually referencing interrupts and mutually referencing switch labels.

## Examples of FORWARD REFERENCE Declarations

The following example declares a forward reference to a switch label named SELECT. Later in the program, SELECT must be declared in full.

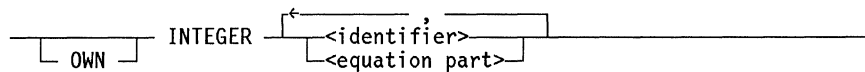
```
SWITCH SELECT FORWARD
```

The following example declares a forward reference to an integer procedure named SUM. Later in the program, SUM must be declared in full, and its parameters must be the same in number and type as in this FORWARD REFERENCE declaration.

```
INTEGER PROCEDURE SUM(A,B,C);  
  VALUE A,B;  
  INTEGER A,B;  
  REAL C;  
  FORWARD
```

## INTEGER Declaration

An INTEGER declaration declares simple variables that can have integer values, that is, arithmetic values that have exponents of 0 (zero) and no fractional parts.

**<integer declaration>****<integer identifier>**

An identifier that is associated with the INTEGER data type in an INTEGER declaration.

A simple variable declared to be OWN retains its value when the program exits the block in which the variable is declared, and that value is again available when the program reenters the block in which the variable is declared.

When an arithmetic value is assigned to an integer simple variable, the value is rounded to an integer, if possible, before it is stored in the simple variable.

When an integer simple variable is allocated, it is initialized to 0 (zero) (a 48-bit word with all bits equal to zero).

See Appendix C, “Data Representation,” for additional information on the internal structure of an integer operand as implemented on A Series systems.

## Equation Part

The equation part causes the simple variable being declared to have the same address as the simple variable associated with the second identifier. This action is called address equation. An identifier can be address-equated only to a previously declared local identifier or to a global identifier. The first identifier must not have been previously declared within the block of the equation part. An equation part is not allowed in the global part of a program.

Address equation is allowed only between INTEGER, REAL, and BOOLEAN variables. Because both identifiers of the equation part have the same address, altering the value of either variable affects the value of both variables. For more information, see “Type Coercion of One-Word and Two-Word Operands” in Appendix C, “Data Representation.”

The OWN specification has no effect on an address-equated identifier. The first identifier of an equation part is OWN only if the second identifier of the equation part is OWN.

## Examples of INTEGER Declarations

The following example declares INDEX as an integer simple variable.

```
INTEGER INDEX
```

The following example declares COUNT, VAL, and NOEXPONENT as integer simple variables.

## Declarations

---

```
INTEGER COUNT,VAL,NOEXPONENT
```

The following example declares SAVEVALUE and MAX as integer simple variables. Because they are declared to be OWN, these simple variables retain their values when the program exits the block in which the simple variables are declared.

```
OWN INTEGER SAVEVALUE,MAX
```

The following example declares INT and CAL as integer simple variables, and address-equates INT to the previously declared simple variable BOOL. The variables INT and BOOL share the same address.

```
INTEGER INT = BOOL, CAL
```

## INTERRUPT Declaration

The INTERRUPT declaration declares an interrupt and associates an unlabeled statement with it.

<interrupt declaration>

```
— INTERRUPT —<identifier>— ; —<unlabeled statement>—————|
```

<interrupt identifier>

An identifier that is associated with an interrupt in an INTERRUPT declaration.

## Interrupting a Program

An interrupt provides a method of forcing a process to depart from its current point of control and to execute the unlabeled statement that the INTERRUPT declaration associates with the interrupt.

After executing the unlabeled statement associated with an interrupt, a program usually returns to its previous point of control. However, the program does not return to this point if a GO TO statement is executed within the unlabeled statement and the specified designational expression references a statement outside of the unlabeled statement.

Once an interrupt is declared, it is enabled until it is explicitly disabled with the DISABLE statement. The DISABLE statement can temporarily render the associated interrupt ineffective. The ENABLE statement is used to reenable a disabled interrupt.

For an interrupt to be used, the interrupt identifier must be attached to an event through the ATTACH statement. An interrupt can be detached from an event through the DETACH statement.

An INTERRUPT declaration can be thought of as describing an unlabeled statement, which can be a block, that is automatically entered on the occurrence (CAUSE) of an event. The operating system ensures that when a program is executing the unlabeled

statement associated with an interrupt, all other interrupts are queued until the program exits the unlabeled statement.

For more information, refer to “ATTACH Statement,” “DETACH Statement,” “DISABLE Statement,” and “ENABLE Statement” in Section 4, “Statements.”

## Examples of INTERRUPT Declarations

The following example declares ERR to be an interrupt and associates with it the statement GO TO ABORT.

```
INTERRUPT ERR; GO TO ABORT
```

The following example declares BLOCK1 to be an interrupt. When BLOCK1 is invoked, two messages are displayed. Because a GO TO statement does not occur within the declaration, after the interrupt code is executed, the program continues from the point at which the interrupt occurred.

```
INTERRUPT BLOCK1;
  BEGIN
    DISPLAY("ERROR");
    DISPLAY("INTERRUPT BLOCK1 OCCURRED");
  END
```

## LABEL Declaration

A LABEL declaration declares each identifier in the declaration to be a label.

<label declaration>

```
— LABEL —┌───<identifier>───┐──────────────────────────────────────────┘
```

<label identifier>

An identifier that is associated with a label in a LABEL declaration.

## Using Label Identifiers

Label identifiers can be used as the targets of GO TO statements and as labels in READ and WRITE statements.

A label identifier must appear in a LABEL declaration within the innermost block in which the label identifier is used to label a statement.

### Examples of LABEL Declarations

The following example declares START as a label.

```
LABEL START
```

The following example declares ENTER, EXIT, START, and LOOP as labels.

```
LABEL ENTER,EXIT,START,LOOP
```

### LIBRARY Declaration

The LIBRARY declaration declares a library identifier and specifies values for the library attributes associated with the library. The library identifier can be used by a program to access entry points in the library.

**<library declaration>**

— LIBRARY —   
**<library specification>**

—<identifier>—

**<library object declaration list>**

**<library identifier>**

An identifier that is associated with a library in a LIBRARY declaration.

The LIBRARY declaration appears in a program that accesses a library. The LIBRARY declaration can be used to assign values to the library attributes of a library. In a program that calls a library, the library identifier also appears in the PROCEDURE declarations for the library entry points.

Libraries can be declared in any block of a user program. The library and its entry points are valid within the scope of the block; when the block is exited, the linkage to the library is broken, and the count of the library users is decremented.

Section 8, “Library Facility,” contains extended examples of libraries and programs that use libraries, as well as information about library attributes, library linkage, and library usage in general.

Programs that declare procedure reference arrays as library objects cannot be used for binding.

## Library Attribute Specifications

**<library attribute specifications>**

← <string or pointer library attribute specification> , <mnemonic library attribute specification> →

**<string or pointer library attribute specification>**

← <string- or pointer-valued library attribute name> = \_\_\_\_\_ →  
 → <EBCDIC string literal> \_\_\_\_\_ |

**<string- or pointer-valued library attribute name>**

┌ FUNCTIONNAME \_\_\_\_\_ |  
 │ INTNAME \_\_\_\_\_ |  
 │ LIBPARAMETER \_\_\_\_\_ |  
 └ TITLE \_\_\_\_\_ |

**<mnemonic library attribute specification>**

← <mnemonic-valued library attribute name> = \_\_\_\_\_ →  
 → <mnemonic library attribute value> \_\_\_\_\_ |

**<mnemonic-valued library attribute name>**

← LIBACCESS \_\_\_\_\_ |

**<mnemonic library attribute value>**

┌ BYFUNCTION \_\_\_\_\_ |  
 │ BYTITLE \_\_\_\_\_ |  
 └ BYINITIATOR \_\_\_\_\_ |

**<library object declaration list>**

← [ <library object declaration> ; <library object attributes> ] →  
 → ] \_\_\_\_\_ |

**<library object declaration>**

← <procedure reference array declaration> \_\_\_\_\_ |

**<library object attributes>**

← ( ← ACTUALNAME = ← <EBCDIC string literal> → ) \_\_\_\_\_ |

The FUNCTIONNAME attribute specifies the system function name used to find the object code file for the library. For example, GENERALSUPPORT is a system library function name.



## Declarations

---

When a value is assigned to the `TITLE` attribute, the EBCDIC string literal must be a properly formed file title as defined in the *A Series Work Flow Language (WFL) Programming Reference Manual*, and must have a period (.) as its last nonblank character within the quotation marks.

When a value is assigned to the `INTNAME` attribute, the EBCDIC string literal can have leading blanks and must have a period as its last character. The sequence of characters beginning with the first nonblank character up to, but not including, the next blank or period constitutes the `INTNAME` and must be a valid identifier. A valid identifier is defined to be any sequence of characters beginning with a letter and consisting of letters, digits, hyphens (-), and underscores (\_). Blanks can be present between the `INTNAME` and the period.

Specification of the `TITLE` and `INTNAME` attributes is optional; by default, the library identifier being declared is used for the `TITLE` and `INTNAME`. If the `INTNAME` is given and the `TITLE` is not, the `INTNAME` is also used for the `TITLE`.

The EBCDIC string literal assigned to the `LIBPARAMETER` attribute is used as a parameter to a selection procedure during dynamic library linkage.

For information on `LIBACCESS`, see Section 8, "Library Facility."

A `PROCEDURE REFERENCE ARRAY` declaration that appears in a `LIBRARY` declaration can be either the local or the global form of the declaration; that is, either `NULL` or `EXTERNAL` can appear at the end of the declaration. However, only the lower bound is required. If an upper bound is given, it is ignored. The procedure reference array is said to be imported from the library.

The handling of a procedure reference array that is declared to be a library object is comparable to the handling of a procedure that is declared to be a library entry point. For more information, see "PROCEDURE Declaration" later in this section.

## Examples of LIBRARY Declarations

The following example declares a reference to the library `LIB` that is to be referenced by the title `OBJECT/LIBRARY`.

```
LIBRARY LIB( TITLE="OBJECT/LIBRARY.");
```

The following example declares a reference to the library `L`, from which the procedure reference array `REFID` is to be imported. The procedure reference array is exported from the library as `PROCREF`.

```
LIBRARY L [ PROCEDURE REFERENCE ARRAY REFID [0] (I);  
           VALUE I; INTEGER I;  
           EXTERNAL (ACTUALNAME="PROCREF")];
```

The following example declares a reference to the library `LIB`, from which the procedure reference arrays `PA1` and `PA2` are imported.

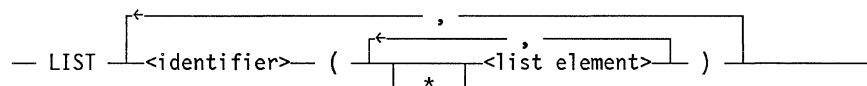
```

LIBRARY LIB [ REAL PROCEDURE REFERENCE ARRAY PA1[0:10];
              NULL;
              PROCEDURE REFERENCE ARRAY PA2[0:3,0:10](R,B);
              REAL R;
              BOOLEAN B;
              NULL ];
    
```

## LIST Declaration

A LIST declaration associates an ordered set of list elements with a list identifier. The list identifier is used in a READ statement or WRITE statement to indicate which entities are to be read or written.

<list declaration>



<list identifier>

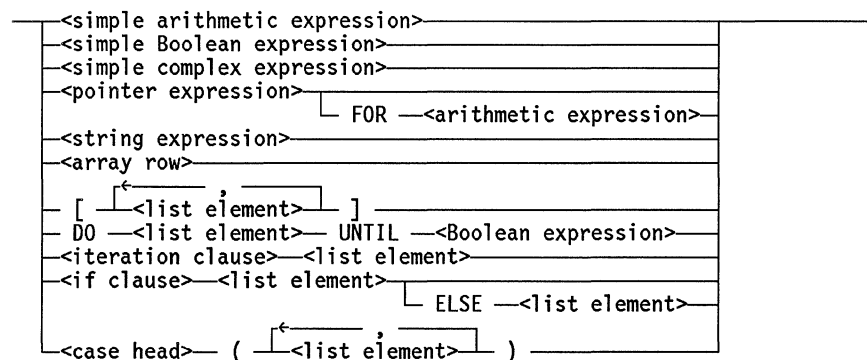
An identifier that is associated with a set of list elements in a LIST declaration.

Although the syntax of the READ statement and WRITE statement allows the list elements to be listed within the statement itself, a LIST declaration provides a way to associate a list identifier with a specific group of list elements.

A simple complex expression or complex value appearing in a list is considered to be a pair of real values: the first value is the real part of the complex value, and the second is the imaginary part.

## List Elements

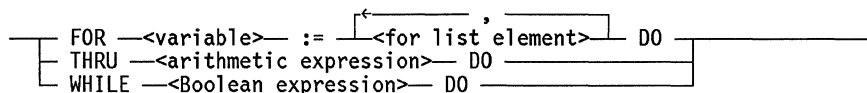
<list element>



## Declarations

---

<iteration clause>



List elements of the following form enable the user to specify the number of characters to be read to or written from the pointer-specified location:

```
<pointer expression> FOR <arithmetic expression>
```

An array row appearing in a list is interpreted as a sequence of variables of the same type as that of the array. A complex array row is considered to be a real array row containing the real and imaginary parts of the complex values in the following order: the real part of the first element, the imaginary part of the first element, the real part of the second element, the imaginary part of the second element, and so on.

A string variable is a valid list element for editing phrase letters A, C, and U and for free-field formatting. For more information on free-field formatting, see “READ Statement” in Section 4, “Statements.”

A string variable acts in the same manner as *<pointer expression> FOR <arithmetic expression>* when used with the A, C, and U editing phrases. For more information about the A, C, and U editing phrases, refer to “FORMAT Declaration” earlier in this section.

Asterisks (\*) prefixed to list elements have meaning only for free-field output; they are ignored for other types of I/O operations. An asterisk prefixed to a list element causes the text of the list element and an equal sign (=) to be written to the left of the edited value of the list element.

## Examples of LIST Declarations

The following example declares L1 as a list identifier for the list consisting of X, Y, the array row A[4,\*], and B[2], B[3], B[4], and B[5].

```
LIST L1 (X,Y,A[4,*],FOR I := 2 STEP 1 UNTIL 5 DO B[I])
```

This list identifier might appear in a WRITE statement such as the following:

```
WRITE (LP_OUT,//,L1);
```

The following example declares ANSWERS and RESULTS as two list identifiers with associated list elements.

```
LIST ANSWERS (P + Q,Z,SQRT(R)),
RESULTS (X1,X2,X3,X4/2)
```

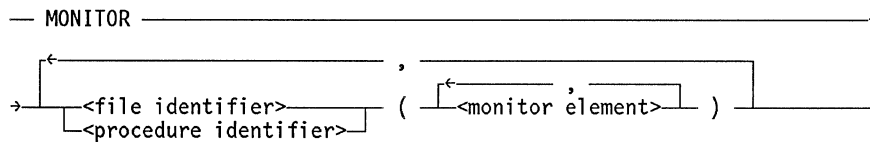
The following example declares LIST3 as a list identifier with an associated list consisting of nested FOR clauses indexing array A. This list identifier can be used in a READ statement to read the specified elements of array A.

```
LIST LIST3 (FOR I := 0 STEP 1 UNTIL 10 DO
            FOR J := 0,3,6 DO
              A[I,J])
```

## MONITOR Declaration

The MONITOR declaration designates items to be monitored during execution of the program and the method by which the items are monitored. The MONITOR declaration is used when diagnostic information is needed.

**<monitor declaration>**



Each time an identifier designated as a monitor element is used in one of the ways described in this section, the identifier and its current value are written to the file or passed as parameters to the procedure specified in the MONITOR declaration.

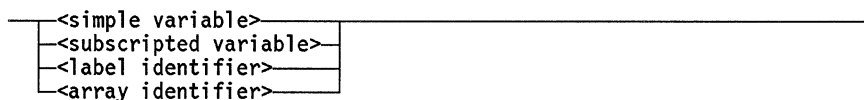
The monitor action does not occur within procedures that are declared before the MONITOR declaration is encountered. Monitoring of a variable in the monitor list does not occur if this identifier is passed as an actual parameter to a call-by-name formal parameter that is modified within the procedure. In addition, the control variable in a FOR statement cannot be monitored. The monitor action does not occur when a value changes as the result of a READ statement or a REPLACE statement.

When a procedure identifier is specified in the MONITOR declaration, printing of the monitor element must be performed by the procedure. Also, the monitoring procedure performs the specified operations depending on the values passed to it.

For a debugging feature, refer to “TADS Option” in Section 6, “Compiling Programs.”

## Monitor Elements

**<monitor element>**



The diagnostic information produced depends on the forms of the monitor elements. When the LINEINFO compiler control option is TRUE and a file identifier is specified in the MONITOR declaration, a stack number, an at sign (@), a code address, and a sequence number are printed in front of the symbolic name of the monitor element (for example, *0143 @ 003:0003:4 (00007000)*). Diagnostic information is given for the specified monitor elements as follows:

## Declarations

---

- If the monitor element is a simple variable or a subscripted variable, the symbolic name and the previous and new values of the variable are printed (for example,  $B = 0: = 13$ ).
- If the monitor element is a label identifier, the symbolic name of the label is shown (for example,  $LABEL L$ ).
- If the monitor element is an array identifier, the symbolic name of the array, the subscript of the element, and the previous and new values of the changed array element are printed (for example,  $A[12] = 0: = 12$ ).

If the monitor element is to be assigned a value, this assignment must be done by the monitoring procedure. This value also can be assigned to the procedure value to be used, for example, in evaluating the remainder of an expression in which the assignment is embedded. In the example under “Monitor Element as an Array Identifier,” the assignment statement  $NAME := MON := VAL$ ; allows the subsequent use of the value assigned to the monitor element.

### Monitor Element as a Simple Variable

When the monitor element is a simple variable, the format of the monitoring procedure must be as follows:

```
REAL PROCEDURE MON(NAME,VAL,SPELL);
```

The procedure must be of the same type as the monitor elements. The procedure must have three parameters:

- The first parameter, NAME, is a call-by-name parameter of the same type as the monitor element. The parameter NAME is passed a reference to the monitor element, and it is normally used to store the value of the second parameter, VAL.
- The second parameter, VAL, is also of the same type as the monitor element, but it is a call-by-value parameter and is passed the new value to be assigned to the monitor element.
- The third parameter, SPELL, must be a call-by-value real variable that is passed the name of the monitor element as a string of characters. Only the first six characters of the symbolic name are passed to this formal parameter. If the symbolic name is less than six characters long, it is left-justified, and trailing blanks are added, up to six characters.

### Monitor Element as a Label Identifier

When the monitor element is a label identifier, the format of the monitoring procedure must be as follows:

```
PROCEDURE MON(SPELL);
```

The procedure must be untyped and must have only one parameter. This parameter is a call-by-value real variable that is passed the first six characters of the symbolic name. If the symbolic name is less than six characters long, it is left-justified, and trailing blanks

are added, up to six characters. The monitoring procedure could compare this name to the symbolic names in the monitor list in order to identify a particular label.

### Monitor Element as an Array Identifier

When the monitor element is an array identifier, the declaration of the monitoring procedure must be as follows:

```
REAL PROCEDURE MON(D1,...,Dn,NAME,VAL,SPELL);
```

The parameters D1 through Dn of the procedure are index parameters that are passed the subscripts for each dimension of the array element that is modified. There must be as many index parameters as the array has dimensions. Each index parameter is a call-by-value integer. The last three parameters are the same as in the simple variable form, except that NAME and VAL are simple variables of the same type as the array.

The value being assigned to the array element also can be assigned to the procedure value to be used, for example, in evaluating the remainder of an expression that contains the array element.

The following procedure can be used to monitor a two-dimensional real array so that the values in the array never become negative:

```
REAL PROCEDURE MON(D1,D2,NAME,VAL,SPELL);
VALUE D1,D2,VAL,SPELL;
REAL NAME,VAL;
REAL SPELL;
INTEGER D1,D2;
BEGIN
  IF VAL < 0 THEN
    GO TO ERROREXIT; % BAD GO TO
  NAME := MON := VAL; % RETURN VALUE FOR FURTHER USE
END;
```

The following statements are equivalent to each other, where A is monitored by MON. A is a two-dimensional array declared in the same program where the monitoring procedure MON is declared. The first assignment statement assigns 4 to A[I,J], as does the second statement because inside the procedure MON the fourth parameter (VAL) is assigned to the 3rd parameter (NAME).

```
B := A[I,J] := 4;

B := MON(I,J,A[I,J],4,"A");
```

### Examples of MONITOR Declarations

The following example declares the simple variable A to be a monitor element. When A is used, monitoring information on A is written to file FYLE.

```
MONITOR FYLE (A)
```

## Declarations

---

In the following program, simple variable I, array MON1, subscripted variable MON2[1], and label FINISH are monitored.

```
100 BEGIN
200
300 FILE TERMOUT(KIND=REMOTE);
400 INTEGER I;
500 LABEL FINISH;
600 ARRAY MON1[0:3],
700     MON2[0:3];
800 MONITOR TERMOUT (I,MON1,MON2[1],FINISH);
900
1000 I := 27;
1100 MON1[0] := I;
1200 MON2[0] := 23;
1300 MON2[1] := MON1[0] * 2;
1400 GO TO FINISH;
1500 FINISH:
1600 END.
```

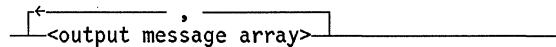
When the program is executed, the following output is written to the terminal:

```
0148 @ 003:000E:4 (00001000) I      =0:=27      (4"000000000001B")
0148 @ 003:0013:4 (00001100) MON1  [0]=0:=27    (4"000000000001B")
0148 @ 003:0020:4 (00001300) MON2  [1]=0:=54    (4"0000000000036")
0148 @ 003:0024:4 (00001500) LABEL FINISH
```

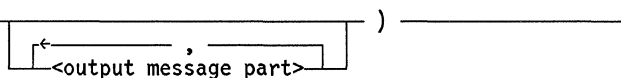
## OUTPUTMESSAGE ARRAY Declaration

An OUTPUTMESSAGE ARRAY declaration declares output message arrays. An output message array contains output messages to be used by the MultiLingual System (MLS). For a description of how to use these arrays, refer to "MESSAGESEARCHER Statement" in Section 4, "Statements."

<output message array declaration>

— OUTPUTMESSAGE — ARRAY — 

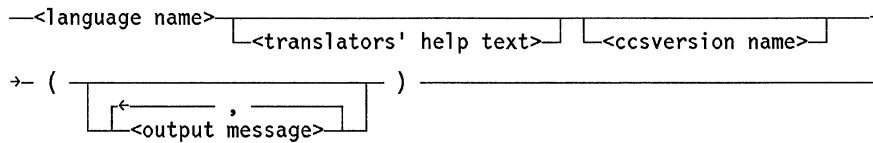
<output message array>

— <identifier> — (  )

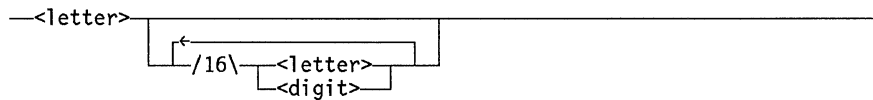
<output message array identifier>

An identifier that is associated with an output message array in an OUTPUTMESSAGE ARRAY declaration.

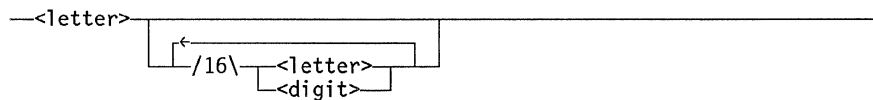
**<output message part>**



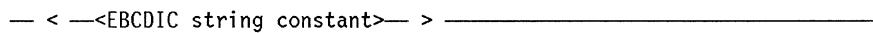
**<language name>**



**<ccsversion name>**



**<translator's help text>**



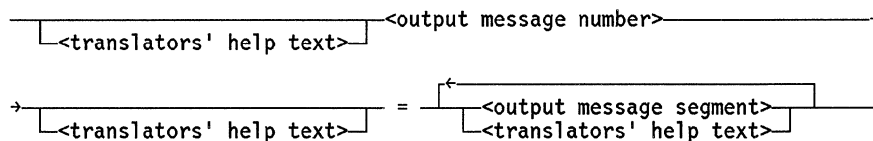
The OUTPUTMESSAGE ARRAY declaration is part of the ALGOL interface to the MultiLingual System (MLS), which enables the user to access system messages in various natural languages, that is languages used by humans rather than machines.

Each output message array identifier must be unique throughout the entire program. This requirement is an exception to the description of the scope of identifiers given in Section 1, "Program Structure."

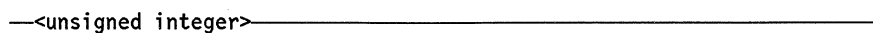
The ccsversion name identifies the ccsversion to be associated with the messages contained in the output message array. This information is used during translation of the declared output messages by the MLSTRANSULATE statement to provide case-insensitivity. If unspecified, the associated ccsversion becomes the internationalized system default collating sequence.

## Output Message

**<output message>**



**<output message number>**

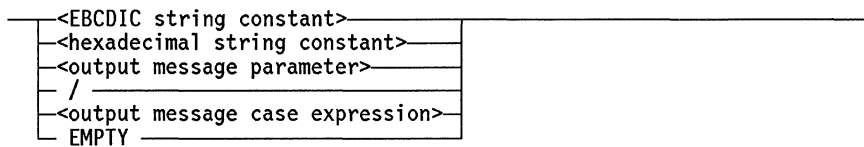




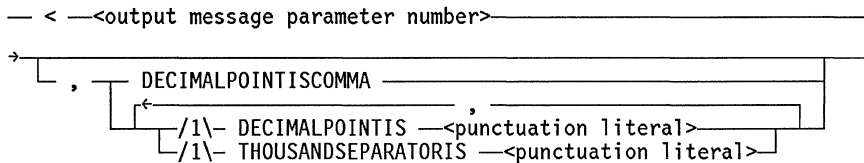
## Declarations

---

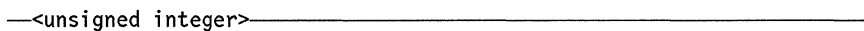
### <output message segment>



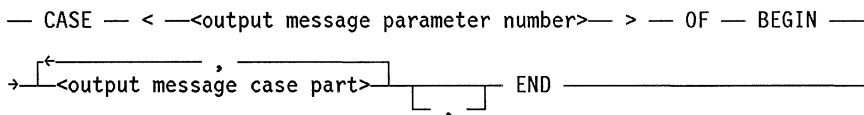
### <output message parameter>



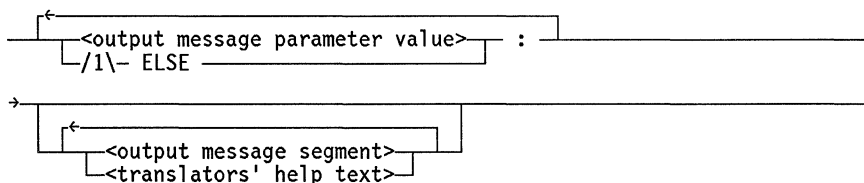
### <output message parameter number>



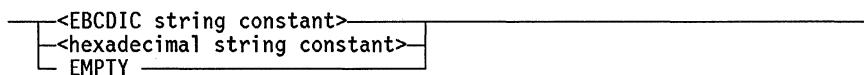
### <output message case expression>



### <output message case part>



### <output message parameter value>



An output message number must be less than 8 digits long. For each output message part, the output message number must uniquely identify an output message. For example, a number is assigned to one and only one output message segment, and each output message segment has only one number assigned to it.

An output message parameter number represents a parameter to be substituted into the message when the MESSAGESEARCHER statement is executed. The number identifies which parameter is to be substituted. The output message parameters are numbered consecutively from 1 through  $n$ , where  $n$  is the number of parameters in the output message.

DECIMALPOINTISCOMMA indicates that any decimal point (.) appearing in the preceding output message parameter number is changed to a decimal comma (,). In addition, all commas are changed to decimal points. DECIMALPOINTIS <punctuation literal> causes any decimal points appearing in the parameter value to be changed to the specified character. THOUSANDSEPARATORIS <punctuation literal> causes any commas appearing in the parameter value to be changed to the specified character.

A slash (/) causes both a carriage return character (48"0D") and a line feed character (48"25") to be inserted into the completed output message.

If an output message case expression does not contain an ELSE clause and no case exists for the value of the output message parameter, then the result of the output message case expression is a null string and an error result is returned with the completed output message. The program requesting the output message can determine whether or not the partially formed output message should be used.

When multiple output message parts occur within the same output message array, they define the same output messages for different languages. Multiple output message arrays can be used to define different groups of output messages.

Defines are expanded within an OUTPUTMESSAGE ARRAY declaration.

### Translators' Help Text

The translators' help text is displayed by the Message Translation Utility (MSGTRANS) when an output message is being translated. For more information on the MSGTRANS, refer to the *A Series Message Translation Utility (MSGTRANS) Operations Guide*. The translators' help text can occur before or after an output message segment or an output message number. If translators' help text needs to appear with all output messages in the language, then the translators' help text is placed after the language name and before the left parenthesis.

### Examples of OUTPUTMESSAGE ARRAY Declarations

In the following example, the output message array ERRORS shows an OUTPUTMESSAGE ARRAY declaration with the same output messages in two languages. The language of the user and the output message number determine the output message that is selected from this array.

```
OUTPUTMESSAGE ARRAY ERRORS (
  ENGLISH (
    1Ø = "POSITIVE INTEGER EXPECTED.",
    2Ø = "TOO MANY PARAMETERS."
  ),
  FRANCAIS (
    1Ø = "DEMANDE UN ENTIER POSITIF.",
    2Ø = "TROP DE PARAMETRES."
  ));
```

## Declarations

---

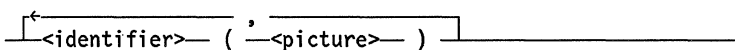
In the following example, the output message array SUMMARY shows an OUTPUTMESSAGE ARRAY declaration with parameters. The first parameter value is not used as part of the message, but rather to select among case alternatives. The second and third parameters are conditionally inserted into the message, based on the value of the first parameter. Note that both the second and third parameters are not necessarily used. When the message is given in the language FRANCAIS, decimal points in the values of parameters 2 and 3 are changed to decimal commas.

```
OUTPUTMESSAGE ARRAY SUMMARY (
  ENGLISH (
    100 =
      "THIS PROGRAM IS TO BE EXECUTED WITH "
    CASE <1> OF
      BEGIN
        "1": "MAX PROCESSING TIME " <2> " SEC.",
        "2": "MAX I/O TIME " <3> " SEC.",
        "3": "MAX PROCESSING TIME " <2> " SEC., MAX "
              "I/O TIME " <3> " SEC."
      END
    ),
  FRANCAIS (
    100 =
      "CE PROGRAMME DOIT S'EXECUTER EN MOINS DE "
    CASE <1> OF
      BEGIN
        "1": <2, DECIMALPOINTISCOMMA>
              " SEC. DE CALCUL.",
        "2": <3, DECIMALPOINTISCOMMA> " SEC. D'E/S.",
        "3": <2, DECIMALPOINTISCOMMA>
              " SEC. DE CALCUL OU "
              <3, DECIMALPOINTISCOMMA> " SEC. D'E/S."
      END
    ));
```

## PICTURE Declaration

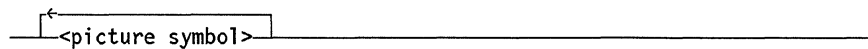
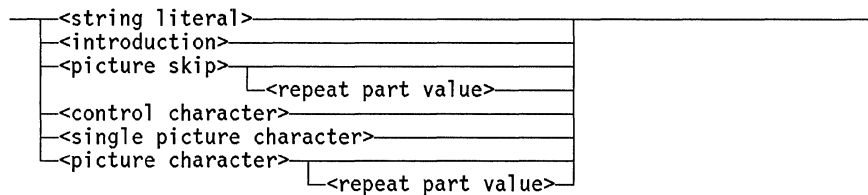
The PICTURE declaration declares pictures that are used in REPLACE statements to perform general editing of characters.

<picture declaration>

```
— PICTURE —  (<picture> )
```

<picture identifier>

An identifier that is associated with a picture in a PICTURE declaration.

**<picture>****<picture symbol>**

A picture is used in a REPLACE statement to perform generalized editing functions as characters are transferred from a source location to a destination. The following editing operations can be performed:

- Unconditional character moves
- Moves of characters with leading 0 (zero) editing
- Moves of characters with leading 0 (zero) editing and floating character insertion
- Moves of characters with conditional character insertion
- Moves of characters with unconditional character insertion
- Moves of only the numeric parts of characters
- Forward and reverse skips of source characters
- Forward skips of destination characters
- Insertion of an overpunch sign on the previous character

A picture consists of a named string of picture symbols enclosed in parentheses. The picture symbols specify the editing to be performed and can be combined in any order to perform a wide range of editing functions.

One value array, also called an edit table, is generated for each PICTURE declaration; therefore, for run-time efficiency, all pictures should be collected under a single PICTURE declaration.

## String Literals

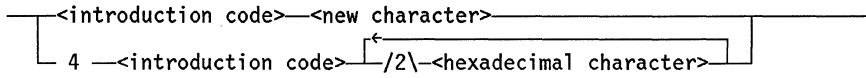
If a string literal appears in a picture, the string is inserted into the destination. If the destination is EBCDIC, the string is inserted unchanged. If the destination is hexadecimal, only the numeric fields of the string characters are inserted into the destination.

## Declarations

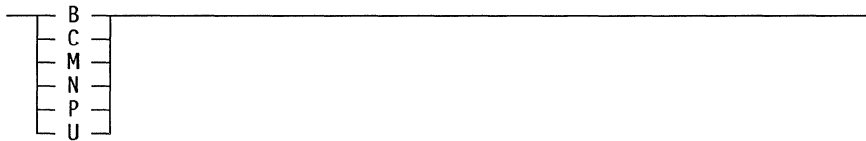
---

### Introduction

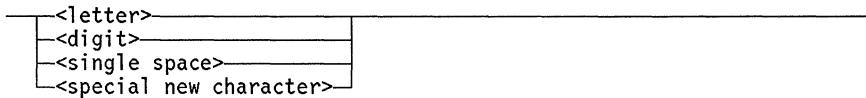
**<introduction>**



**<introduction code>**



**<new character>**



**<special new character>**

Any of the following special characters:

. , [ ] ( ) + - /  
> < = % & \* ; @ :  
# \$ "

### Introduction Codes

The introduction codes can be used to change the implicit characters used by some of the picture symbols. The <introduction> construct specifies the new character to be used. If two hexadecimal characters are used to specify the new character, they are assumed to represent a single EBCDIC character.

Introduction Code	Action
B	Specifies the zero character to be used by D, E, F, and Z. The default zero character is the blank character.
C	Specifies the nonzero character to be used by D. The default nonzero character is the comma (,).
M	Specifies the minus character to be used by E, R, and S. The default minus character is the hyphen (-).
N	Specifies the insert character to be used by I. The default insert character is the period (.).
P	Specifies the plus character to be used by E, R, and S. The default plus character is the plus sign (+).
U	Specifies the dollar character to be used by F and J. The default dollar character is the dollar sign (\$).

## Characters Used by Picture Symbols

Certain picture symbols implicitly define characters to be inserted into the destination. These characters are referred to as the insert character, zero character, nonzero character, minus character, plus character, and dollar character.

The insert character is the character inserted into the destination by the picture symbol I. It is, by default, the period (.), and it can be changed by the introduction code N.

The zero character is used by the picture symbol D, and by the picture symbols E, F, and Z for leading zero replacement. It is, by default, the blank character, and it can be changed by the introduction code B.

The nonzero character is used by the picture symbol D. It is, by default, the comma (,), and it can be changed by the introduction code C.

The minus character is used by the picture symbols E, R, and S. The default minus character is the hyphen (-), and it can be changed by the introduction code M.

The plus character is used by the picture symbols E, R, and S. The default plus character is the plus sign (+), and it can be changed by the introduction code P.

The dollar character is used by the picture symbols F and J. The default dollar character is the dollar sign (\$), and it can be changed by the introduction code U.

## Flip-Flops Used by Picture Symbols

Two hardware flip-flops affect the operation of certain picture symbols: the float flip-flop (FLTF) and the external sign flip-flop (EXTF).

The value of FLTF affects the function performed by the picture symbols D, E, F, J, R, and Z. FLTF is set to 0 (zero) at the beginning of every picture. The picture symbols E, F, and Z can change the value of FLTF to 1, and the picture symbols J, R, and D unconditionally assign the number 0 to FLTF.

The value of EXTF affects the function performed by the picture symbols E, F, J, Q, R, and S. EXTF is not assigned a value by the REPLACE statement that is using the picture; EXTF remains in the state in which it was left after the most recent operation that affected it. For example, a REPLACE statement of the following form sets EXTF to reflect the sign of the first arithmetic expression: the number 1 if the arithmetic expression is positive, and the number zero if it is negative.

```
REPLACE <destination> BY <arithmetic expression>  
FOR <arithmetic expression> DIGITS
```

## Character Fields

Pictures can act on both EBCDIC and hexadecimal characters. In the descriptions of the picture symbols, the term *numeric field* is used to mean either an entire hexadecimal

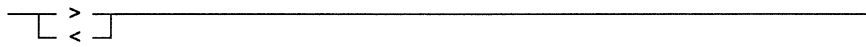
## Declarations

---

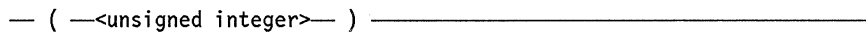
character or the rightmost four bits of an EBCDIC character. The term *zone field* is used to mean the leftmost four bits of an EBCDIC character.

## Picture Skip Characters

<picture skip characters>



<repeat part value>

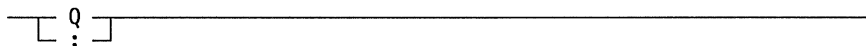


The picture skip characters are described in the following table. If a repeat part value is given with the picture symbol, then this unsigned integer indicates the number of characters that are to be skipped in the source. If no repeat part value is given, one character is skipped in the source.

Character	Action
>	The source pointer is skipped forward (to the right) the specified number of characters.
<	The source pointer is skipped backward (to the left) the specified number of characters.

## Control Characters

<control character>

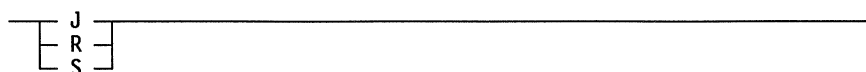


The control characters are described in the following table.

Character	Action
Q	If the value of EXTF is 1, a 4"D" character is inserted into the zone field of the preceding destination character. If the value of EXTF is 0, the destination character is not altered. The destination pointer must be EBCDIC, and it is left pointing to the same character that it was pointing to before the Q action was taken.
:	FLTF is unconditionally assigned the value 0.

## Single Picture Characters

<single picture character>

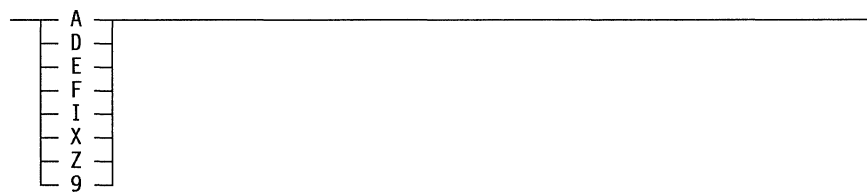


The single picture characters are described in the following table.

Character	Action
J	If the value of FLTF is 0, the dollar character is inserted into the destination. If the value of FLTF is 1, no character is inserted, and the destination pointer is not advanced. FLTF is then assigned the value 0. If the destination is hexadecimal, only the numeric field of the dollar character is inserted.
R	If the values of FLTF and EXTF are 0, the plus character is inserted into the destination. If FLTF is 0 and EXTF is 1, the minus character is inserted into the destination. If FLTF is 1, no character is inserted, and the destination pointer is not advanced. FLTF is then assigned the value 0. If the destination is hexadecimal, only the numeric field of the plus or minus character is inserted.
S	If EXTF is 1, the minus character is inserted into the destination; otherwise, the plus character is inserted into the destination. The destination must be EBCDIC.

## Picture Characters

<picture character>



The picture characters are described in the following table. If a repeat part value is given with the picture symbol, then the unsigned integer in the repeat part value specifies the number of characters to be skipped, inserted, or transferred from the source to the destination. If no repeat part value is given, one character is skipped, inserted, or transferred from the source to the destination.

Character	Action
A	The specified number of characters are transferred from the source to the destination. If the destination is hexadecimal, only the numeric fields of the characters are transferred.
D	If the value of FLTF is 0, the specified number of zero characters are inserted into the destination. If FLTF is 1, the specified number of nonzero characters are inserted into the destination. If the destination is hexadecimal, only the numeric field of the zero or nonzero character is inserted.

*continued*



## Declarations

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*continued*

<b>Character</b>	<b>Action</b>
E	For the specified number of source characters, the following action takes place. While the value of FLTF is 0 and the numeric field of the source character is 4"0", the zero character is inserted into the destination. If the destination is hexadecimal, only the numeric field of the zero character is inserted. If the value of FLTF is 0 and the numeric field of the source character is not equal to 4"0", several things happen. If EXTF is 0, the plus character is inserted into the destination. If EXTF is 1, the minus character is inserted into the destination. If the destination is hexadecimal, only the numeric field of the plus or minus character is inserted. The numeric field of the source character is transferred to the destination, with a zone field of 4"F" if the destination is EBCDIC. FLTF is assigned a value of 1. While FLTF is 1, the numeric field of the source character is transferred to the destination, with a zone field of 4"F" if the destination is EBCDIC.
F	For the specified number of source characters, the following action takes place. While the value of FLTF is 0 and the numeric field of the source character is 4"0", the zero character is inserted into the destination. If the destination is hexadecimal, only the numeric field of the zero character is inserted. If FLTF is 0 and the numeric field of the source character is not equal to 4"0", several things can happen. The dollar character is inserted into the destination. If the destination is hexadecimal, only the numeric field of the dollar character is inserted. The numeric field of the source character is transferred to the destination, with a zone field of 4"F" if the destination is EBCDIC. FLTF is assigned a value of 1. While FLTF is 1, the numeric field of the source character is transferred to the destination, with a zone field of 4"F" if the destination is EBCDIC.
I	The specified number of insert characters are inserted into the destination. If the destination is hexadecimal, only the numeric field of the insert character is inserted.
X	The destination pointer is skipped forward (to the right) the specified number of characters.
Z	For the specified number of source characters, the following action takes place. While the value of FLTF is 0 and the numeric field of the source character is 4"0", the zero character is inserted into the destination. If the destination is hexadecimal, only the numeric field of the zero character is inserted. If the value of FLTF is 0 and the numeric field of the source character is not equal to 4"0", the numeric field of the source character is transferred to the destination, with a zone field of 4"F" if the destination is EBCDIC. FLTF is assigned a value of 1. While FLTF is 1, the numeric field of the source character is transferred to the destination, with a zone field of 4"F" if the destination is EBCDIC.
9	If the source and destination are both EBCDIC, the numeric fields of the specified number of characters are transferred from the source to the destination with zone fields of 4"F". If the source and destination are both hexadecimal, the specified number of characters are transferred from the source to the destination.

## Examples of PICTURE Declarations

The following picture transfers five characters from the source to the destination:

```
PICTURE NUM (ZZZZ9)
```

The first four characters are transferred with leading zero replacement; that is, leading zeros are transferred to the destination as the zero character, which is a blank character by default. The fifth character is not replaced by the zero character. If the source and destination are EBCDIC, digits are transferred as digits, but other characters have their zone field replaced by 4"F", turning them into digits. If the source and destination are hexadecimal, only the numeric field of the zero character is transferred to replace leading zeros. The following table gives some sample results of this picture.

Source	Destination
8"00000"	8" 0"
8"00500"	8" 500"
8"00356"	8" 356"
8"0ABCD"	8" 1234"
4"00000"	4"00000"
4"00500"	4"00500"
4"00356"	4"00356"
4"0ABCD"	4"0ABCD"

The following picture transfers nine characters from the source to the destination and inserts one character into the destination, yielding 10 characters in the destination:

```
PICTURE USECS (ZZZI999999)
```

The first three characters from the source are transferred to the destination with leading zero replacement. Then the insert character, which is a period (.) by default, is inserted into the destination. Six characters are then transferred from the source to the destination with no leading zero replacement. The following table gives some sample results of this picture.

Source	Destination
8"000000000"	8" .000000"
8"356000012"	8"356.000012"
8"005123400"	8" 5.123400"
8"150000376"	8"150.000376"

The following picture transfers six characters from the source:

```
PICTURE TIMENOW (N: " " 9(2) I 9(2) I 9(2))
```

The introduction code N causes the insert character to be the colon (:). The string literal " " causes the blank character to be inserted into the destination. The first and second source characters are transferred to the destination without leading zero

## Declarations

---

replacement, the insert character is inserted into the destination, the third and fourth source characters are transferred to the destination, the insert character is inserted, and the fifth and sixth source characters are transferred to the destination. The destination receives a total of nine characters. The following table gives some sample results of this picture.

Source	Destination
8"000000"	8" 00:00:00"
8"123456"	8" 12:34:56"
8"000523"	8" 00:05:23"
8"150007"	8" 15:00:07"

The following picture transfers 11 characters from the source to the destination, formatting the information into a table:

```
PICTURE TABLE ("1983 = " F(4) X(2) "1984 = " :F(4) X(2)
                "CHANGE = " :E(3) "%")
```

First, the string *1983 =* is inserted into the destination. Then four characters are transferred from the source to the destination, with leading zero replacement and a dollar sign (\$) inserted in front of the first nonzero character. Then the destination pointer is advanced two characters, and the string *1984 =* is inserted into the destination. The colon (:) control character causes leading zero replacement to be restored. Four characters are transferred from the source to the destination with leading zero replacement and a dollar sign (\$) inserted in front of the first nonzero character. The destination pointer is advanced two characters, and the string *CHANGE =* is inserted into the destination. Again, the colon is used to restore leading zero replacement. Then three characters are transferred from the source to the destination with leading zero replacement and a plus sign (+) or a minus sign (-) inserted in front of the first nonzero character, depending on the value of EXTF. Finally, the string % is inserted into the destination. A total of 42 destination characters are produced by this picture.

The following table gives some sample results of this picture. In the table, it is assumed that the destination area was filled with blanks before the picture was used, and that EXTF was properly set up to reflect the sign of the change value.

Source	Destination
8"00035000420020"	8"1983 = \$35 1984 = \$42 CHANGE = +20%"
8"00110003680235"	8"1983 = \$110 1984 = \$368 CHANGE = +235%"
8"02246021060006"	8"1983 = \$2246 1984 = \$2106 CHANGE = -6%"
8"00089000350061"	8"1983 = \$89 1984 = \$35 CHANGE = -61%"



## Declarations

---

pointer pointing to an array declared at a higher lexical (lex) level than that at which the pointer is declared is disallowed by the compiler. Such an assignment is called an up-level pointer assignment.

An explicit up-level pointer assignment such as the following results in a syntax error, because the locally declared array LOCALARRAY might be deallocated, leaving the global pointer GLOBALPOINTER pointing at an invalid memory location:

```
GLOBALPOINTER := POINTER(LOCALARRAY)
```

A potential up-level pointer assignment such as the following also results in a syntax error, because the local pointer LOCALPOINTER can point to a locally declared array:

```
GLOBALPOINTER := LOCALPOINTER
```

Of course, LOCALPOINTER can point to an array declared at a lex level equal to or less than that at which GLOBALPOINTER is declared (in which case up-level assignment would not occur). However, because there is no way for the compiler to determine where LOCALPOINTER will be pointing when the assignment is executed, such potential up-level pointer assignments are not allowed.

The lex level restriction part causes assignments to the declared pointer to be restricted so that the pointer can be used to assign values to pointers declared at lower lex levels. The lex level restriction part specifies that, for up-level pointer assignment checking, the compiler is to treat the pointer being declared as if it were declared at the same lex level as the pointer or array whose identifier follows the *FOR*. For example, the following declaration declares a pointer LOCALPOINTER that can point only to arrays declared at lex levels equal to or less than the lex level at which GLOBALPOINTER is declared:

```
POINTER LOCALPOINTER FOR GLOBALPOINTER
```

Because assignments to LOCALPOINTER are restricted by the lex level restriction part in the preceding declaration, an assignment such as the following one cannot result in an up-level pointer assignment, and therefore is allowed by the compiler:

```
GLOBALPOINTER := LOCALPOINTER
```

The lex level restriction part is not allowed in the formal parameter part or the global part of a PROCEDURE declaration.

## Examples of POINTER Declarations

In the following example, program 1 and program 2 are nearly identical. The only difference is found in the POINTER declaration at line 1000. In program 1, LOCALPOINTER is declared without a lex level restriction part, and the potential up-level pointer assignment at line 1200 of program 1 causes a syntax error. In program 2, LOCALPOINTER is declared with the lex level restriction part FOR GLOBALARRAY2, so the pointer assignment at line 1200 of program 2 cannot be an up-level pointer assignment and does not cause a syntax error. However, the restrictions imposed by the lex level restriction part cause a syntax error at line 1300 of program 2, where no error occurred in program 1.

```

100 %%%%%%%%%%
200 %%%%%%%%%% PROGRAM 1 %%%%%%%%%%
300 %%%%%%%%%%
400 BEGIN                                     % LEX LEVEL 2
500     POINTER GLOBALPOINTER;
600     ARRAY GLOBALARRAY1,
700         GLOBALARRAY2[0:9];
800     GLOBALPOINTER := POINTER(GLOBALARRAY1);
900     BEGIN                                 % LEX LEVEL 3
1000     POINTER LOCALPOINTER;
1100     ARRAY LOCALARRAY[0:9];
1200     GLOBALPOINTER := LOCALPOINTER;      % SYNTAX ERROR
1300     LOCALPOINTER := POINTER(LOCALARRAY);
1400     END;
1500 END.

```

```

100 %%%%%%%%%%
200 %%%%%%%%%% PROGRAM 2 %%%%%%%%%%
300 %%%%%%%%%%
400 BEGIN                                     % LEX LEVEL 2
500     POINTER GLOBALPOINTER;
600     ARRAY GLOBALARRAY1,
700         GLOBALARRAY2[0:9];
800     GLOBALPOINTER := POINTER(GLOBALARRAY1);
900     BEGIN                                 % LEX LEVEL 3
1000     POINTER LOCALPOINTER FOR GLOBALARRAY2;
1100     ARRAY LOCALARRAY[0:9];
1200     GLOBALPOINTER := LOCALPOINTER;
1300     LOCALPOINTER := POINTER(LOCALARRAY); % SYNTAX ERROR
1400     END;
1500 END.

```

As the following example illustrates, a call-by-name formal pointer parameter cannot be assigned the value of any pointer other than itself, because there is no way for the compiler to determine the lex level of the actual pointer parameter passed to the call-by-name formal pointer parameter.

## Declarations

---

```
BEGIN
  POINTER P1, P2;                % LEX LEVEL 2
  ARRAY A[0:9];
  PROCEDURE P(PTRA, PTRB);
  POINTER PTRA, PTRB;
  BEGIN
    PTRA := PTRA + 3;            % OK
    REPLACE PTRA:PTRA BY PTRB:PTRB FOR 5; % OK
    PTRA := PTRB;                % SYNTAX ERROR
    PTRA := P2;                  % SYNTAX ERROR
    PTRB := POINTER(A);          % SYNTAX ERROR
    REPLACE PTRA:PTRB BY "X";    % SYNTAX ERROR
  END;
  P2 := POINTER(A);
  P(P1, P2);
END.
```

As the following example illustrates, to prevent up-level pointer assignments that can result from separate compilation of procedures with global parts, a pointer declared in the global part cannot be assigned the value of any pointer other than itself.

```
[POINTER PTRA,PTRB;]
PROCEDURE P;
  BEGIN
    ARRAY A[0:9];
    PTRA := PTRA + 2;           % OK
    PTRA := POINTER(A);        % SYNTAX ERROR -- THIS IS AN
                                % UP-LEVEL POINTER ASSIGNMENT.
    PTRA := PTRB;              % SYNTAX ERROR -- THE LEX LEVELS
                                % OF PTRA AND PTRB ARE NOT KNOWN,
                                % SO THIS IS A POTENTIAL UP-LEVEL
                                % POINTER ASSIGNMENT.
  END.
```

## PROCEDURE Declaration

A **PROCEDURE** declaration defines a procedure and associates a procedure identifier with it. The procedure can then be invoked by using the procedure identifier.

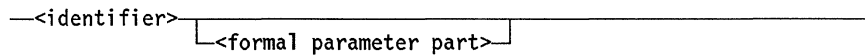
**<procedure declaration>**

```
┌──────────────────┐ PROCEDURE ──<procedure heading>── ; ───────────>
└─<procedure type>─┘
→<procedure body>──────────────────────────────────────────────────────────┘
```

**<procedure type>**

```
┌──────────────────┐
└─<type>──────────┘ ┌──────────────────┐
                     └─<string type>─┘ STRING ───────────────────┘
```

**<procedure heading>**



A procedure becomes a function by preceding the word PROCEDURE with a procedure type and by assigning a value (the result to be returned by the procedure) to the procedure identifier somewhere within the procedure body. This kind of procedure is referred to in ALGOL as a typed procedure. For examples of typed procedures, see procedures RESULT, HEXPROC, MATCH, and MUCHO under “Examples of PROCEDURE Declaration” later in this section. A typed procedure can be used either as a statement or as a function. When used as a statement, the returned result is automatically discarded.

If the <string type> variable is not specified in the <procedure type> construct in the declaration of a string procedure, then the string procedure is of the default character type. The default character type can be designated by the compiler control options ASCII and BCL. If no such compiler control option is used, the default character type is EBCDIC. For more information, refer to “Default Character Type” in Appendix C, “Data Representation.”

## Identifiers

**<procedure identifier>**

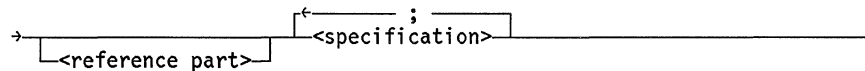
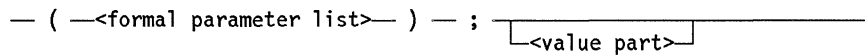
An identifier that is associated with a procedure in a PROCEDURE declaration.

**<string procedure identifier>**

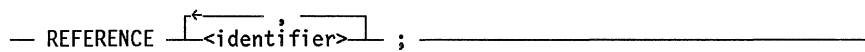
An identifier that is associated with a procedure that is declared a string procedure in a PROCEDURE declaration.

## Formal Parameter Part

**<formal parameter part>**



**<reference part>**

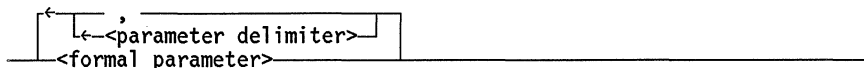




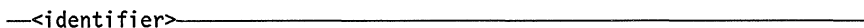
## Declarations

---

<formal parameter list>



<formal parameter>



<value part>



The formal parameter part lists the items to be passed in as parameters when the procedure is invoked. A formal parameter part is optional. Every formal parameter for a procedure must appear in a specification.

For maximum efficiency, as many formal parameters as possible should be call-by-value, and each specified lower bound should have a value of 0 (zero).

The formal parameter specifier causes the compiler to generate more efficient code for passing procedures as parameters. When a procedure is declared **FORMAL**, the compiler checks the parameters of the actual procedure passed to it at compilation time; otherwise, the parameters are checked at run time. If **FORMAL** is specified, the formal procedure is called a fully specified formal procedure.

To ensure that a parameter is passed call-by-reference, the parameter name must appear in the <reference part> of the parameter description. Constants and arithmetic expressions cannot be passed to parameters whose name appears in the reference part.

If a formal parameter is call-by-reference and the actual parameter being passed to it is itself a parameter and is call-by-name, then evaluation of the call-by-name parameter is done in order to generate the call-by-reference parameter. This ensures that any expressions evaluated due to an accidental entry generated for the call-by-name parameter are evaluated only once for the call-by-reference parameter.

The value part specifies which formal parameters are to be call-by-value. When a formal parameter is call-by-value, the formal parameter is assigned the value of the corresponding actual parameter when the procedure is invoked. Thereafter, the formal parameter is handled as a variable that is local to the procedure body. That is, any change made to the value of a call-by-value formal parameter has no effect outside the procedure body.

For more information on <parameter delimiter>, see Section 2, "Language Components."

Only arithmetic, Boolean, complex, designational, pointer, and string expressions can be passed as actual parameters to call-by-value formal parameters. These expressions are evaluated once before entry into the procedure body.

Formal parameters not listed in the value part are call-by-name, except for string parameters and file parameters. Wherever a call-by-name formal parameter appears in

the procedure body, the formal parameter is, in effect, replaced by the actual parameter itself and not by the value of the actual parameter. A call-by-name formal parameter is essentially global to the procedure body, because any change made to its value within the procedure body also changes the value of the corresponding actual parameter outside the procedure body. If the formal parameter is a complex call-by-name parameter and the actual parameter is not of type COMPLEX, an assignment within the procedure body to the formal parameter causes the program to discontinue with a fault.

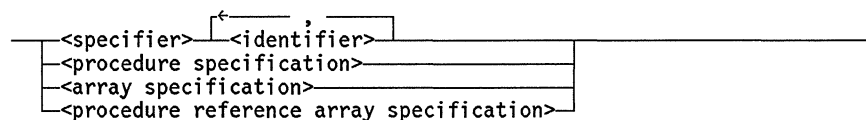
An expression can be passed as an actual parameter to a call-by-name formal parameter. This situation results in a *thunk*, or accidental entry. A thunk is a compiler-generated typed procedure that calculates and returns the value of the expression each time the formal parameter is used. This situation can be time-consuming if the formal parameter is repeatedly referenced. In addition, a fault occurs if an attempt is made to store into that parameter.

The default mode of passing a string is call-by-reference instead of call-by-name. Any string expression can be passed to a call-by-reference string formal parameter. When a string variable or a subscripted string variable is passed as an actual parameter to a call-by-reference string formal parameter, a reference to the actual string is passed. If the value of the formal parameter is changed within the procedure body, the actual string is also changed.

If any other form of string expression is passed as an actual parameter to a call-by-reference string formal parameter, the string expression is evaluated once at the time the expression is passed, and a reference to the value of the expression is passed to the called procedure. This value can be altered by the called procedure. However, any change in the value of the formal parameter within the procedure body has no effect outside the procedure body. A string expression cannot be passed as an actual parameter to a call-by-name parameter of a procedure in a PROCESS or CALL statement.

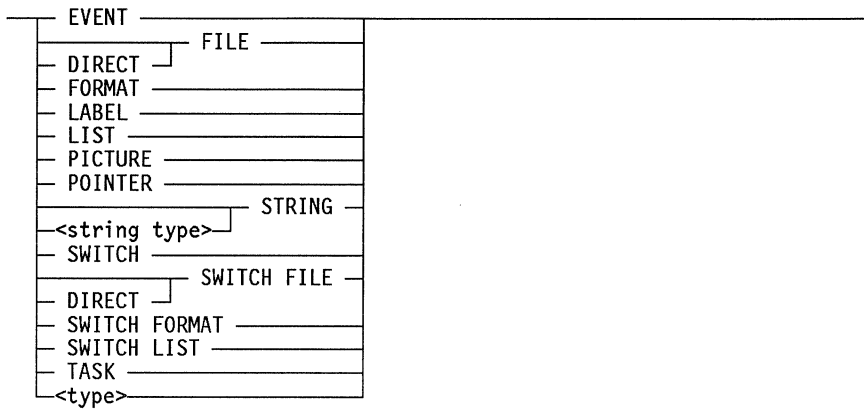
## Specification

<specification>

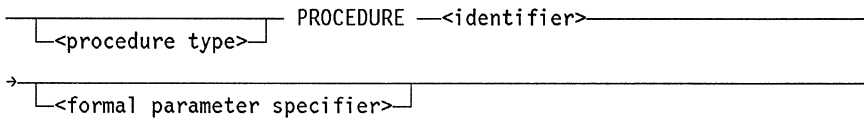


# Declarations

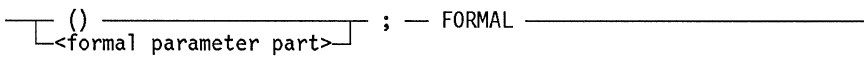
## <specifier>



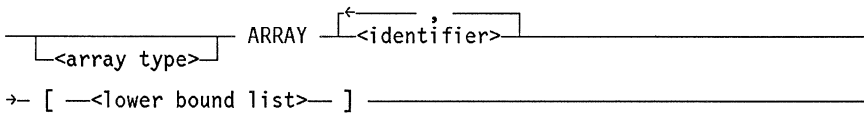
## <procedure specification>



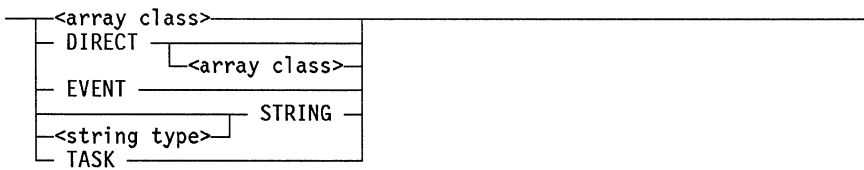
## <formal parameter specifier>



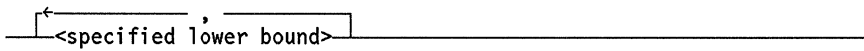
## <array specification>



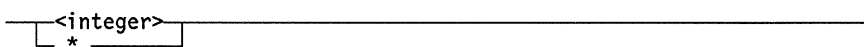
## <array type>



## <lower bound list>



## <specified lower bound>



An array specification must be provided for every formal array. The array specification indicates the number of dimensions in the formal array and indicates the lower bound for each dimension.

If the specified lower bound is an integer, then the corresponding dimension of the formal array equals that integer. An asterisk (\*) used as a specified lower bound indicates that the corresponding dimension of the formal array has a lower bound that is passed to the procedure with the actual array.

Array rows that are passed as actual parameters to procedures have their subscripts evaluated at the time of the procedure call, rather than at the time the corresponding formal array is referenced.

### Procedure Reference Array Specification

<procedure reference array specification>

```

┌──────────────────────────┐ PROCEDURE — REFERENCE — ARRAY —<identifier>→
└─<procedure type>─┘
→ [ ─<lower bound list>─ ] ─<formal parameter specifier>──────────┘
    
```

A procedure reference array specification must have a formal parameter specifier.

If a program is a procedure, parameters can be passed to it. If the procedure is initiated through CANDE (which passes only one parameter, a quoted string), then the formal parameter must be declared as a real array with an asterisk lower bound. If the procedure is initiated through Work Flow Language (WFL), a formal parameter for a string actual parameter must be declared as a real array with an asterisk lower bound. Both CANDE and WFL pass strings as arrays. For more information, refer to the EXECUTE command in the *A Series CANDE Operations Reference Manual* and the RUN statement in the *A Series Work Flow Language (WFL) Programming Reference Manual*. When the program is initiated, the array is allocated the minimum number of words needed to contain the string plus at least one null character (48"00"), which is appended to the end of the string.

### Procedure Body

<procedure body>

```

┌──────────────────────────────────────────────────────────────────────────┐
├─<unlabeled statement>──────────────────────────────────────────────────┘
├─ EXTERNAL ─────────────────────────────────────────────────────────────────┘
├─<dynamic procedure specification>────────────────────────────────────────┘
└─<library entry point specification>────────────────────────────────────────┘
    
```

Procedures can be called recursively; that is, inside the procedure body, a procedure can invoke itself.

The procedure body EXTERNAL is used to declare a procedure that is to be bound in to the program (as opposed to actually appearing within the program) or that is an external code file to be invoked. An attempt to invoke a procedure that is declared external but

## Declarations

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has not been bound in nor associated with an external code file results in a run-time error.

### Dynamic Procedure Specification

**<dynamic procedure specification>**

— BY CALLING —<selection procedure identifier>—————|

**<selection procedure identifier>**

—<procedure identifier>—————|

A dynamic procedure specification is used in a library program to declare a procedure that is to be exported dynamically. Such a procedure is also called a by-calling procedure. For more information on by-calling procedures, refer to Section 8, “Library Facility.” The by-calling procedure cannot be declared FORWARD and cannot be a separately compiled procedure. Also, the by-calling procedure cannot be referenced directly in the library program that declares it.

A selection procedure identifier must specify an untyped procedure with two parameters. The first parameter must be a call-by-value EBCDIC string. The second parameter must be a fully specified untyped procedure with one parameter that is a task. When the operating system invokes this selection procedure, the task variable passed to its procedure parameter must already be associated with a library that has been processed using this task variable.

### Library Entry Point Specification

**<library entry point specification>**

— LIBRARY —<library identifier>—————→

→—————|  
| ( — ACTUALNAME — = — <EBCDIC string literal> — ) |

A library entry point specification declares a procedure to be an entry point in the library known to this program by the library identifier. The procedure cannot be declared FORWARD or EXTERNAL.

If a program declares a library and entry points in that library, the object code file for the program contains a structure called a library template, which describes the library and its declared entry points. Each declared library has one template. The template description of an entry point includes the entry point name, a description of the procedure type, and descriptions of the entry point parameters.

When a library entry point is called, the entry point description in the library template of the calling program is compared to the entry point description of the same name in the library directory associated with the referenced library. Refer to “EXPORT Declaration” earlier in this section for a discussion of library directories. If the entry point does not exist in the library or if the two entry point descriptions are not compatible, then a run-time error is given and the program is terminated.

The name given for an entry point in a library template is the procedure identifier in the entry point declaration, unless an ACTUALNAME clause appears, in which case the name is given by the EBCDIC string literal. The EBCDIC string literal in the ACTUALNAME clause must not contain any leading, trailing, or embedded blanks and must be a valid identifier, that is, any sequence of characters beginning with a letter and consisting of letters, digits, hyphens (-), and underscores (\_).

## Allowed Formal and Actual Parameters

All parameters can be declared to be call-by-name or, in the case of strings, call-by-reference. The following types of parameters also can be declared to be call-by-value:

- ASCII string
- Boolean simple variable
- complex simple variable
- double simple variable
- EBCDIC string
- hexadecimal string
- integer simple variable
- label
- pointer
- real simple variable
- string

## Parameter Matching

### Array Parameters

If a formal parameter is an array, the actual parameter passed to that formal array must be an array designator that has the same number of dimensions as the formal array.

The types of actual arrays that can be passed to formal arrays are listed in Table 3-1.

**Table 3–1. Array Parameters**

Formal Parameters	Allowed Actual Parameters
ASCII array	ASCII array ASCII value array
ASCII string array	ASCII string array

continued

**Table 3–1. Array Parameters (cont.)**

<b>Formal Parameters</b>	<b>Allowed Actual Parameters</b>
BCL array	BCL array BCL value array
Boolean array	Boolean array Direct Boolean array Boolean value array
Complex array	Complex array Complex value array
Direct ASCII array	Direct ASCII array
Direct BCL array	Direct BCL array
Direct Boolean array	Direct Boolean array
Direct double array	Direct double array
Direct EBCDIC array	Direct EBCDIC array
Direct hexadecimal array	Direct hexadecimal array
Direct integer array	Direct integer array
Direct real array	Direct real array
Double array	Double array Direct double array Double value array
EBCDIC array	EBCDIC array EBCDIC value array
EBCDIC string array	EBCDIC string array
Event array	Event array
Hexadecimal array	Hexadecimal array Hexadecimal value array
Hexadecimal string array	Hexadecimal string array
Integer array	Integer array
Real array	Real array Direct integer array Direct real array Integer value array Real value array
Task array	Task array

## Procedure Reference Array Parameters

If a formal parameter is a procedure reference array, the actual parameter passed to that formal procedure reference array must be a procedure reference array designator that has the same number of dimensions as the formal procedure reference array.

The following must also be true:

- The actual procedure reference array designator must have the same number of parameters as the formal procedure reference array.
- Each parameter of the actual procedure reference array designator must have the same type as the corresponding parameter in the formal procedure reference array.
- Each parameter of the actual procedure reference array designator must be passed in the same manner (call-by-name or call-by-value) as the corresponding parameter in the formal procedure reference array.

The types of procedure reference array designators that can be passed to formal procedure reference arrays are listed in Table 3-2.

**Table 3–2. Procedure Reference Array Parameters**

Formal Parameter	Allowed Actual Parameters
ASCII string procedure reference array	ASCII string procedure reference array designator
Boolean procedure reference array	Boolean procedure reference array designator
Complex procedure reference array	Complex procedure reference array designator
Double procedure reference array	Double procedure reference array designator
EBCDIC procedure reference array	EBCDIC procedure reference array designator
Hexadecimal procedure reference array	Hexadecimal procedure reference array designator
Integer procedure reference array	Integer procedure reference array designator
Real procedure reference array	Real procedure reference array designator
Untyped procedure reference array	Untyped procedure reference array designator

## Procedure Parameters

If a formal parameter is a procedure, the actual parameter passed to that formal procedure must be the identifier of a procedure for which the following is true:

- The actual procedure has the same number of parameters as the formal procedure.
- Each parameter of the actual procedure must have the same type as the corresponding parameter in the formal procedure.



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- Each parameter of the actual procedure must be passed in the same manner (call-by-name or call-by-value) as the corresponding parameter in the formal procedure.

The types of the procedures that can be passed to formal procedures are listed in Table 3-3.

**Table 3–3. Procedure Parameters**

<b>Formal Parameter</b>	<b>Allowed Actual Parameters</b>
ASCII string procedure	ASCII string procedure ASCII string procedure reference array element
Boolean procedure	Boolean procedure Boolean procedure reference array element
Complex procedure	Complex procedure Complex procedure reference array element
Double procedure	Double procedure Double procedure reference array element
EBCDIC string procedure	EBCDIC string procedure EBCDIC string procedure reference array element
Hexadecimal string procedure	Hexadecimal string procedure Hexadecimal string procedure reference array element
Integer procedure	Integer procedure Integer procedure reference array element
Real procedure	Real procedure Real procedure reference array element
Untyped procedure	Untyped procedure Untyped procedure reference array element

### Simple Variable Parameters

The types of actual parameters that can be passed to formal parameters that are simple variables are listed in Table 3-4.

Table 3–4. Simple Variable Parameters

Formal Parameter	Allowed Actual Parameters
Boolean simple variable (call-by-name or call-by-value)	Boolean identifier Boolean procedure identifier Boolean expression
Complex simple variable (call-by-name or call-by-value)	Complex identifier Double identifier Integer identifier Real identifier Complex procedure identifier Double procedure identifier Integer procedure identifier Real procedure identifier Arithmetic expression (single or double precision) Complex expression
Double simple variable (call-by-name)	Double identifier Double procedure identifier Arithmetic expression (double precision only)
Double simple variable (call-by-value)	Double identifier Integer identifier Real identifier Double procedure identifier Integer procedure identifier Real procedure identifier Arithmetic expression (single or double precision)
Integer simple variable Real simple variable (call-by-name)	Integer identifier Real identifier Integer procedure identifier Real procedure identifier Arithmetic expression (single precision only)
Integer simple variable Real simple variable (call-by-value)	Double identifier Integer identifier Real identifier Double procedure identifier Integer procedure identifier Real procedure identifier Arithmetic expression (single or double precision)

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### String Parameters

The types of actual parameters that can be passed to formal parameters that are strings are listed in Table 3-5.

**Table 3-5. String Parameters**

<b>Formal Parameter</b>	<b>Allowed Actual Parameters</b>
ASCII string (call-by-reference or call-by-value)	ASCII string identifier ASCII string procedure identifier ASCII string expression
EBCDIC string (call-by-reference or call-by-value)	EBCDIC string identifier EBCDIC string procedure identifier EBCDIC string expression
Hexadecimal string (call-by-reference or call-by-value)	Hexadecimal string identifier Hexadecimal string procedure identifier Hexadecimal string expression

### File Parameters

The types of actual parameters that can be passed to formal parameters that are files are listed in Table 3-6.

**Table 3-6. File Parameters**

<b>Formal Parameter</b>	<b>Allowed Actual Parameters</b>
Direct file	Direct file identifier Subscripted direct switch file identifier
Direct switch file	Direct switch file identifier
File	File identifier Subscripted switch file identifier
Switch file	Switch file identifier

### Other Types of Parameters

The types of actual parameters that can be passed to formal parameters that are not arrays, procedures, simple variables, strings, or files are listed in Table 3-7.

Table 3–7. Other Types of Parameters

Formal Parameter	Allowed Actual Parameters
Event	Event identifier An element of an event array File identifier.event-valued file attribute name Subscripted switch file identifier.event-valued file attribute name
Format	Format identifier Subscripted switch format identifier
Label (call-by-name) (call-by-value)	Label identifier Subscripted switch identifier Designational expression
List	List identifier Subscripted switch list identifier
Picture	Picture identifier
Pointer (call-by-name)	Pointer identifier
Pointer (call-by-value)	Pointer identifier Pointer expression
Switch label	Switch label identifier
Switch format	Switch format identifier
Switch list	Switch list identifier
Task	Any task designator

## Examples of PROCEDURE Declarations

The following examples show how the procedure body of a procedure can vary in complexity from a simple unlabeled statement to a block.

The following example declares `SIMPL` to be an untyped procedure with no parameters. The body of `SIMPL` is a single statement.

```
PROCEDURE SIMPL;
  X := X + 1
```

The following example declares `TUFFER` to be an untyped procedure with one parameter, `PARAM`, which is a call-by-value real variable. The body of `TUFFER` consists of a single statement.

```
PROCEDURE TUFFER(PARAM);
  VALUE PARAM;
  REAL PARAM;
  X := X + PARAM
```

## Declarations

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In the following example, procedure `RESULT` is a typed procedure that returns a real value. The value to be returned is assigned to the procedure identifier by the following assignment:

```
RESULT := X + PARAM;
```

`RESULT` has two parameters, a call-by-name real variable and a file.

```
REAL PROCEDURE RESULT(PARAM, FYLEIN);
REAL PARAM;
FILE FYLEIN;
BEGIN
    .
    .
    .
    RESULT := X + PARAM;
    .
    .
    .
END
```

The following example declares `HEXPROC` to be a typed procedure that returns a hexadecimal string value. The value to be returned is assigned to the procedure identifier in the assignment that makes up the body of `HEXPROC`.

```
HEX STRING PROCEDURE HEXPROC;
HEXPROC := 4"123"
```

The following example declares `MATCH` to be a typed procedure that returns a Boolean value. `MATCH` has three parameters that are all call-by-value integer variables.

```
BOOLEAN PROCEDURE MATCH(A,B,C);
VALUE A,B,C;
INTEGER A,B,C;
MATCH := A=B OR A=C OR B=C
```

The following example is a `FORWARD PROCEDURE` declaration for the procedure `FURTHERON`. For more information, refer to “`FORWARD REFERENCE Declaration`” earlier in this section.

```
PROCEDURE FURTHERON;
FORWARD
```

The following example declares `MUCHO` to be a double-precision procedure with three parameters. `DBL1` is a call-by-name double-precision variable, `DBL2` is a call-by-value double-precision variable, and `BOOL` is a call-by-value Boolean variable. The body of `MUCHO` is a block.

```

DOUBLE PROCEDURE MUCHO(DBL1,DBL2,BOOL);
VALUE DBL2,BOOL;
DOUBLE DBL1,DBL2;
BOOLEAN BOOL;
BEGIN
REAL LOCALX,LOCALY;
.
.
.
MUCHO := DOUBLE(LOCALX,LOCALY);
END OF MUCHO

```

The following example declares GETDATA to be a by-calling procedure. The selection procedure is SELECTDATASOURCE. GETDATA has one parameter, a one-dimensional real array, A, with an asterisk lower bound, meaning that the lower bound is to be passed as a parameter.

```

PROCEDURE GETDATA(A);          % BY-CALLING PROCEDURE
ARRAY A[*];
BY CALLING SELECTDATASOURCE

```

The following example declares NUMRECORDS to be an entry point in the library DATAHANDLER. The entry point is exported from DATAHANDLER with the name COUNTRECS, but will be called NUMRECORDS in this program.

```

INTEGER PROCEDURE NUMRECORDS(TYPE); % LIBRARY ENTRY POINT
VALUE TYPE;
INTEGER TYPE;
LIBRARY DATAHANDLER (ACTUALNAME="COUNTRECS")

```

## PROCEDURE REFERENCE ARRAY Declaration

The PROCEDURE REFERENCE ARRAY declaration declares a procedure reference array, which is a structure that allows a group of like procedures to be treated as a single entity. A procedure in the group can be invoked by referencing an element of the procedure reference array.

<procedure reference array declaration>

```

┌<local procedure reference array declaration>┐
└<global procedure reference array declaration>┘

```

<local procedure reference array declaration>

```

┌<procedure type>┐ PROCEDURE — REFERENCE — ARRAY —<identifier>→
↪ [ —<bound pair list> — ] ┌<formal parameter part>┐ ; — NULL —┘

```



A procedure reference array element can be passed as an actual parameter to a formal procedure that is of the same type and that has the same parameter descriptions.

A local PROCEDURE REFERENCE ARRAY declaration cannot appear in the global part of a program unit. A global PROCEDURE REFERENCE ARRAY declaration can appear in the global part of a program unit or in a LIBRARY declaration.

### Example of PROCEDURE REFERENCE ARRAY Declaration

The following example declares a 10-element procedure reference array, each element of which references a procedure of type INTEGER with two parameters. The first parameter is a call-by-value integer simple variable, and the second is an untyped procedure reference array with a lower bound of 0 (zero) and no parameters.

```

INTEGER PROCEDURE REFERENCE ARRAY REFARRAY[1:10] (Q,R);

        VALUE                Q;
        INTEGER              Q;
        PROCEDURE REFERENCE ARRAY R[0] ();

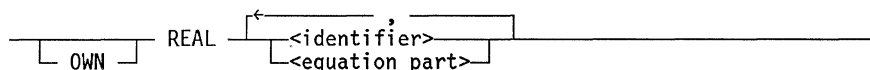
        FORMAL;

        NULL
    
```

### REAL Declaration

A REAL declaration declares simple variables that can have real values, that is, arithmetic values that have exponents and fractional parts.

<real declaration>



<real identifier>

An identifier that is associated with the REAL data type in a REAL declaration.

### Declaration of Simple Variables

A simple variable declared to be OWN retains its value when the program exits the block in which the variable is declared, and that value is again available when the program reenters the block in which the variable is declared.

The equation part causes the simple variable being declared to have the same address as the simple variable associated with the second identifier.

For more information on <equation part>, see “BOOLEAN Declaration” earlier in this section.



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This action is called address equation. An identifier can be address-equated only to a previously declared local identifier or to a global identifier. The first identifier must not have been previously declared within the block of the equation part. An equation part is not allowed in the global part of a program unit.

Address equation is allowed only between integer, real, and Boolean variables. Because both identifiers of the equation part have the same address, altering the value of either variable affects the value of both variables. For more information, see “Type Coercion of One-Word and Two-Word Operands” in Appendix C, “Data Representation.”

The OWN specification has no effect on an address-equated identifier. The first identifier of an equation part is OWN only if the second identifier of the equation part is OWN.

If a real or integer value is assigned to a real variable, it is stored as is into the variable. If a double-precision value is assigned to a real variable, it is rounded to single precision before it is stored in the variable.

When a real simple variable is allocated, it is initialized to 0 (zero), which is a 48-bit word with all bits equal to 0.

See Appendix C, “Data Representation,” for additional information on the internal structure of a real operand as implemented on A Series systems.

## Examples of REAL Declarations

The following example declares INDX, X, Y, and TOTAL as real variables.

```
REAL INDX,X,Y,TOTAL
```

The following example declares CALC, INDEX, and VALU as real variables. CALC is address-equated to the simple variable BOOL, and VALU is address-equated to the simple variable INTR. According to this declaration, CALC and BOOL share the same address, and VALU and INTR share the same address.

```
REAL CALC = BOOL, INDEX, VALU = INTR
```

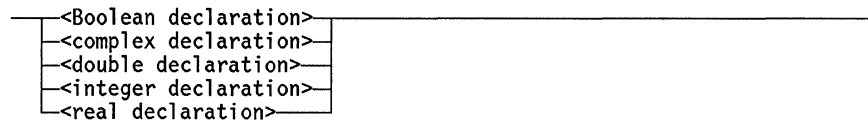
The following example declares DISTANCE and REALINDEX as real variables. Because these variables are declared to be OWN, the variables retain their values when the program exits the block in which they are declared.

```
OWN REAL DISTANCE, REALINDEX
```

## SIMPLE VARIABLE Declaration

A **SIMPLE VARIABLE** declaration declares simple variables that can be used in a manner appropriate to the specified type.

**<simple variable declaration>**



Type-transfer functions can be used, as can the equation part construct, to perform operations on a variable other than those that are valid for the type of the variable.

Each type of simple variable is used as follows:

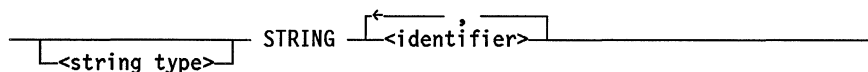
Type	Meaning/Description
BOOLEAN	Boolean values. A Boolean variable is a one-word variable in which the Boolean value (TRUE or FALSE) depends on the low-order bit (bit zero) of the word. The use of partial word parts and concatenation enables all 48 bits to be tested or manipulated as needed.
COMPLEX	Complex values. A complex variable consists of two real variables in which the first variable contains the real part and the second variable contains the imaginary part.
DOUBLE	Double-precision arithmetic values. A double-precision variable is a two-word variable.
INTEGER	Integer arithmetic values. An integer value is one that has an exponent of 0 (zero) and no fractional part. Integer variables are one-word variables.
REAL	Real arithmetic values. A real value is one that can have an exponent and a fractional part. Real variables are one-word variables.

See Appendix C, “Data Representation,” for more information regarding the internal structure of each type of simple variable as implemented on A Series systems.

## STRING Declaration

A **STRING** declaration declares simple variables to be strings. Strings allow storage and manipulation of character strings in a program.

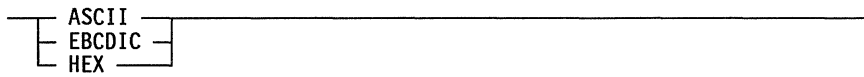
**<string declaration>**



## Declarations

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<string type>



<string identifier>

An identifier that is associated with the `STRING` data type in a `STRING` declaration.

## STRING Type

The type `STRING` is a structured data type that contains characters of only one character type.

A string has two components: contents and length. No trailing blanks or null characters are added to a string; therefore the length of a string is exactly the number of characters stored in the string. The maximum string length allowed is  $2^{16}-2$  characters.

All strings declared in a `STRING` declaration are of the same string type. If no string type is specified in the `STRING` declaration, then the default character type is used. If the default character type in this case is `BCL`, a syntax error is given. The default character type can be designated by the compiler control options `ASCII` and `BCL`. If no such compiler control option is designated, the default character type is `EBCDIC`. For more information, refer to “Default Character Type” in Appendix C, “Data Representation.”

The number of strings that can be declared in a program is limited by the operating system to 500. If this limit is exceeded, the message *STRING POOL EXCEEDED* is given.

## Examples of STRING Declarations

The following example declares `S1`, `S2`, and `S3` as string simple variables of string type `ASCII`. `S1`, `S2`, and `S3` contain `ASCII` characters.

```
ASCII STRING S1,S2,S3
```

The following example declares `S5`, `S6`, `S7`, and `S8` as string simple variables of string type `EBCDIC`. These strings contain `EBCDIC` characters.

```
EBCDIC STRING S5,S6,S7,S8
```

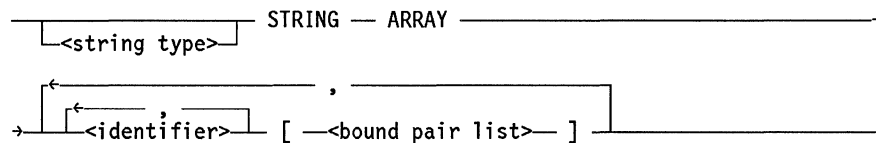
The following example declares `S9` as a string simple variable. Because no string type is specified, the default character type is used. This character type is `EBCDIC` unless the compiler control option `ASCII` is `TRUE`, in which case the string type is `ASCII`, or the compiler control option `BCL` is `TRUE`, in which case the string type is `BCL`. If the default character type is `BCL`, this declaration is given a syntax error.

```
STRING S9
```

## STRING ARRAY Declaration

A **STRING ARRAY** declaration declares string arrays. A string array is an array that has string elements.

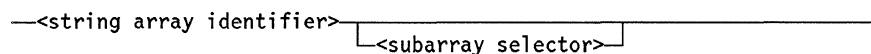
**<string array declaration>**



**<string array identifier>**

An identifier that is associated with a string array in a **STRING ARRAY** declaration.

**<string array designator>**



## String Array Type

All string arrays declared in a **STRING ARRAY** declaration are of the same string type. If no string type is specified, the default character type is used. If the default character type in this case is BCL, a syntax error is given. The default character type can be designated by the compiler control options ASCII and BCL. If no such compiler control option is used, the default character type is EBCDIC. For more information, refer to “Default Character Type” in Appendix C, “Data Representation.”

The restrictions that apply to arrays also apply to string arrays. For more information on bound pair lists, subarray selectors, and arrays, see “**ARRAY Declaration**” earlier in this section.

## Examples of **STRING ARRAY** Declarations

The following example declares SA, SB, and SC as one-dimensional arrays of strings, each with a lower bound of 0 and an upper bound of 10. Because no string type is specified, the default character type is used. This character type is EBCDIC unless the compiler control option ASCII is TRUE, in which case the string type is ASCII, or the compiler control option BCL is TRUE, in which case the string type is BCL. If the default character type is BCL, this declaration is given a syntax error.

```
STRING ARRAY SA,SB,SC[0:10]
```

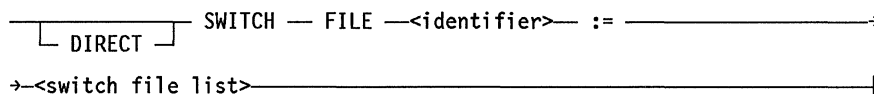
The following example declares ESA, ESB, and ESC as arrays of strings. The string type is EBCDIC, so each is an array of EBCDIC strings. ESA is one-dimensional and has a lower bound of 1 and an upper bound of 15. Arrays ESB and ESC are two-dimensional arrays with lower bounds of 0 and upper bounds of 10 for both dimensions.

EBCDIC STRING ARRAY ESA[1:15], ESB, ESC[0:10, 0:10]

## SWITCH FILE Declaration

A SWITCH FILE declaration associates an identifier with a list of file designators. Any of these file designators can later be referenced by using the identifier and a number corresponding to the position of the file designator in the list.

**<switch file declaration>**



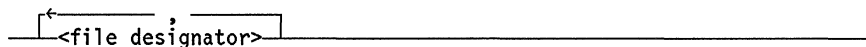
**<switch file identifier>**

An identifier that is associated with a switch file list in a SWITCH FILE declaration.

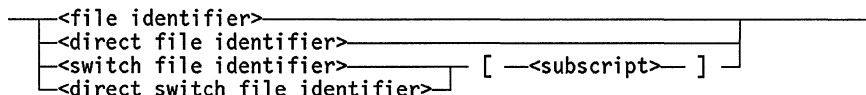
**<direct switch file identifier>**

An identifier that is associated with a switch file list in a DIRECT SWITCH FILE declaration.

**<switch file list>**



**<file designator>**



## Switch File List

An integer index is associated with each file designator in the switch file list. The indexes are 0, 1, 2, and so on through N-1, where N is the number of file designators in the list. These indexes are obtained by counting the file designators in order of their appearance in the list. A file designator in the list can be referenced by subscripting the switch file identifier with a subscript whose value is equal to the index of the file designator.

If a subscript to a switch file identifier yields a value outside the range of the switch file list (that is, less than 0 or greater than N-1), a fault occurs at run time.

Any subscripts in the switch file list are evaluated at the time of the SWITCH FILE declaration.

A switch file can reference itself in the switch file list, in which case a stack overflow might occur when the program is executed. For example, assume a switch file is declared as the following:

```
SWITCH FILE SF := F1, F2, SF[N]
```

If N equals 2, the subscripted switch file identifier SF[N] references itself indefinitely.

The switch file list of a switch file that is not designated as DIRECT can contain only file designators that are not DIRECT, and the switch file list of a switch file that is designated DIRECT can contain only file designators that are DIRECT.

### Example of SWITCH FILE Declaration

The following example declares CHOOSEUNIT to be a switch file identifier with a list of three file designators. CHOOSEUNIT[0] evaluates to file CARDOUT, CHOOSEUNIT[1] evaluates to file TAPEOUT, and CHOOSEUNIT[2] evaluates to file PRINTOUT.

```
SWITCH FILE CHOOSEUNIT :=
    CARDOUT,
    TAPEOUT,
    PRINTOUT;
.
.
.
WRITE(CHOOSEUNIT[0], 14, A[*]); % WRITES TO CARDOUT
WRITE(CHOOSEUNIT[1], 14, A[*]); % WRITES TO TAPEOUT
WRITE(CHOOSEUNIT[2], 14, A[*]); % WRITES TO PRINTOUT
```

### SWITCH FORMAT Declaration

A SWITCH FORMAT declaration associates an identifier with a list of items representing editing specifications. Any of these items and the associated editing specifications can later be referenced by using the identifier and a number corresponding to the position of the item in the list.

**<switch format declaration>**

```
— SWITCH — FORMAT —<identifier>— := —<switch format list>—|
```

**<switch format identifier>**

An identifier that is associated with a switch format list in a SWITCH FORMAT declaration.

**<switch format list>**

```
—| —<switch format segment>—|
```

## Declarations

---

**<switch format segment>**

**<format designator>**  
[ ( **<editing specifications>** ) ]  
[ **<editing specifications>** ]

**<format designator>**

**<format identifier>**  
[ **<switch format identifier>** [ **<subscript>** ] ]

## Switch Format List

An integer index is associated with each switch format segment in the switch format list. The indexes are 0, 1, 2, and so on through N-1, where N is the number of switch format segments in the list. These indexes are obtained by counting the switch format segments in order of their appearance in the list. A switch format segment in the list can be referenced by subscripting the switch format identifier with a subscript whose value is equal to the index of the switch format segment.

If a subscript to a switch format identifier yields a value outside the range of the switch format list (that is, less than 0 or greater than N-1), a fault occurs at run time.

Any subscripts in the switch format list are evaluated at the time the subscripted switch format identifier is encountered.

A switch format can reference itself in the switch format list, in which case a stack overflow might occur when the program is executed. For example, assume a switch format is declared as the following:

```
SWITCH FORMAT SF := FMT1, FMT2, SF[N]
```

If N equals 2, the subscripted switch format identifier SF[N] references itself indefinitely.

A simple string literal in a SWITCH FORMAT declaration is always read-only if the switch format segment in which it appears consists of editing specifications rather than a format designator.

## Examples of SWITCH FORMAT Declarations

The following example declares SF to be a switch format identifier with a switch format list of four sets of editing specifications. The editing specifications (X78, I2), for example, can be referenced as SF[2].

```
SWITCH FORMAT SF := (A6, 3I4, I2, X60), % 0  
                   (I4, X2, 2I4, 3I2), % 1  
                   (X78, I2), % 2  
                   (X2) % 3
```

The following example declares `SWHFT` to be a switch format identifier with a switch format list of three format designators. `SWHFT[0]` evaluates to format `FMT1`, `SWHFT[1]` to `FMT2`, and `SWHFT[2]` to `FMT3`.

```
SWITCH FORMAT SWHFT := FMT1,FMT2,FMT3
```

## SWITCH LABEL Declaration

A `SWITCH LABEL` declaration associates an identifier with a list of designational expressions, which are expressions that evaluate to labels. Any of these designational expressions can later be referenced by using the identifier and a number corresponding to the position of the designational expression in the list.

**<switch label declaration>**

```
— SWITCH —<identifier>— := —<switch label list>—————|
```

**<switch label identifier>**

An identifier that is associated with a switch label list in a `SWITCH LABEL` declaration.

**<switch label list>**

```
—|<designational expression>—————|
```

## Switch Label List

An integer index is associated with each designational expression in the switch label list. The indexes are 1, 2, 3, and so on through `N`, where `N` is the number of designational expressions in the list. These indexes are obtained by counting the designational expressions in order of their appearance in the list. A designational expression in the list can be referenced by subscripting the switch label identifier with a subscript whose value is equal to the index of the designational expression.

Note that the indexing of a switch label list begins at 1.

If a subscript to a switch label identifier yields a value outside the range of the switch label list (that is, less than 1 or greater than `N`), the statement using the switch label is not executed, and control proceeds to the next statement. Typically, the next statement is a specification of some form of error handling.

The designational expressions in a switch label list are evaluated at the time the subscripted switch label identifier is encountered.

A switch label can reference itself in the switch label list, in which case a stack overflow might occur when the program is executed. For example, assume a switch label is declared as the following:

```
SWITCH SW := L1, L2, L3, SW[N]
```



## Declarations

---

If N equals 4, the designational expression SW[N] references itself indefinitely.

### Examples of SWITCH LABEL Declarations

The following example declares CHOOSEPATH to be a switch label identifier with labels L1, L2, L3, and L4 in the switch label list. CHOOSEPATH[1] evaluates to label L1, CHOOSEPATH[2] to L2, and so on.

```
SWITCH CHOOSEPATH := L1,L2,L3,L4
```

The following example declares SELECT to be a switch label identifier with labels START and ERROR1 and designational expression CHOOSEPATH[2] in the switch label list. Note that from the previous SWITCH LABEL declaration, CHOOSEPATH[2] evaluates to L2; therefore, SELECT[3] evaluates to L2.

```
SWITCH SELECT := START,          % 1
                  ERROR1,        % 2
                  CHOOSEPATH[2]  % 3
```

### SWITCH LIST Declaration

A SWITCH LIST declaration associates an identifier with a list of list designators. Any of these list designators can later be referenced by using the identifier and a number corresponding to the position of the list designator in the list.

<switch list declaration>

```
— SWITCH — LIST —<identifier>— := —<list designator>—
```

<switch list identifier>

An identifier that is associated with a list of list designators in a SWITCH LIST declaration.

<list designator>

```
—<list identifier>— [ —<switch list identifier>— [ —<subscript>— ] ]
```

### List Designator

An integer index is associated with each list designator in the declaration. The indexes are 0, 1, 2, and so on through N-1, where N is the number of list designators in the declaration. These indexes are obtained by counting the list designators in order of their appearance in the declaration. Any of these list designators can be referenced by subscripting the switch list identifier with a subscript whose value is equal to the index of the list designator.

If a subscript to a switch list identifier yields a value outside the range of the list of list designators (that is, less than 0 or greater than N-1), a fault occurs at run time.

Any subscripts in the list of list designators are evaluated at the time the subscripted switch list identifier is encountered.

A switch list can reference itself in the list of list designators, in which case a stack overflow might occur when the program is executed. For example, assume a switch list is declared as the following:

```
SWITCH LIST SL := L1, L2, SL[N]
```

If N equals 2, the subscripted switch list identifier SL[N] references itself indefinitely.

### Example of SWITCH LIST Declaration

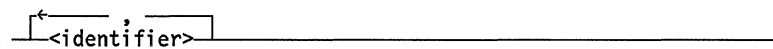
The following example declares NUMVARIABLES to be a switch list identifier and associates four list designators with it. NUMVARIABLES[0] evaluates to the list NOVARS, NUMVARIABLES[1] evaluates to ONEVAR, and so on.

```
SWITCH LIST NUMVARIABLES := NOVARS,   % 0
                          ONEVAR,    % 1
                          TWOVARS,   % 2
                          THREEVARS % 3
```

## TASK and TASK ARRAY Declarations

The TASK and TASK ARRAY declarations are used to declare tasks and task arrays, which can then be associated with a process or coroutine. Task attributes can be used to control or to contain information about the process or coroutine.

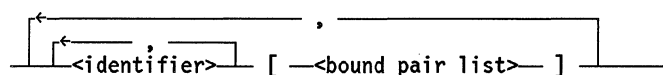
**<task declaration>**

```
— TASK — 
```

**<task identifier>**

An identifier that is associated with a task in a TASK declaration.

**<task array declaration>**

```
— TASK — ARRAY 
```

**<task array identifier>**

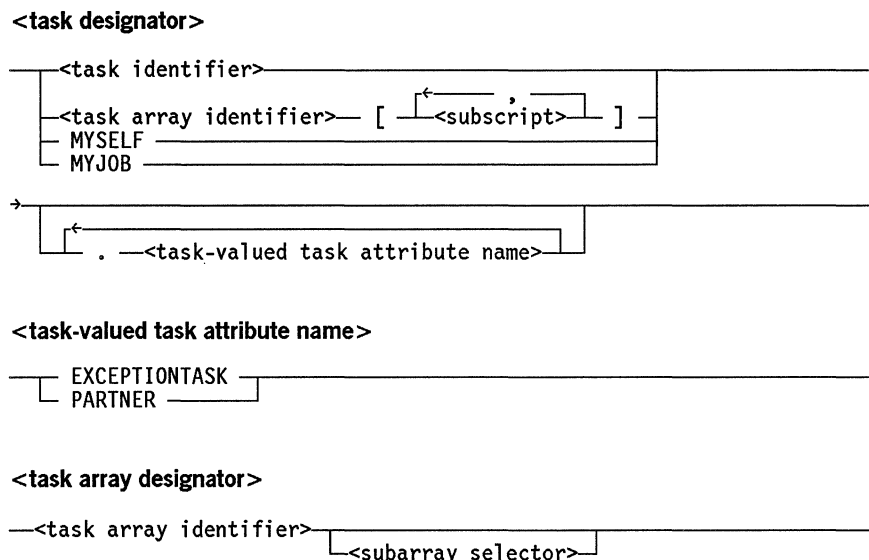
An identifier that is associated with a task array in a TASK ARRAY declaration.

## Declarations

---

A task array is an array whose elements are tasks. A task array can have no more than 15 dimensions.

### Task and Task Array Designator



A task designator represents a single task. A task array designator represents an array of tasks. MYSELF is the task designator for the currently running program. MYJOB is the task designator for the currently running job.

When a process or coroutine is invoked, a task can be associated with it. For example, a task designator can appear in a CALL statement, PROCESS statement, or RUN statement. Task attributes can be assigned values by the program to control the process or coroutine, and the program can interrogate the values of task attributes as the process or coroutine executes.

Attributes associated with a task designator can be assigned values or interrogated in a program by specifying the task designator and the appropriate task attribute names in assignment statements.

For information on processes and coroutines, see “CALL Statement,” “PROCESS Statement,” and “RUN Statement” in Section 4, “Statements.” For more information on assigning and interrogating task attributes, see the <arithmetic task attribute> construct under “Arithmetic Assignment,” the <Boolean task attribute> construct under “Boolean Assignment” and “Task Assignment” in Section 4, “Statements.”

### Examples of TASK and TASK ARRAY Declarations

The following example declares PROCESSTASK to be a task identifier.

```
TASK PROCESSTASK
```

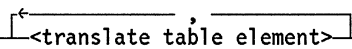
The following example declares CHILDREN as a one-dimensional task array with a lower bound of 0 (zero) and an upper bound of LIM. The CHILDREN task array might be used to store the tasks associated with a group of processes and coroutines initiated by a program.

```
TASK ARRAY CHILDREN[0:LIM]
```

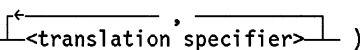
## TRANSLATETABLE Declaration

The TRANSLATETABLE declaration defines one or more translate tables. Used in a REPLACE statement, a translate table indicates translations to be performed from one group of characters to another group of characters.

**<translate table declaration>**

```
— TRANSLATETABLE —  —
```

**<translate table element>**

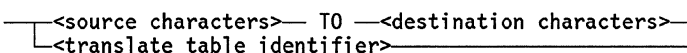

```
— <identifier> — (  ) —
```

**<translate table identifier>**

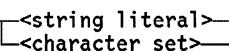

An identifier that is associated with a group of one or more translation specifiers in a TRANSLATETABLE declaration.

## Translation Specifier

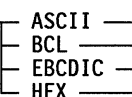
**<translation specifier>**

```
   
 
```

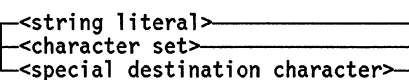
**<source characters>**

```
   
 
```

**<character set>**

```

```

**<destination characters>**

```

```

## Declarations

---

**<special destination character>**

A string literal that is 1 character long.

Specifying a character set is equivalent to specifying all the characters in that set, in ascending binary sequence. The length of a character set is equal to the total number of characters in the set.

A string literal specifies all the characters in the string literal. The length of a string literal is equal to the number of characters in the string literal in terms of the largest character size specified by the string literal.

A translation specifier is enclosed in parentheses, and each succeeding translation specifier overrides the previous translation specifiers.

Within a single translate table, all source character sizes and all destination character sizes must be the same, although the character sizes of the source and destination parts need not be the same.

The number of destination characters must equal the number of source characters, unless the special destination character is used or unless a character set is used for both the source characters and the destination characters. If the special destination character is used, all the source characters are translated to the special destination character.

Every translate table has a default base in which all source characters are translated to characters with all bits equal to 0 (zero). This means that all source characters that do not appear in the TRANSLATETABLE declaration are translated to the character whose binary representation had all bits equal to 0 (zero).

The use of a character set for both the source and destination parts invokes a standard table from the operating system and provides a way of obtaining a legitimate base on which additional translation specifiers can be used, if desired, to override certain parts of the standard table. The use of a translate table identifier as a translation specifier can also be used to provide a base.

When string literals of equal length are used for the source and destination parts, translation is based on the corresponding positions of the source and destination characters, from left to right.

## Translate Table Indexing

The size of a translate table is determined by the size of the source characters (the characters to be translated): 4-bit characters require a 4-word table; 6-bit characters require a 16-word table; 7-bit and 8-bit characters require a 64-word table. A translate table is a one-dimensional read-only array.

Each word in a translate table (Figure 3-1) has its low-order 32 bits divided into four 8-bit fields, numbered 0 to 3 from left to right. The high-order 16 bits are all zeros.

When a character is to be translated, the binary representation of the character is divided into two parts: a word index and a field index. The field index consists of the

two low-order bits; the word index consists of the remaining high-order bits. The word index designates the word in the translate table in which the field index designates the character into which the source character is to be translated.

The diagram below shows indexing for the translation of *a* to *A* that would result from the following declaration:

```

TRANSLATETABLE UPCASE (EBCDIC TO EBCDIC,
                        "abcdefghijklmnopqrstuvwxy" to
                        "ABCDEFGHIJKLMNQPQRSTUVWXYZ")
    
```

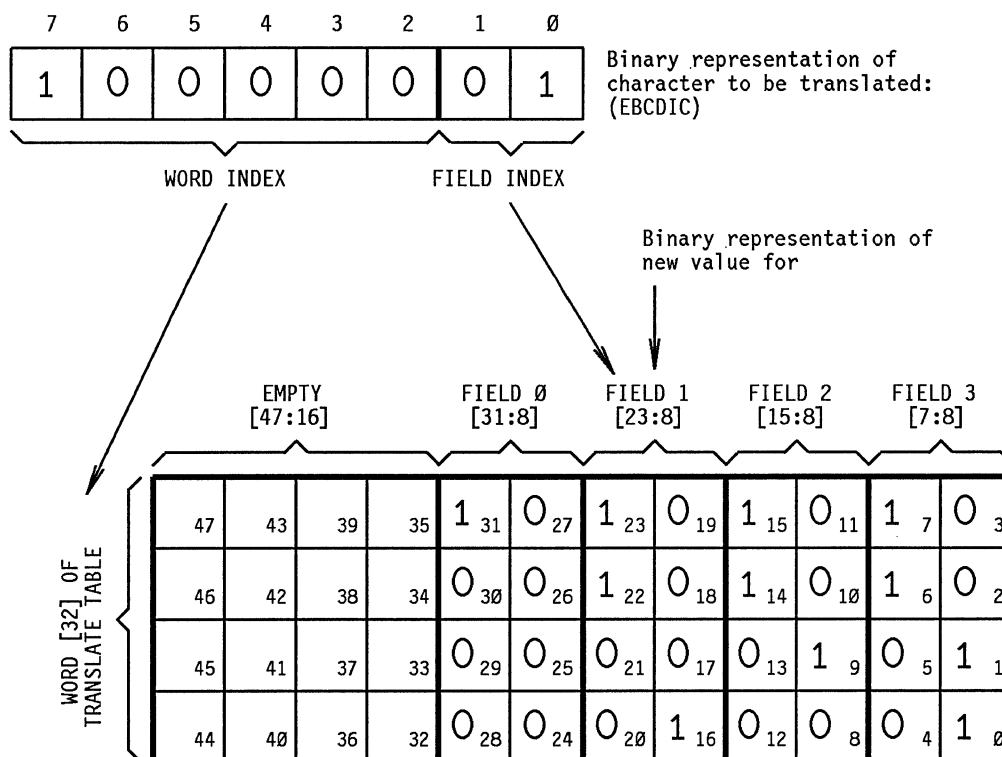


Figure 3-1. Translate Table Indexing

### Examples of TRANSLATETABLE Declarations

The following example translates the letters *L* to *G*, *E* to *O*, *A* to *L*, and *D* to *D*. All other characters are translated to the character whose binary representation has all bits equal to 0 (zero). Both the source and the destination characters are of the default character type.

```

TRANSLATETABLE ALCHEMY ("LEAD" TO "GOLD")
    
```

The following example translates all EBCDIC characters to themselves except for the lowercase letters, which it translates to uppercase letters.

## Declarations

---

```
TRANSLATETABLE UPCASE (EBCDIC TO EBCDIC,  
                        "abcdefghijklmnopqrstuvwxy" TO  
                        "ABCDEFGHIJKLMNOPQRSTUVWXYZ")
```

The following example translates all EBCDIC characters to themselves except for the left parenthesis (, which is translated to the left square bracket ([).

```
TRANSLATETABLE PAREN_TO_BRACKET (EBCDIC TO EBCDIC, 8"(" TO 8"[")
```

The following example translates all EBCDIC characters to themselves except for the digits, which it translates to periods (.

```
TRANSLATETABLE NUMBERS_TO_PERIODS (EBCDIC TO EBCDIC,  
                                    "0123456789" TO ".")
```

## TRUTHSET Declaration

The TRUTHSET declaration associates an identifier with a set of characters. From the characters in a TRUTHSET declaration, the compiler builds a truth set table, which is used in a truth set test to determine whether a given character is a member of that group of characters. The identifier can then be used in a SCAN statement to scan while or until any character in the truth set occurs.

The identifier also can appear as a condition in a REPLACE statement, so that replacement takes place while or until any character in the truth set occurs.

**<truth set declaration>**

— TRUTHSET  $\overbrace{\langle \text{identifier} \rangle ( \langle \text{membership expression} \rangle )}$  —

**<truth set identifier>**

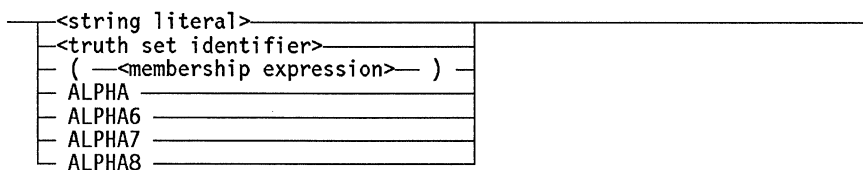
An identifier that is associated with a membership expression in a TRUTHSET declaration.

## Membership Expression

**<membership expression>**

$\overbrace{\left[ \begin{array}{l} \left[ \text{membership primary} \right] \\ \left[ \text{NOT} \right] \end{array} \right] \left[ \begin{array}{l} \text{AND} \\ \text{OR} \\ \text{!} \\ \text{IMP} \\ \text{EQV} \end{array} \right] \left[ \text{membership primary} \right]}$

**<membership primary>**



All membership primaries of a membership expression must be of the same character size (4-bit, 6-bit, 7-bit, or 8-bit); this character size determines the type of the truth set. The character size of a string literal is determined by the maximum character size indicated by its component string codes. For more information, refer to “String Literal” in Section 2, “Language Components.”

A membership expression is evaluated according to the normal rules of precedence for Boolean operators. This precedence is described under “Boolean Expression” in Section 5, “Expressions and Functions.”

ALPHA, ALPHA6, ALPHA7, and ALPHA8 are intrinsic truth sets defined as follows:

Truth Set	Definition
ALPHA6	A truth set that contains the BCL digits and uppercase letters
ALPHA7	A truth set that contains the ASCII digits and uppercase letters
ALPHA8	A truth set that contains the EBCDIC digits and uppercase letters
ALPHA	A truth set that contains the digits and uppercase letters of the default character type

If a default character type is not explicitly specified by the compiler control options ASCII or BCL, then the default character type is EBCDIC, and ALPHA is the same as ALPHA8. If the ASCII compiler control option is TRUE, then ALPHA is the same as ALPHA7. If the BCL compiler control option is TRUE, then ALPHA is the same as ALPHA6.

*Note: The BCL data type is not supported on all A Series systems. The appearance of a BCL construct that can cause the creation of a BCL descriptor, such as the ALPHA6 intrinsic truth set, causes the program to get a compile-time warning message.*

## Truth Set Test

From the characters in a TRUTHSET declaration, the compiler builds a truth set table, which is used in a truth set test to determine whether a given character is a member of that group of characters.

All truth sets declared by a single TRUTHSET declaration are stored in a single read-only array. Separate TRUTHSET declarations produce separate read-only arrays.

A truth set test references a bit in the read-only array containing the truth set by dividing the binary representation of the character being tested into two parts: the low-order five bits are used as a bit index, and the three high-order bits are used as a



## Declarations

word index. If the size of the source character is smaller than eight bits, high-order zero bits are inserted to make an 8-bit character before the indexing algorithm is used.

The word index selects a particular word in the truth set table. The bit index is then subtracted from 31, and the result is used to reference one of the low-order 32 bits in the selected word. If the bit selected by the following expression is equal to 1, the character is a member of the truth set:

```
TABLE[CHAR. [7:3]] . [(31-CHAR. [4:5]):1]
```

Figure 3-2 shows an example of a truth set test. In this example, the referenced bit (13) is equal to 1; therefore, the test character is a member of the truth set.

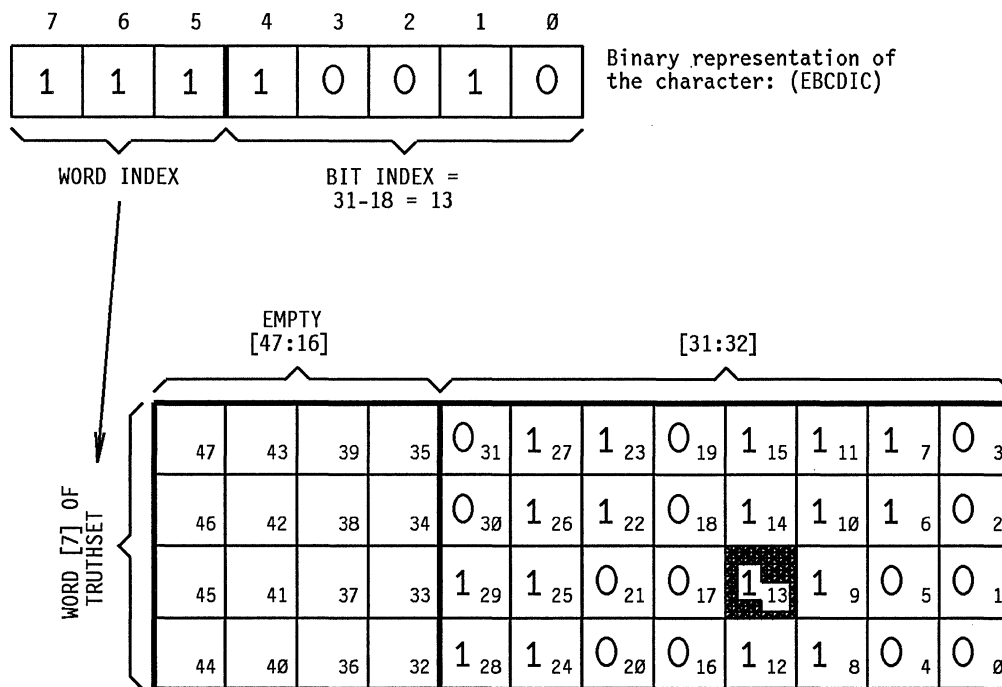


Figure 3-2. Truth Set Test

## Examples of TRUTHSET Declarations

The following example declares T to be a truth set with membership equal to that of ALPHA. ALPHA consists of all uppercase letters and the digits 0 through 9, in the default character set.

```
TRUTHSET T(ALPHA)
```

The following example declares Z to be a truth set with membership of ALPHA8 and the hyphen (-).

```
TRUTHSET Z(ALPHA8 OR "-")
```

The following example declares NUMBERS to be a truth set with a membership of the digits 0 through 9 in the default character set.

```
TRUTHSET NUMBERS("0123478956")
```

The following example declares LETTERS to be a truth set with a membership of ALPHA but not the digits 0 through 9; that is, consisting of the uppercase letters in the default character set.

```
TRUTHSET LETTERS(ALPHA AND NOT NUMBERS)
```

The following example declares three truth sets:

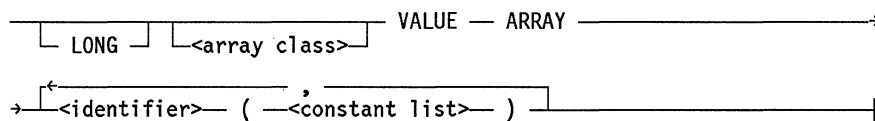
- HEXN, with a membership of the hexadecimal characters 1, 2, and 3
- BCLN, with a membership of the BCL characters 1, 2, and 3
- ASCN, with a membership of the ASCII characters 1, 2, and 3

```
TRUTHSET HEXN(4"123"), BCLN(6"123"), ASCN(7"123")
```

## VALUE ARRAY Declaration

A VALUE ARRAY declaration declares a read-only, one-dimensional array of constants.

<value array declaration>



<value array identifier>

An identifier that is associated with a value array in a VALUE ARRAY declaration.

A value array is a one-dimensional, read-only array. An element of a value array is referenced in the same manner as for any other array; that is, through a subscripted variable or by using a pointer. However, an attempt to store a value into a value array is flagged with a compile-time or run-time error.

The lower bound of a value array is 0 (zero).

Normally, a value array longer than 1024 words is automatically paged (segmented) at run time into segments 256 words long. LONG specifies that the value array is not to be paged, regardless of its length.

If no array class appears in a VALUE ARRAY declaration, a REAL array is assumed.

## Declarations

---

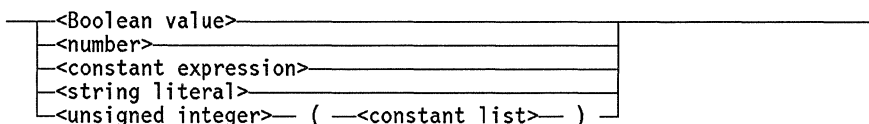
**Note:** *The BCL data type is not supported on all A Series systems. The appearance of a BCL construct that can cause the creation of a BCL descriptor, such as a BCL value array, causes the program to get a compile-time warning message.*

## Constants

**<constant list>**



**<constant>**



**<constant expression>**

An arithmetic, Boolean, or complex expression that can be entirely evaluated at compilation time.

Each constant initializes an integral number of words. The number of words initialized depends on the type of the array and the kind of constant.

Single-precision numbers, single-precision expressions, Boolean values, and Boolean expressions initialize one word in value arrays other than double or complex value arrays. In double value arrays, this word is extended with a second word of 0 (zero). In complex value arrays, this word is normalized and then extended with an imaginary part of 0 (zero).

Double-precision numbers and expressions are stored unchanged in two words in double value arrays. In complex value arrays, the value is rounded and normalized to single precision and then extended with an imaginary part of 0 (zero). For other types of value arrays, the second word of the double-precision value is dropped and the first word initializes one word of the array.

Complex expressions can appear only in complex value arrays, and they initialize two words of the array.

String literals more than 48 bits long initialize as many words as are needed to contain the string and are left-justified with trailing zeros inserted in the last word, if necessary. In complex and double value arrays, long string literals can initialize an odd number of words, causing the following constant to start in the middle of a two-word element of the array.

String literals less than or equal to 48 bits long are right-justified within one word with leading zeros, if necessary. This word initializes one word in value arrays other than

double or complex value arrays. In double value arrays, this word is extended with a second word of 0 (zero). In complex value arrays, this word is normalized and then extended with an imaginary part of 0 (zero).

The < unsigned integer > (< constant list >) form of constant causes the values within the parentheses to be repeated the number of times specified by the unsigned integer.

The operating system overlays value arrays more efficiently than other arrays because value arrays need not be written to disk when their space in memory is relinquished.

The maximum size of an unpagged value array is 4095 words; the maximum size of a pagged value array is 32,767 words.

### Example of VALUE ARRAY Declaration

The following example declares DAYS to be a value array of real elements. DAYS stores the names of the days of the week, one day name in each two words. The string *FRIDAY*, for example, is stored in DAY[8] and DAY[9], and can be retrieved by assigning a pointer to DAY[8] and using the pointer.

```
VALUE ARRAY DAYS ("MONDAY      ", "TUESDAY      ",
                  "WEDNESDAY   ", "THURSDAY    ",
                  "FRIDAY      ", "SATURDAY    ",
                  "SUNDAY      ")
```



# Section 4

## Statements

Statements are the active elements of an ALGOL program. They indicate an operation to be performed. Statements are normally executed in the order in which they appear in the program. This sequential flow of execution can be altered by a statement that transfers control to another program location. Note that a statement can be null or empty.

In this section, the ALGOL statements are listed and discussed in alphabetical order. In many cases, portions of the syntax of a statement are discussed before moving on to the next syntax segment.

The syntax for any statement is recursive: a statement can be a block or a compound statement, each of which, in turn, can include statements. For a description of the syntax of <block> and <compound statement>, see Section 1, "Program Structure."

Statements can be labeled or unlabeled. A <labeled statement> is of the following form:

—<label identifier>— : —<statement>—————|

An <unlabeled statement> is any statement that does not contain a label identifier.

## ACCEPT Statement

The ACCEPT statement causes the display of a specified message on the Operator Display Terminal (ODT).

<accept statement>

— ACCEPT — ( —<pointer expression>————— ) —————|  
                  | —<string variable>—————|  
                  | —<subscripted string variable>—————|

## ACCEPT Parameters

The message displayed on the ODT is designated by the parameter to the ACCEPT statement. If the parameter is a pointer expression, then the characters to which the pointer expression points are displayed on the ODT. The pointer expression must point to EBCDIC characters, and the message to be displayed must be terminated by the EBCDIC null character (48"00"). Following display of the characters, the program is suspended until a response is entered at the ODT. The response is placed, left-justified, with leading blanks discarded and with an EBCDIC null character added at the end, into the location to which the pointer expression points, and the program continues execution with the statement following the ACCEPT statement.

## Statements

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If the parameter to the ACCEPT statement is a string variable or subscripted string variable, then the contents of the specified string are displayed on the ODT. The string variable or subscripted string variable must be of type EBCDIC. Following the display of the characters, the program is suspended until a response is entered at the ODT. The response is placed in the string variable or subscripted string variable, and the program continues execution with the statement following the ACCEPT statement.

The ACCEPT statement can be used as a Boolean function. If a response is not available, the value of the ACCEPT statement is FALSE. If a response is available, the value of the ACCEPT statement is TRUE, and the response is placed in the specified location. The program continues execution regardless of the value returned by the ACCEPT statement.

No more than 430 characters can be displayed by the ACCEPT statement. No more than 960 characters can be accepted as a response.

The response to the ACCEPT statement can be entered before the actual execution of that statement. The response can be entered using the AX (Accept) system command. For more information, refer to the *A Series System Commands Operations Reference Manual*.

## Examples of ACCEPT Statement

The following example displays the string of EBCDIC characters in the array Z, from the beginning of the array to the EBCDIC null character (48"00).

```
ACCEPT (POINTER(Z,8))
```

The following example displays the contents of string STR on the ODT. If a response is available, the string "THANK YOU." is displayed. If no response is available, the string "PLEASE REENTER." is displayed.

```
IF ACCEPT(STR) THEN
  DISPLAY("THANK YOU.")
ELSE
  DISPLAY("PLEASE REENTER.")
```

## ASSIGNMENT Statement

The ASSIGNMENT statement causes the item on the right of the assignment operator (`:=`) to be evaluated and the resulting value to be assigned to the item on the left of the assignment operator.

**<assignment statement>**

<arithmetic assignment>
<array reference assignment>
<Boolean assignment>
<complex assignment>
<mnemonic attribute assignment>
<pointer assignment>
<procedure reference array assignment>
<string assignment>
<task assignment>

The action of an ASSIGNMENT statement is as follows:

- The location of the target is determined.
- The item following the assignment operator (`:=`) is evaluated.
- The resulting value is assigned to the target.

The various forms of the ASSIGNMENT statement are called assignments instead of statements because they can appear both as statements and in expressions. For example, the following is a statement when it stands alone:

```
A := A + 1
```

However, the same construct can be used in an expression, such as in the following:

```
IF (A := A + 1) > 100 THEN <statement>
```

Too many arithmetic, Boolean, complex, pointer, or string assignments in one statement can cause a stack overflow fault in the compiler. The fault can be avoided by breaking the statement into several separate statements, each containing fewer assignments, or by increasing the maximum stack size for the program by using the task attribute `STACKLIMIT`.

### Arithmetic Assignment

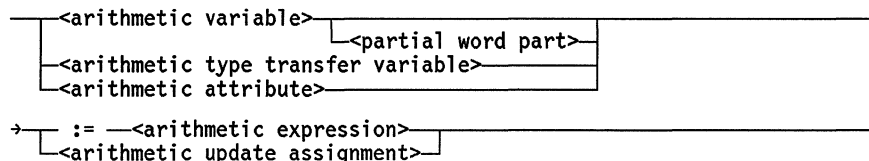
An arithmetic assignment assigns the value of the arithmetic expression on the right side of the assignment operator (`:=`) to the arithmetic target on the left side.



## Statements

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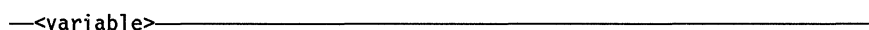
### <arithmetic assignment>



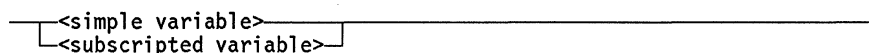
## Arithmetic Variable

The attribute error number returned from the operating system can be captured in the arithmetic variable.

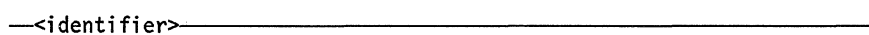
### <arithmetic variable>



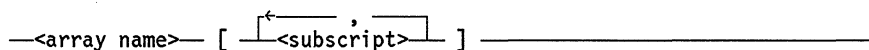
### <variable>



### <simple variable>



### <subscripted variable>



If the *<arithmetic variable>* *<partial word part>* syntax or the *<arithmetic attribute>* syntax appears in a statement with multiple assignments, then it must appear as the leftmost target in the statement. The following examples illustrate this rule.

#### Allowed

X.[7:8] := Y := 1

F1.MAXRECSIZE := RECLNGTH := 30

#### Not Allowed

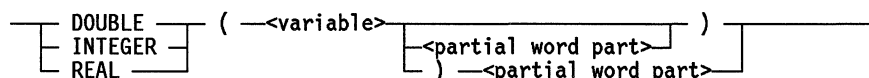
Y := X.[7:8] := 1

RECLNGTH := F1.MAXRECSIZE := 30

An *<arithmetic variable>* *<partial word part>* assignment leaves the remainder of the arithmetic variable unchanged, despite any possible side effects, such as embedded assignments, in the arithmetic expression.

## Arithmetic Type Transfer Variable

### <arithmetic type transfer variable>



If the declared type of the target item to the left of the assignment operator (`:=`) and the type of the value to be assigned to it are different, then the appropriate implicit type conversion is performed according to the following rules:

- If the left side is of type `INTEGER` and the expression value is of type `REAL`, then the value is rounded to an integer before it is stored.
- If the left side is of type `INTEGER` and the expression value is of type `DOUBLE`, then the value is rounded to a single-precision integer before it is stored.
- If the left side is of type `REAL` and the expression value is of type `INTEGER`, then the value is stored unchanged.
- If the left side is of type `REAL` and the expression value is of type `DOUBLE`, then the value is rounded to single precision before it is stored.
- If the left side is of type `DOUBLE` and the expression value is of type `INTEGER` or `REAL`, then the value is converted to double precision by appending a second word of zero (all bits equal to zero) before it is stored.

The use of an arithmetic type transfer variable causes the value on the right side of the assignment operator to be stored unchanged into the variable on the left side, regardless of type. However, if an attempt is made to assign a double-precision value into a single-precision variable by using the `DOUBLE` form of the construct, only the first word of the double-precision value is stored unchanged into the single-precision variable. For more information, see “Type Coercion of One-Word and Two-Word Operands” in Appendix C, “Data Representation.”

If more than one assignment operator appears in a single assignment (for example, `A := B := C := 1.414`), assignment of values is executed from right to left. If, during this process, a value is converted to another type so that it can be assigned, then it remains in that converted form following that assignment; that is, the value does not resume its original form. For example, assume you are executing the following program:

```
BEGIN
  DOUBLE DBL1, DBL2;
  REAL REL1, REL2;
  INTEGER INT1;
  DBL2:= REL2:= INT1:= REL1:= DBL1:= 1.414213562373095048801000;
END.
```

In this program, the variables are assigned the following values:

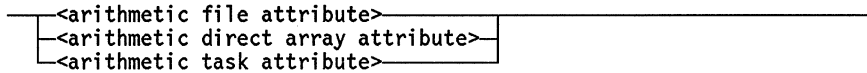
```
DBL1 = 1.414213562373095048801
REL1 = 1.41421356237
INT1 = 1
REL2 = 1.0
DBL2 = 1.0
```

## Statements

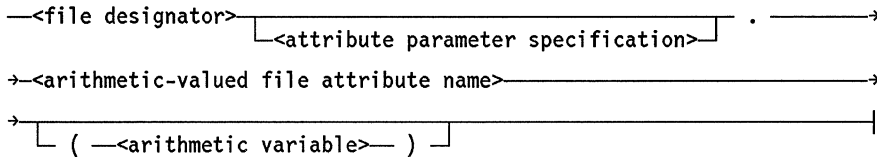
---

### Arithmetic Attribute

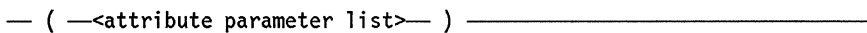
#### <arithmetic attribute>



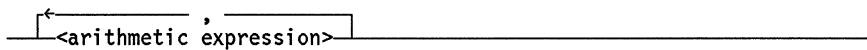
#### <arithmetic file attribute>



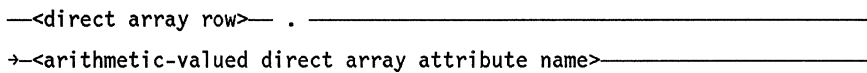
#### <attribute parameter specification>



#### <attribute parameter list>



#### <arithmetic direct array attribute>



#### <arithmetic-valued direct array attribute name>

ALGOL supports all direct array attributes and direct array attribute values described in the *A Series File Attributes Programming Reference Manual*.

#### <arithmetic task attribute>



#### <arithmetic-valued task attribute name>

ALGOL supports all task attributes of type real and integer described in the *A Series Task Attributes Programming Reference Manual*.

## Arithmetic Update Assignment

**<arithmetic update assignment>**

—<update symbols> —————  
                   └<arithmetic operator>—<arithmetic expression>┘

<update symbols>

— := — \* —————

The arithmetic update assignment is a shorthand form of assignment that can be used when the arithmetic target on the left side of the assignment operator also appears in the arithmetic expression on the right side of the operator. The arithmetic update assignment form can be specified only following an arithmetic target that does not contain a partial word part. The asterisk (\*) represents a duplication of the item to the left of the assignment operator. For example, the same results are produced by the following two assignments:

A := \* + 1

A := A + 1

The target item is not reevaluated at the appearance of the asterisk. Hence, if I equals zero initially, the following applies:

Assignment	Equivalent	Not Equivalent
B[I := I + 1] := * + 1	B[1] := B[1] + 1	B[1] := B[2] + 1

If the item to the left of the assignment operator is a subscripted variable, it cannot reference a value array.

If an expression is used as a subscript to a variable, the subscript is evaluated first. In the following example, the expression used as a subscript [I + 2] is evaluated first:

A[I+2] := I := 10

### Examples of Arithmetic Assignment

```
VAL := 7

A[4,5].[30:4] := X

FYLE.AREAS := 50

FYLE(5).AREAS := 10

FYLE.SYNCHRONIZE := VALUE(OUT)

DIRARRAY.IOCW := 4"1030"

TSK.COREESTIMATE := 10000

NEWARRAY[I] := * + OLDARRAY[I]

ONE := SIN(X := 3)**2 + COS(X)**2

DISTANCE := SQRT(X**2 + Y**2 + 2**2)
```

### Array Reference Assignment

<array reference assignment>

—<array reference variable>— := —<array designator>—————|

An array reference assignment associates a variable, called an array reference variable, with an array or a portion of an array. The array reference variable can then be used to reference the array or array portion.

An array reference assignment generates a copy descriptor of an array or array row.

Typical uses of an array reference assignment include the following:

- To perform more efficiently arithmetic operations on multidimensional arrays (for example, by extracting a particular row to avoid repeated indexing to the same row)
- For concurrent, but different, uses of the same array (for example, for storing values of type REAL into an array that is originally declared as Boolean)

### Array Reference Variable

<array reference variable>

—<array reference identifier>—————|

The array reference variable cannot be global to the array designator.

If the array reference variable is declared as `DIRECT`, then only an array designator for a direct array can be assigned to it. However, a nondirect array reference variable can be assigned an array designator for either a direct or a nondirect array.

The dimensionality of the array reference variable and the array designator must be the same. If both are multidimensional, then the array classes must be compatible. `INTEGER`, `REAL`, and `BOOLEAN` types are compatible with each other. Other array classes are compatible only with themselves. If the array reference identifier and the array designator are both one-dimensional, then they can have any array class.

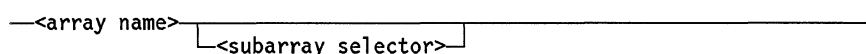
The size of each dimension of a multidimensional array reference variable is the same as the size of the corresponding dimension of the array designator. The size of a one-dimensional array reference variable is determined by the size and element width of the array designator and the element width for the array class with which the array reference variable was declared. Let  $S_a$  and  $W_a$  be the size and element width, respectively, of the array designator, and let  $W_r$  be the element width for the array reference variable. The size of the array reference variable,  $S_r$ , is then the following:

$$S_r := (S_a * W_a) \text{ DIV } W_r$$

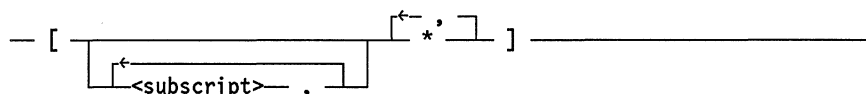
Because of the truncation implicit in the `DIV` operation,  $S_r * W_r$  might be less than  $S_a * W_a$ . In this case, indexing the array reference variable by  $S + LB$ , where `LB` is the lower bound in the `ARRAY REFERENCE` declaration, causes an invalid index fault. Nevertheless, pointer operations using the array reference variable can access the entire area of memory allocated to the original array to which the array designator ultimately refers; the memory area may hold more than  $S_r$  elements of width  $W_r$ .

## Array Designator

**<array designator>**



**<subarray selector>**



The array designator indicates the array or array portion to be associated with the array reference variable. Following an array reference assignment, the array reference variable becomes a referred array, describing the same data as the array designator, which can itself be an original array or another referred array.

A subarray selector selects part of an array by specifying subscripts for high-order dimensions and leaving others unspecified. The unspecified dimensions are indicated by an asterisk (\*). The dimensionality of the subarray is the number of asterisks in the subarray selector.

The total number of subscripts and asterisks in a subarray selector must equal the dimensionality of the array identifier to which the subarray selector is suffixed. In

## Statements

---

the case of no subscripts, the number of asterisks equals that dimensionality, and the subarray is the whole array. In all other cases, the subarray selector specifies a subarray of reduced dimensionality.

For example, assume you are using the following declarations:

```
ARRAY A[0:9,1:40,0:99];  
INTEGER I,J; % (ASSUME 0 <= I <= 9 AND 1 <= J <= 40)
```

For these declarations, the following applies:

A and A[*,*,*]	Denote the entire three-dimensional array.
A[I,*,*]	Denotes one of the 10 two-dimensional arrays that constitute A.
A[I,J,*]	Denotes one of the 40 one-dimensional arrays (array rows) that constitute A[I,*,*], and one of the 400 one-dimensional arrays that constitute A.

If the array designator is an uninitialized array reference variable, the array reference assignment causes the target array reference variable to become uninitialized.

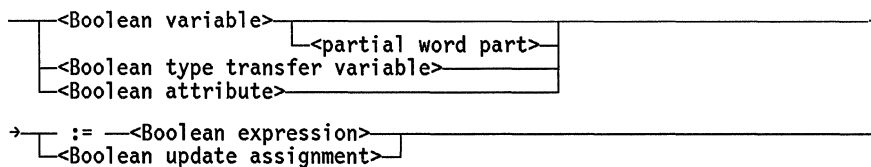
### Examples of Array Reference Assignment

```
BOOLARRAY := REELARRAY  
EBCDICARAY := INPUTARAY[*]  
SUBARRAY := BIGARRAY[N,*,*]  
ARAYROW := MULTIDIMARAY[I,J,K,*]
```

### Boolean Assignment

A Boolean assignment assigns the value of the Boolean expression on the right side of the assignment operator (:=) to the Boolean target on the left side.

<Boolean assignment>

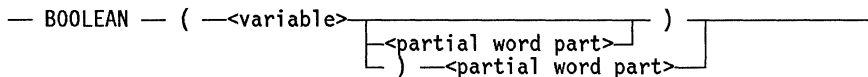


### Boolean Variables

<Boolean variable>

A <variable> of type Boolean.

**<Boolean type transfer variable>**



If the *<Boolean variable>* *<partial word part>* syntax or the *<Boolean attribute>* syntax appears in a statement with multiple assignments, then it must appear as the leftmost target in the statement. The following examples illustrate this rule.

**Allowed**

X.[7:8] := Y := FALSE  
 F1.OPEN := OPENED := FALSE

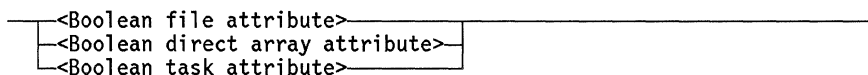
**Not Allowed**

Y := X.[7:8] := FALSE  
 OPENED := F1.OPEN := FALSE

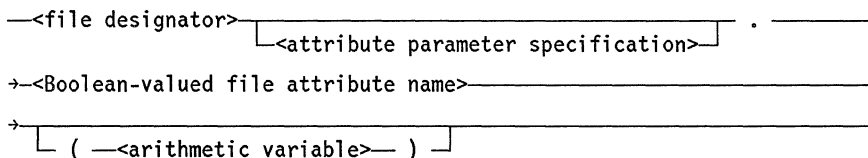
A *<Boolean variable>* *<partial word part>* assignment leaves the remainder of the Boolean variable unchanged, despite any possible side effects, such as embedded assignments, in the Boolean expression.

**Boolean Attributes**

**<Boolean attribute>**

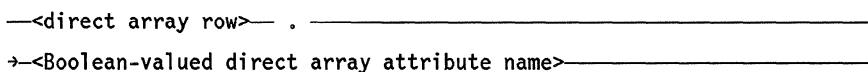


**<Boolean file attribute>**



The attribute error number returned from the operating system can be captured in the *<arithmetic variable>*.

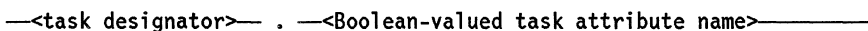
**<Boolean direct array attribute>**



**<Boolean-valued direct array attribute name>**

ALGOL supports all direct array attributes and direct array attribute values described in the *A Series File Attributes Programming Reference Manual*.

**<Boolean task attribute>**

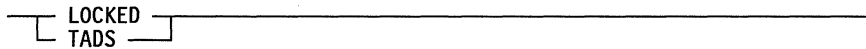




## Statements

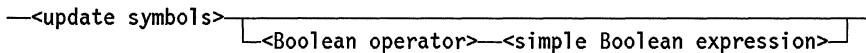
---

<Boolean-valued task attribute name>



### Boolean Update Assignment

<Boolean update assignment>



The Boolean update assignment is a shorthand form of assignment that can be used when the Boolean target on the left side of the assignment operator (:=) also appears in the Boolean expression on the right side of the operator. The Boolean update assignment form can be specified only following a Boolean target that does not contain a partial word part. The asterisk (\*) represents a duplication of the item to the left of the assignment operator. For example, the following two assignments produce the same results:

```
B := * AND BOOL
```

```
B := B AND BOOL
```

The target item is not reevaluated at the appearance of the asterisk.

If the item to the left of the assignment operator is a subscripted variable, it cannot reference a value array.

### Examples of Boolean Assignment

```
BOOL := TRUE
```

```
BOOLARRAY[N].[30:1] := Q < VAL
```

```
HIGHER := PTR > PTS FOR 6
```

```
TAUTOLOGY := * OR TRUE
```

### Complex Assignment

A complex assignment assigns the value of the complex expression on the right side of the assignment operator (:=) to the complex variable on the left side.

<complex assignment>



<complex variable>

—<variable>—————|

## Complex Update Assignment

<complex update assignment>

—<update symbols>—┌—————┐  
                           |<complex operator>—<simple complex expression>|

The complex update assignment is a shorthand form of assignment that can be used when the complex variable on the left side of the assignment operator (:=) also appears in the complex expression on the right side of the operator. The asterisk (\*) represents a duplication of the variable to the left of the assignment operator. For example, the following two assignments produce the same results:

C := \* + COMPLEX(3,4)

C := C + COMPLEX(3,4)

The target variable is not reevaluated at the appearance of the asterisk.

If the item to the left of the assignment operator is a subscripted variable, it cannot reference a value array.

## Examples of Complex Assignment

C1 := COMPLEX(8,1.5)

C2 := \* + C1/2

## Mnemonic Attribute Assignment

A mnemonic attribute assignment assigns a value to the mnemonic-valued library attribute LIBACCESS.

Refer to “Library Attributes” in Section 8, “Library Facility,” for a description of the library attribute LIBACCESS.

<mnemonic attribute assignment>

—<mnemonic attribute>— := — VALUE — ( —————→  
 ↳<mnemonic attribute value>— ) —————|

<mnemonic attribute>

—<mnemonic library attribute>—————|

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**<mnemonic library attribute>**

—<library identifier> . —————→  
→<mnemonic-valued library attribute name>—————|

**<mnemonic attribute value>**

—<mnemonic library attribute value>—————|

The following are examples of Mnemonic Attribute Assignment:

```
L.LIBACCESS := VALUE(BYTITLE)
```

```
L.LIBACCESS := VALUE(BYFUNCTION)
```

## Pointer Assignment

A pointer assignment assigns the pointer on the left side of the assignment operator (:=) to point to the location in an array indicated by the expression on the right side of the assignment operator. Such a pointer is then considered initialized and can be used in the REPLACE and SCAN statements for character manipulation.

**<pointer assignment>**

—<pointer variable> — := —<pointer expression>—————|  
                                  └<pointer update assignment>┘

**<pointer variable>**

—<pointer identifier>—————|

**<pointer update assignment>**

—<update symbols> —————|  
                          └<skip>┘

## Pointer Variable

A pointer assignment causes the creation of a pointer variable, or copy descriptor, to an array. The pointer variable can be set up with the needed character size by using the POINTER function syntax. For more information, see “POINTER Function” in Section 5, “Expressions and Functions.”

## Examples of Pointer Assignment

The following example assigns a pointer named PTS to point to the EBCDIC character in the EBCDIC array EBCDICARAY identified by the subscripted variable EBCDICARAY[5].

```
PTS := EBCDICARAY[5]
```

The following example assigns a pointer named PTR to point to the leftmost character position in the first element of the real array REALARRAY.

```
PTR := POINTER(REALARRAY)
```

The following example assigns the pointer PINFO to point to the 17th character position after the character position pointed to by the pointer PTR.

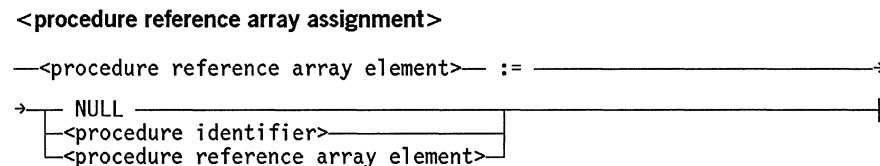
```
PINFO := PTR + 17
```

The following example assigns the pointer POUT to point to the leftmost character position in the array element identified by INSTUFF[N]. The 4 following the comma indicates that POUT is a hexadecimal pointer and thus points to hexadecimal characters.

```
POUT := POINTER(INSTUFF[N],4)
```

## Procedure Reference Array Assignment

A procedure reference array assignment associates a procedure reference with a procedure reference array element. The element can then be used to refer to the procedure.



## Procedure Reference Array Element

If NULL is specified and there is an environment called NULL, then a reference to the procedure called NULL is assigned. If NULL is specified and there is no environment called NULL, then a NULL value is assigned to the procedure reference array element. When a NULL reference is assigned, the previous contents are overwritten with a tag 0 (zero) word. If the procedure reference array element is invoked while it is NULL, a program interrupt occurs.

The procedure reference array element on the left side of the assignment operator (:=) and the procedure or procedure reference array element on the right side must be of the same type and have the same parameter descriptions.

The procedure reference array on the left side of the assignment operator cannot be global to the procedure or procedure reference array on the right side. If the procedure reference array element on the left side of the assignment operator is a formal parameter, a procedure reference array element on the right side can only be another element of the same procedure reference array that appears on the left side.

A procedure reference array that is declared to be part of a library cannot appear on the left side of a procedure reference array assignment. An attempt to assign into such a procedure reference array results in an error at compilation time or at run time.

## Statements

---

If the procedure reference array element on the right side of the assignment operator is uninitialized, then a later attempt to use the statement on the left side results in an error.

### Example of Procedure Reference Array Assignment

In the following example, P and Q are REAL procedures and RA is a REAL procedure reference array. Neither P, Q, nor RA have parameters. The program sample assigns references to elements one through four of the procedure reference array RA.

```
BEGIN
  REAL PROCEDURE P;
  BEGIN
    REAL A;
    A := T * T;
    P := A;
  END;

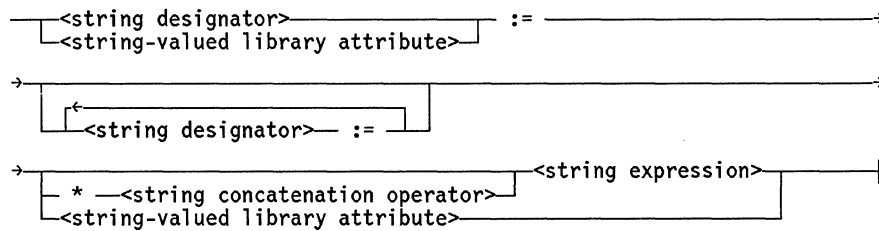
  REAL PROCEDURE Q;
  BEGIN
    INTEGER A;
    A := T * T * T;
    IF A > 0 THEN
      Q := A
    ELSE
      Q := -1;
    END;

  REAL PROCEDURE REFERENCE ARRAY RA[1:10];
  NULL;
  RA[1] := P;    %RA[1] CONTAINS A REFERENCE TO PROCEDURE P
  RA[2] := Q;
  RA[3] := NULL; %RA[3] CONTAINS A NULL VALUE
  RA[4] := RA[3]; %RA[4] CONTAINS A REFERENCE TO RA[3]
END.
```

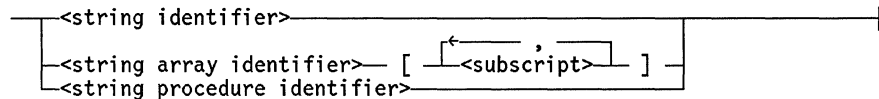
### String Assignment

A string assignment assigns the string that results from evaluation of the string expression on the right side of the assignment operator (:=) to the string target on the left side.

**<string assignment>**



**<string designator>**



The result of the expression on the right side of the assignment operator (:=) must be a string of the same character type as the declared type of the string designator on the left side.

Embedded assignment is not allowed. For example, the following is not allowed:

```
S1 := DROP(S2 := "ABC", 2)
```

Assignment can be made to a string procedure identifier only within the body of that string procedure.

**String Concatenation Operator**

The \* *<string concatenation operator>* form is a shorthand form of assignment that can be used when the string designator on the left side of the assignment operator also appears in the expression on the right side of the operator. The asterisk (\*) represents a duplication of the item to the left of the assignment operator. For example, the following two assignments produce the same results:

```
S := * CAT "ABC"
```

```
S := S CAT "ABC"
```

**Examples of String Assignment**

The following example assigns the EBCDIC string ABCD123 to the string variable STR1.

```
STR1 := 8"ABCD123"
```

The following example assigns the string 1234 (of the default character type) to both of the string variables S2 and S1.

```
S1 := S2 := "1234"
```

## Statements

---

The following example concatenates the string INPUT onto the end of the string stored in SOUT1, and then assigns the result to both of the string variables SOUT1 and SOUT.

```
SOUT := SOUT1 := * CAT "INPUT"
```

The following example concatenates the string ABC onto the end of the string stored in SOUT, and this string is then concatenated onto the end of the string stored in SOUT. The resulting string is assigned to the string variable SOUT.

```
SOUT := * || SOUT || "ABC"
```

## Task Assignment

A task assignment associates the task designator on the right side of the assignment operator (:=) with the task indicated by the expression on the left side.

<task assignment>

```
—<task designator>— . —<task-valued task attribute name>— := —————>
→<task designator>—————|
```

For information on task designator and task-valued task attribute name, see “TASK and TASK ARRAY Declarations” in Section 3, “Declarations.”

The PARTNER task attribute is used in conjunction with the CONTINUE statement.

The following are examples of Task Assignment:

The following example assigns the task TASKIT to the EXCEPTIONTASK attribute of TASKIT.

```
TASKIT.EXCEPTIONTASK := TASKIT
```

The following example assigns the task identified by the task array element TASKARRAY[N] to the EXCEPTIONTASK attribute of TSK.

```
TSK.EXCEPTIONTASK := TASKARRAY[N]
```

The following example assigns the task COHORT to the PARTNER attribute of TASKVARB.

```
TASKVARB.PARTNER := COHORT
```

The following example assigns the task identified by the task array element COWORKERS[INDX] to the PARTNER attribute of MYSELF.

```
MYSELF.PARTNER := COWORKERS[INDX]
```

The following example assigns the task that is the PARTNER attribute of the task MYSELF.PARTNER to the task that is the EXCEPTIONTASK attribute of the task MYSELF.PARTNER.

```
MYSELF.PARTNER.EXCEPTIONTASK := MYSELF.PARTNER.PARTNER
```

## ATTACH Statement

The **ATTACH** statement associates an interrupt with an event so that when the event is caused, the program is interrupted, and the interrupt code is placed in execution, provided that the interrupt is enabled.

**<attach statement>**

```
— ATTACH —<interrupt identifier>— TO —<event designator>—————|
```

## Attachment of Interrupts

Although different interrupts can be simultaneously attached to the same event, a particular interrupt can be attached to only a single event at any one time. For this reason, if, at attach time, the interrupt is found to be already attached to an event, then it is automatically detached from the old event and attached to the new event. Any pending invocations of the interrupt are lost.

An interrupt can be attached to an event that is declared in a different block. For example, a local interrupt can be attached to a formal event. Such an attachment can cause compile-time or run-time up-level attach errors if the block containing the event can be exited before the block that contains the interrupt is exited.

Event-valued file attributes are allowed. If the file is declared (or specified as a formal parameter) at least as global as the interrupt, then run-time checking can be bypassed.

However, the operating system can prevent some attachments at run time. For example, the **INPUTEVENT** of a remote file is available only after the file has been opened with an **OPEN** statement. In the operating system, run-time verification that an interrupt is not declared more global than the event always fails for attribute events. This causes a task fatal **UP LEVEL ATTACH** error. Therefore, a formal parameter event whose actual parameter is a file attribute cannot be attached nor can an attribute of a formal parameter file be attached to a global interrupt.

## Examples of ATTACH Statement

The following example attaches the interrupt **THEPHONE** to the event **THEBELL**. When **THEBELL** is caused, the code associated with **THEPHONE** begins executing.

```
ATTACH THEPHONE TO THEBELL
```

The following example attaches the interrupt **ANSWERHI** to the event **MYSELF.EXCEPTIONEVENT**. Whenever the task **MYSELF** undergoes a change in status, the **EXCEPTIONEVENT** attribute is caused, and the code associated with **ANSWERHI** begins executing.

```
ATTACH ANSWERHI TO MYSELF.EXCEPTIONEVENT
```



## AWAITOPEN Statement

The AWAITOPEN statement is used to await a request for dialog establishment. Information on networks that support this function can be found in the *A Series I/O Subsystem Programming Guide*.

### <awaitopen statement>

```
— AWAITOPEN — ( —<awaitopen file part> —<awaitopen options> ) —
```

### <awaitopen file part>

```
—<file designator> — [ SUBFILE —<subfile index>— ] —
```

### <awaitopen options>

```
— [ , —<awaitopen control option>— ] —>
-> [ , — PARTICIPATE — ] —>
      = [ TRUE — ]
        [ FALSE — ]
-> [ , —<connecttimelimit option>— ] —
```

### <awaitopen control option>

```
— [ AVAILABLE — ] —
  [ DONTWAIT — ] —
  [ WAIT — ] —
```

### <connecttimelimit option>

```
— CONNECTTIMELIMIT — = —<arithmetic expression>—
```

The AWAITOPEN statement can be used only when the kind of the file designator is PORT and only when the SERVICE attribute for the port is set to a network type that supports this feature.

The subfile index, if present, specifies the subfile that is waiting for dialog establishment.

The AWAITOPEN statement can be used as an arithmetic function. It returns the same values as the file attribute AVAILABLE. For a description of these values refer to the *A Series File Attributes Programming Reference Manual*. If the result of this statement is not interrogated by the program, the program terminates when the awaitopen action fails.

The control options AVAILABLE, DONTWAIT, and WAIT are described in the *A Series I/O Subsystem Programming Guide*. The control option is used to indicate when control should be returned to the program. If a control option is not specified, WAIT is assumed.

## PARTICIPATE Option

The PARTICIPATE option is used to indicate that the program specifies the option of accepting or rejecting offers, through the RESPOND statement, when the subfile is matched to an incoming dialog request. Specifying PARTICIPATE is equivalent to specifying PARTICIPATE = TRUE. Upon notification of a matching dialog request, through CHANGEVENT and FILESTATE attributes, the program can interrogate the value of attributes, read open userdata, and negotiate the value of negotiable attributes. The program can then reject or accept an incoming dialog request. For more information on FILESTATE and CHANGEVENT attributes, see the *A Series File Attributes Programming Reference Manual*. If the PARTICIPATE option is not included, a default value of FALSE is assumed, and any offer is unconditionally accepted.

## CONNECTTIMELIMIT Option

The CONNECTTIMELIMIT option can be used to specify the maximum amount of time, in minutes, that the system will allow for a successful match with a corresponding endpoint. The default for this option is an unlimited wait. If the amount specified is negative, an error result is returned. If the value is zero, there is no time limit on the wait. If the value is not a single-precision integer, it is integerized. If the FILESTATE of the port file does not change to an OPENED or OPENRESPONSEPLEASE file state within the time specified, the AWAITOPEN fails and an implicit CLOSE ABORT is performed on the subfile.

## Examples of AWAITOPEN Statement

The following example indicates that the program is being used to await dialog establishment on all subfiles of the port file FILEID.

```
AWAITOPEN (FILEID [SUBFILE Ø])
```

The following example indicates that the program is being used to await dialog establishment on subfile I of the port file FILEID.

```
AWAITOPEN (FILEID [SUBFILE I])
```

The following example indicates that the program is being used to await dialog establishment on subfile 1 of port file FILEID. Control is not returned to the program until the subfile is matched. In addition, the participate option is used to indicate that the program can accept or reject any offers through the RESPOND statement.

```
AWAITOPEN (FILEID [SUBFILE 1], WAIT, PARTICIPATE=TRUE)
```

The following example indicates that the program is being used to await dialog establishment on subfile N of port file FILEID. The maximum amount of time to wait for a successful match is set to the result of the arithmetic expression  $(X * 60 + 3)$ .

```
AWAITOPEN (FILEID [SUBFILE N], CONNECTTIMELIMIT=(X * 60 + 3))
```

## CALL Statement

The CALL statement initiates a procedure as a coroutine.

```
<call statement>
— CALL —<procedure identifier> —————>
      |—————<actual parameter part>—————|
→ [ —<task designator>— ] —————|
```

## Coroutines

Initiation of a coroutine consists of setting up a separate stack, passing any parameters (call-by-name or call-by-value), and beginning the execution of the procedure.

Processing of the initiating program, called the *initiator* or the *primary coroutine*, is suspended.

The called procedure, referred to as the *secondary coroutine*, cannot be a typed procedure. If the procedure identifier is a system supplied process, such as an intrinsic, the library GENERALSUPPORT must be declared using a library entry point specification. The procedure identifier must be declared in the program or the syntax error, *PROCEDURE MUST BE USER DECLARED*, results. The actual parameter part must agree in number and type with the formal parameter part in the declaration of the procedure; otherwise, a run-time error occurs.

The task designator associates a task with the coroutine at initiation; the values of the task attributes of that task, such as COREESTIMATE, STACKSIZE, and DECLAREDPRIORITY, can be used to control the execution of the coroutine. For more information about assigning values to task attributes, refer to <arithmetic task attribute> under “Arithmetic Assignment,” <Boolean task attribute> under “Boolean Assignment,” and “Task Assignment” earlier in this section.

Every coroutine has a partner task to which control can be passed by using the CONTINUE statement. The partner task of the secondary coroutine is the initiator by default but can be changed by assignment to the task-valued task attribute PARTNER of the task designator. Local variables and call-by-value parameters of the secondary coroutine retain their values as control is passed to or from the coroutine.

The *critical block*, described in “PROCESS Statement” later in this section, in the initiator cannot be exited until the secondary coroutine is terminated. Any attempt by the initiator to exit that block before the secondary coroutine is terminated causes the initiator and all tasks it has initiated through CALL or PROCESS statements to be terminated.

A secondary coroutine is terminated by exiting its own outermost block or by execution in the initiator of the following statement, where the task designator specifies the task associated with the secondary coroutine to be terminated:

```
<task designator>.STATUS := VALUE(TERMINATED)
```

**Note:** *The CALL statement causes the initiation of a separate stack as a coroutine. Because of the cost involved, a coroutine should be established once and then used through CONTINUE statements. If a CALL statement is used to invoke a procedure, overall system efficiency is severely degraded. A string expression cannot be passed as an actual parameter to a call-by-name parameter of a procedure in a CALL statement.*

## Example of CALL Statement

The following example initiates as a coroutine the procedure COROOTEEN, and passes the parameters X, Y, 7, and  $X + Y + Z$ . COROOTEEN has the task designator T associated with it.

```
CALL COROOTEEN(X, Y, 7, X + Y + Z) [T]
```

## CANCEL Statement

The CANCEL statement can be used to delink a library from a program and cause the library program to thaw (or unfreeze) and resume running as a regular program.

<cancel statement>

```
— CANCEL — ( —<library identifier>— ) _____|
```

## Delinking a Library from a Program

Normally, a library is linked to a program when the program calls one of the library's entry points or the LINKLIBRARY intrinsic, and the library is delinked from the program when the block in which the library is declared is exited. The CANCEL statement can be used to delink a library before it would normally be delinked.

When a library is canceled, all users of the library are delinked from the library, and the library thaws and resumes running as a regular program regardless of whether it is temporary or permanent. Refer to "FREEZE Statement" later in this section for a discussion of temporary and permanent libraries.

After a program has canceled a library, the program can again link to a new instance of the library as if for the first time.

Only libraries whose SHARING compiler control option is specified as PRIVATE or SHARED BY RUNUNIT can be canceled. If an attempt is made to cancel a library that is not PRIVATE or SHARED BY RUNUNIT, a run-time message is given and the library is delinked as if DELINKLIBRARY was called.

To delink a program from a library without affecting any other users of the library, use the DELINKLIBRARY function. For more information, see "DELINKLIBRARY Function" in Section 5, "Expressions and Functions."

## Statements

---

For more information on libraries, refer to Section 8, "Library Facility."

### Example of CANCEL Statement

The following example delinks the library LIB from the program.

```
CANCEL(LIB)
```

### CASE Statement

The CASE statement provides a means of dynamically selecting one of many alternative statements.

**<case statement>**

```
— <case head> — <case body> ————— |
```

**<case head>**

```
— CASE — <arithmetic expression> — OF ————— |
```

**<case body>**

```
— BEGIN — [ <statement list> ————— ] END ————— |  
          | [ <numbered statement list> ] |
```

**<numbered statement list>**

```
— [ <numbered> ; <numbered statement group> ] ————— |
```

**<numbered statement group>**

```
— <number list> — <statement list> ————— |
```

**<number list>**

```
— [ <constant arithmetic expression> — : ————— ]  
  | [ ELSE ————— ] |
```

### Unnumbered Statement List

If the case body contains an unnumbered statement list, then the statement to be executed is selected in the following manner:

- The arithmetic expression in the case head is evaluated. If the resulting value is not an integer, it is integerized by rounding.
- The integer value is used as an index into the list of statements in the case body. The N statements in the case body are numbered 0 to N-1. The statement corresponding to the index value is the statement executed. If the index value is less than zero or greater than N-1, the program is discontinued with a fault.

### Numbered Statement List

If the case body contains a numbered statement list, then the statement list to be executed is selected in the following manner:

- The arithmetic expression in the case head is evaluated. If the resulting value is not an integer, it is integerized by rounding.
- If the integer value is equal to one of the statement numbers, the statement list associated with the number is executed.

If the integer value is not equal to any of the statement numbers, then an invalid index fault occurs unless the word ELSE appears in a number list in the CASE statement, in which case control is transferred to the statement list following ELSE.

The statement numbers given by the constant arithmetic expressions in the number list must lie in the range 0 to 1023, inclusive. The word ELSE can appear only once in a CASE statement.

### Examples of CASE Statement

```
CASE I OF
  BEGIN
    J := 1;  % STATEMENT 0
    J := 20; % STATEMENT 1
    BEGIN   % STATEMENT 2
      J := 3;
      K := 0;
    END;
    J := 4;  % STATEMENT 3
  END;
```

```
CASE I OF
  BEGIN
    1:
    2:
    5:
    7:
      J := 3;
      Q := J-1;
    3:
    4:
    20:
      J := 4;
    ELSE:
      GO TO BADCASEVALUE;
  END;
```

### CAUSE Statement

The CAUSE statement activates all tasks that are waiting on the specified event.

<cause statement>

— CAUSE — ( —<event designator>— ) —————|

### Causes of Events

Normally, the CAUSE statement also sets the happened state of the event to TRUE (happened). For an explanation of exceptions to this condition, see “WAITANDRESET Statement” later in this section.

If an enabled interrupt is attached to the event, each cause of the event results in one execution of the interrupt code.

Activating a task does not necessarily place the task into immediate execution. Activating a task consists of delinking the task from an event queue (each event has its own queue) and linking that task in priority order into a system queue called the ready queue.

The ready queue is a queue of all tasks that are capable of running. Tasks are taken out of the ready queue either when a processor is assigned to the task or when the task must wait for an operation (such as an I/O operation) to complete or for an event to be caused. A task is placed in execution only when it is the top item in the ready queue and a processor is available.

When a program causes a happened event, the CAUSE statement is ignored (a *no-op* is caused); the system does not remember every cause unless an interrupt is attached to the event. For more information on events, see “EVENT Statement” later in this section.

## Examples of CAUSE Statement

The following example activates the tasks waiting for the event EVNT.

```
CAUSE (EVNT)
```

The following example activates the tasks waiting for the event identified by EVNTARAY[INDX].

```
CAUSE (EVNTARAY[INDX])
```

The following example activates the tasks waiting for a change in the status of the task TSK.

```
CAUSE (TSK.EXCEPTIONEVENT)
```

## CAUSEANDRESET Statement

The CAUSEANDRESET statement activates all tasks that are waiting on the specified event and sets the happened state of the event to FALSE (not happened).

<causeandreset statement>

```
— CAUSEANDRESET — ( —<event designator>— ) —————|
```

## Relationship to CAUSE Statement

This statement differs from the CAUSE statement in that the happened state of the event is set to FALSE (not happened).

For further information on the relationship between the CAUSEANDRESET statement and events see the discussion in “CAUSE Statement” earlier in this section.



## Examples of CAUSEANDRESET Statement

The following example activates the tasks waiting for the event EVNT, and sets the happened state of EVNT to FALSE (not happened).

```
CAUSEANDRESET (EVNT)
```

The following example activates the tasks waiting for the event identified by EVNTARAY[INDX], and sets the happened state of that event to FALSE (not happened).

```
CAUSEANDRESET (EVNTARAY [INDX])
```

The following example activates the tasks waiting for a change in the status of the task TSK, and sets the happened state of TSK.EXCEPTIONEVENT to FALSE (not happened).

```
CAUSEANDRESET (TSK.EXCEPTIONEVENT)
```

## CHANGEFILE Statement

The CHANGEFILE statement changes the names of files without opening them.

<change file statement>

```
— CHANGEFILE — ( —<directory element>— , —<directory element>—→  
→ ) —————|
```

The CHANGEFILE statement returns a value of TRUE if an error occurs. Error numbers, stored in field [39:20] of the result, correspond to the causes of failure as follows:

Value	Meaning
10	The first directory element is in error.
20	The second directory element is in error.
30	File names have not been changed.

File names and directory names must be specified in EBCDIC and must be followed by a period. All errors in the names are detected at run time.

If a family substitution specification is in effect, the CHANGEFILE statement affects only the substitute family, not the alternate family.

If a directory name is specified as the source, the names of the files in that directory are changed according to the following rules:

- If the specified target directory is a new directory, then the names of all the files in the source directory are changed.
- If the specified target directory is not a new directory, then only files that do not have corresponding names in the target directory are changed. For example, the first column below shows file names that exist before the statement *CHANGEFILE("A.", "B.")* is executed, and the second column shows the file names resulting from execution of the statement.

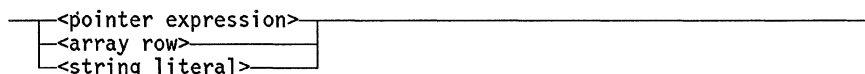
Existing Files	Resulting Files
A/B/C	B/B/C
A/B/D	A/B/D
A/C/C	B/C/C
B/B/D	B/B/D
B/C/D	B/C/D

Note that because the file name B/B/D already exists, the file name A/B/D is not changed.

- A directory element of the form *<file name>/=* affects only files in that directory. It does not affect a file named *<file name>*.

## Directory Element

*<directory element>*



A directory element is a file name, a directory name, or both a file name and a directory name. A directory name references a group of files. For example, the following files are all in the directory named JAMES. The first six files are in the directory named (JAMES)OBJECT, and the first five files are in the directory named (JAMES)OBJECT/TEST. Note that (JAMES)OBJECT/TEST/PRIMES is both a file name and a directory name.

```
(JAMES)OBJECT/TEST/COMM
(JAMES)OBJECT/TEST/SORT
(JAMES)OBJECT/TEST/PRIMES
(JAMES)OBJECT/TEST/PRIMES/1
(JAMES)OBJECT/TEST/PRIMES/2
(JAMES)OBJECT/LIBRARY1
(JAMES)MEMO
```

In the *CHANGEFILE* statement, the second directory element, the *target*, designates the name to which the first directory element, the *source*, is to be changed. If the change applies to files on pack, and a family substitution specification is not in effect (either by default through the USERDATA file or by specification in either CANDE or WFL), the target must include *ON <family name>*, and the source must not include a family name. If a family substitution specification is in effect, *ON <family name>* is not

## Statements

---

required; if *ON* <family name> does not appear, the family substitution specification is used to determine the family on which the files reside.

### Example of CHANGEFILE Statement

The following program changes A/B to C/D and then removes C/D.

```
BEGIN
  ARRAY OLD, NEW[0:44];
  BOOLEAN B;
  REPLACE POINTER(OLD) BY 8"A/B.";
  REPLACE POINTER(NEW) BY 8"C/D.";
  IF B := CHANGEFILE(OLD,NEW) THEN
    DISPLAY("CHANGEFILE ERROR");
  IF B := REMOVEFILE(8"C/D.") THEN
    DISPLAY("REMOVEFILE ERROR");
END.
```

### CHECKPOINT Statement

The CHECKPOINT statement writes to a disk file the complete state of the job at a specified point. Using the disk file, the job can later be restarted from this point.

<checkpoint statement>

— CHECKPOINT — ( —<device>— , —<disposition>— ) —————|

<device>

—| DISK —————|  
—| DISKPACK —|  
—| PACK ————|

The checkpoint/restart facility can protect a program against the disruptive effects of unexpected interruptions during the program's execution. If a halt/load or other system interruption occurs, a job is restarted either before the initiation of the task that was interrupted or, if the operator permits, at the last checkpoint, whichever is more recent. Checkpoint information can also be retained after successful runs to permit restarting jobs to correct bad data situations.

The device options determine the medium to be used for the checkpoint files.

The CHECKPOINT statement can be used as a Boolean function. An attempted checkpoint returns a value with the following information:

```
[ 0: 1] = Exception bit
[10:10] = Completion code
[25:12] = Checkpoint number
[46: 1] = Restart flag (1 = restart)
```



### Restarting a Job

A job can be restarted in two ways:

- After a halt/load. The system automatically attempts to restart any job that was active at the time of a halt/load. If a checkpoint has been invoked during the execution of the interrupted task, then the operator is given a message requiring a response to determine whether the job should be restarted. The operator can respond with the system command OK (to restart at the last checkpoint), DS (to prevent a restart), or QT (to prevent a restart but save the files for later restart if the job was a checkpoint with PURGE).
- By a Work Flow Language (WFL) RERUN statement. A WFL job can be restarted programmatically by use of the WFL RERUN statement.

The following conditions can inhibit a successful restart:

- An invalid usercode
- Recompilation of the program since the checkpoint
- The operating system has changed since the checkpoint. The restart fails if the creation time stamp of the operating system that created the checkpoint file does not match the creation time stamp of the current operating system.
- Intrinsic after the checkpoint that are different from the intrinsic before the checkpoint

The messages in the following list can appear as the result of an attempt to restart.

Restart Messages

-----

RESTART PENDING (RSVP)

MISSING CHECKPOINT FILE

IO ERROR DURING RESTART

USERCODE NO LONGER VALID

OPERATOR DSED RESTART

OPERATOR QTED RESTART

MISSING CODE FILE

NOT ABLE TO RESTART

INVALID JOB FILE

RESTART AS CP/nnnn

MISSING JOB FILE

FILE POSITIONING ERROR

WRONG JOB FILE

WRONG CODE FILE

BAD CHECKPOINT FILE

BAD STACK NUMBER

WRONG MCP

The following can inhibit a successful checkpoint/restart:

- Direct I/O (direct arrays or files)
- Datacomm I/O (open datacomm files)
- Open Data Management System II (DMSII) sets
- The task being checkpointed must have no tasks initiated through CALL or PROCESS statements, it must have been initiated by a WFL job, and this WFL job must not have initiated other tasks that are also running.
- ODT files
- Duplicated files
- Output directly to a printer or card punch (backup files are acceptable)
- Checkpoints taken inside sort input or output procedures. The sort intrinsic provides its own restart capability; for more information, see "SORT Statement" later in this section.
- Checkpoints taken in a compile-and-go program

If a job that produces printer backup files is restarted, the backup files can already have been printed and removed, and on restart the job requests the missing backup files. In this situation, when the backup files are requested, the operator must respond with the system command OF (Optional File). A new backup file is created. Output preceding the checkpoint is not re-created.

The messages in the following table can appear as the result of a checkpoint/restart. Error conditions can be handled in a program by checking for them by completion code number and instructing the program to handle the result.

<b>Checkpoint Message</b>	<b>Completion Code</b>
CHECKPOINT#nn	0
INVALID AREA IN STACK	1
SYSTEM ERROR	2
BAD IPC ENVIRONMENT	3
NO USER DISK FOR CP FILE	4
IO ERROR DURING CHECKPOINT	5

*continued*

## Statements

---

*continued*

Checkpoint Message	Completion Code
# ROWS IN CP FILE > 1024	6
DIRECT FILE NOT ALLOWED	7
TOO MANY TEMPORARY DISK FILES	8
PAPER TAPE FILE NOT ALLOWED	9
DUPLICATED FILE NOT ALLOWED	10
CON FILE NOT ALLOWED	11
CARD PUNCH FILE NOT ALLOWED	12
OPEN REVERSED TAPE FILE NOT ALLOWED	13
DISKHEADER IN STACK	14
DMS AREA IN STACK	15
DIRECT ARRAY IN STACK	16
DIRECT DOPE VECTOR IN STACK	17
SUBSPACE IN STACK	18
STACKMARK	19
SORT AREA IN STACK	20
REMOTE FILE NOT ALLOWED	21
ILLEGAL CONSTRUCT	22
BDBASE ILLEGAL	23
TEMP FILE ON NAMED PACK	24

## Locking

For jobs that take a large number of checkpoints with LOCK, the checkpoint number counts up to 999 and then recycles to 1 (leaving zero undisturbed). When this recycling occurs, previous checkpoint files are lost as new ones using the same numbers are created.

If a temporary disk file is open at a checkpoint, it is locked under the CP directory. If it is subsequently locked by the program, the name is changed to the current file title. At restart time, the file is sought only under the CP directory, resulting in a no-file condition. To avoid this condition, all files that are to be locked eventually should be opened with the file attribute PROTECTION assigned the value SAVE. To remove the file, it must be closed with PURGE. True temporary files, which are never locked, do not have this problem. All data files must be on the same medium as at the checkpoint, but need not be on the same units or the same locations on disk or disk pack. They must retain the same characteristics, such as blocking. The checkpoint/restart system makes no attempt to restore the contents of a file to their state at the time of the checkpoint; the file is merely repositioned. At this time, volume numbers are not verified.

**Note:** *CANDE and remote job entry (RJE) cannot be used to run a program with checkpoints. The checkpoints are ignored if used.*

## Rerunning Programs

If a rerun is initiated and the job number is in use by another job, a new job number is supplied, and the CP/<JN> directory node is changed to reflect the new job number.

If a rerun is initiated and the PROCESSID function is used, the value returned by the function can be different for the restarted job. Refer to “PROCESSID Function” in Section 5, “Expressions and Functions,” for more information.

When a job is restarted at some checkpoint before the last, subsequent checkpoints taken from the restarted job continue in numerical sequence from the checkpoint used for the restart. Previous higher numbered checkpoints are lost.

## Example of CHECKPOINT Statement

```
BOOL := CHECKPOINT(DISK,PURGE)
```

## CLOSE Statement

The CLOSE statement breaks the link between a logical file declared in the program and its associated physical file, which is the actual file data is sent to or from. For port files, it is used to close dialogs between processes.

<close statement>

```
— CLOSE — ( —<close file part> [ , —<close options> ] ) —
```

<close file part>

```
—<file designator> [ — SUBFILE —<subfile index>— ] —
—<task designator>— . —<file-valued task attribute name>—
```

<subfile index>

```
—<arithmetic expression>—
```

The CLOSE statement can be used as an arithmetic function. For information about results returned, see the *A Series File Attributes Programming Reference Manual*.

When no CLOSE option is specified, the CLOSE statement closes the file, depending on the kind of file, as follows:

### Card Output File

A card containing an ending label is punched. The file must be labeled.



## Statements

---

### Line Printer File

The printer is skipped to channel 1, an ending label is printed, and the printer is again skipped to channel 1. The file must be labeled.

### Unlabeled Tape Output File

A double tape mark is written after the last block on the tape, and the tape is rewind.

### Labeled Tape Output File

A tape mark is written after the last block on the tape; then an ending label is written followed by a double tape mark, and the tape is rewind.

### Disk File

If the file is a temporary file, the disk space is returned to the system.

For all types of files, the I/O unit and the buffer areas are released to the system.

The <subfile index> syntax is used to specify the subfile to be closed.

## CLOSE Options

<close options>

*	_____
CRUNCH	_____
LOCK	_____
PURGE	_____
REEL	_____
REWIND	_____
<port close option>	_____

If the asterisk (\*) is used and the file is a tape file, the I/O unit remains under program control, and the tape is not rewind. This construct is used to create multifile reels.

When the asterisk is used on multifile input tapes and the value of the LABEL file attribute is STANDARD, the CLOSE statement closes the file as follows:

- If the value of the DIRECTION file attribute is FORWARD, the tape is positioned forward to a point just following the ending label of the file.
- If the value of the DIRECTION file attribute is REVERSE, the tape is positioned to a point just in front of the beginning label for the file.
- If the end-of-file branch of a READ statement or WRITE statement has been taken, the CLOSE statement does not position the file.

The close action performed on a single-file reel is the same as that performed on a multifile reel. The next I/O operation performed on the file must be done in the direction opposite to that of the prior I/O operations; otherwise, an end-of-file error is returned.

When the asterisk is used and the LABEL file attribute does not have the value STANDARD, the tape is spaced beyond the tape mark (on input), or a tape mark is written going forward (on output). The essential difference is that if LABEL is OMITTEDEOF, labels are not spaced over, but if LABEL is STANDARD, labels are spaced over.

The CRUNCH option is meaningful only for disk files. It causes the unused portion of the last row of disk space, beyond the end-of-file indicator, to be returned to the system. The file cannot be expanded but can be written inside of the end-of-file limit.

If the LOCK option is used, the file is closed. If the file is a tape file, it is rewound, and a system message is printed that notifies the operator that the reel must be saved. The tape unit is made inaccessible to the system until the operator readies it manually. If the file is a disk file, it is kept as a permanent file on disk. The file buffer areas are returned to the system.

If the PURGE option is used, the file is closed, purged, and released to the system. If the file is a permanent disk file, it is removed from the disk directory, and the disk space is returned to the system.

If the REEL option is used, the file must be a multireel tape file. The current reel is closed, and the next reel is opened. This option is provided primarily for use with direct tape files, for which the system does not automatically perform reel switching.

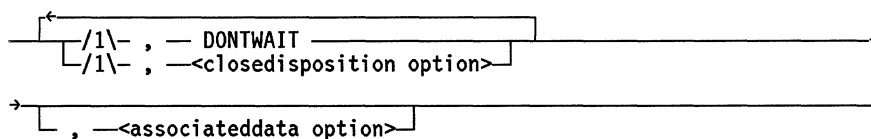
If the REWIND option is specified, the file is closed. If the file is a paper tape or magnetic tape file, it is rewound. For disk files, the record pointer is reset to the first record of the file. The file buffer areas are returned to the system, and the I/O unit (or disk file) remains under program control. For paper tape files, the REWIND option can be used only on input.

All forms of the CLOSE statement that are not appropriate for the type of unit assigned to the file are equivalent to using the REWIND option. For example, when the asterisk or the REEL option is specified for a disk file, the result is the same as when the REWIND option is specified for a disk file.

A CLOSE statement that leaves the disk file under program control is referred to as a *close with retention*. For example, a CLOSE statement that designates a disk file and the asterisk option or the REWIND option is a close with retention.

## PORT CLOSE Option

<port close option>





In the following example, assuming FILEID is a multireel tape file, the current reel is closed, and the next reel is opened.

```
CLOSE(FILEID,REEL)
```

The following example closes FILEID and, assuming FILEID is a disk file, returns to the system the unused portion of the last row of FILEID.

```
CLOSE(FILEID,CRUNCH)
```

The following example requests an orderly close on subfile 1 of port file FILEID. Control is returned to the program as soon as the close has been checked for semantic consistency, because the DONTWAIT port close option is included.

```
CLOSE (FILEID [SUBFILE 1], CLOSEDISPOSITION = ORDERLY, DONTWAIT)
```

The following example requests a close of subfile 1 of port file FILEID. Since the <closedisposition option> is not specified, a CLOSEDISPOSITION ABORT operation is performed. Since the <control option> is not specified, WAIT is assumed, and control is not returned to the file until the close is complete.

The information specified in the <associateddata option> is sent to the correspondent program during the close process. The length need not be specified because a string expression is being used.

```
CLOSE (FILEID [SUBFILE 1], ASSOCIATEDDATA = STRNG)
```

The following example requests a close of subfile 1 of port file FILEID. During the close process, 14 characters of data are taken, beginning at the location pointed to by PTR, and are sent to the correspondent process as associated data.

```
CLOSE (FILEID [SUBFILE 1], ASSOCIATEDDATALENGTH = 14,
      ASSOCIATEDDATA = PTR)
```

## CONTINUE Statement

The CONTINUE statement causes control to pass from the program in which the statement appears to a coroutine.

<continue statement>

```
— CONTINUE —┌──────────────────────────────────────────────────────────────────────────────────┐
               │ ( —<task designator>— ) │
```

## Coroutines

A coroutine is a procedure that is initiated as a separate task by using a CALL statement. The caller is referred to as the primary coroutine and the called procedure as the secondary coroutine.

## Statements

---

Because the execution of `CONTINUE` statements causes control to alternate between primary and secondary coroutines, processing always continues at the point where it last terminated.

The secondary coroutine uses the `CONTINUE` statement form without the task designator to pass control back to its partner task, which is the primary coroutine by default. The task designator is used by the primary coroutine to pass control to the secondary coroutine associated with that task designator by the `CALL` statement. For more information, refer to “`CALL` Statement” earlier in this section.

### Examples of `CONTINUE` Statement

The following example passes control from this program, a secondary coroutine, to its partner task, which is, by default, the primary coroutine.

```
CONTINUE
```

The following example passes control to the coroutine associated with the task `TSK`.

```
CONTINUE(TSK)
```

### `DEALLOCATE` Statement

The `DEALLOCATE` statement causes the contents of the specified array row or procedure reference array row to be discarded and the memory area to be returned to the system.

*Note:* The `DEALLOCATE` statement cannot be used for task arrays.

**<deallocate statement>**

```
— DEALLOCATE — ( [ <array row> ] [ <procedure reference array row> ] )
```

### Deallocation with Arrays

When an array row or procedure reference array row is deallocated, it is made not present (all data is lost). When the array row or procedure reference array row is used again, it is made present, and each element is reinitialized to 0 (zero) if it is an array row and to the uninitialized state if it is a procedure reference array row.

Array rows of paged (segmented) arrays and event arrays cannot be deallocated by using the `DEALLOCATE` statement.

When a procedure reference array is imported from a library, it cannot be deallocated using the `DEALLOCATE` Statement. An attempt to deallocate an imported procedure reference array results in a compile-time or run-time error.

## Examples of DEALLOCATE Statement

The following example discards the contents of ARAY and returns the memory area to the system. Note that ARAY must be a one-dimensional array or a syntax error results.

```
DEALLOCATE (ARAY)
```

The following example discards the contents of the row MATRIXARY[INDX,\*] and returns the memory area to the system.

```
DEALLOCATE (MATRIXARY [INDX,*])
```

The following example discards the contents of the procedure reference array row PROCARRAY[1,\*] and returns the memory area to the system.

```
DEALLOCATE (PROCARRAY [1,*])
```

## DETACH Statement

The DETACH statement severs the association of an interrupt with an event.

<detach statement>

```
— DETACH —<interrupt identifier>—————|
```

## Detaching Interrupts

Any pending invocations of a detached interrupt are discarded. Detaching an interrupt that is not attached to an event is essentially a *no-operation*; no error occurs.

The enabled/disabled condition of an interrupt is not changed by a DETACH statement. When an interrupt is attached after it has been detached, the enabled/disabled condition of the interrupt is the same as it was before it was detached. For more information, see “ATTACH Statement,” “DISABLE Statement,” and “ENABLE Statement” in this section and “INTERRUPT Declaration” in Section 3, “Declarations.”

## Example of DETACH Statement

The following example severs the association between the interrupt THEPHONE and the event it is attached to.

```
DETACH THEPHONE
```

## DISABLE Statement

The `DISABLE` statement prevents interrupt code from being executed.

`<disable statement>`  
— `DISABLE` — `<interrupt identifier>` —

### Disabling Interrupts

A `DISABLE` statement that does not specify an interrupt identifier is referred to as a *general disable*. A general disable has the effect of disabling all the interrupts for the task. The interrupts whose associated events are caused are placed in an interrupt queue for the task.

If the `DISABLE` statement specifies an interrupt identifier, only that interrupt is disabled. The system queues these interrupts until the interrupt is enabled.

Interrupts are queued to ensure that none are lost during the time they are attached. Queuing continues until the appropriate `ENABLE` statement is executed.

Disabling or enabling an interrupt is not affected by whether or not the interrupt is attached to an event.

For more information, see “`ATTACH` Statement,” “`DETACH` Statement,” and “`ENABLE` Statement” in this section and “`INTERRUPT` Declaration” in Section 3, “Declarations.”

### Examples of `DISABLE` Statement

The following example is a general disable; it disables all interrupts.

```
DISABLE
```

The following example disables the interrupt named `THEPHONE`.

```
DISABLE THEPHONE
```

## DISPLAY Statement

The `DISPLAY` statement causes the specified message to be displayed on the Operator Display Terminal (ODT) and to be printed in the job summary of the program.

`<display statement>`  
— `DISPLAY` — ( `<pointer expression>` | `<string expression>` ) —

## Pointer and String Expressions

The message to be displayed is specified by the pointer expression or the string expression. If the parameter to the DISPLAY statement is a pointer expression, execution of the DISPLAY statement causes the characters to which the pointer expression points to be displayed on the ODT. The pointer expression must point to EBCDIC characters and the message to be displayed must be terminated by a null character (48"00").

If the parameter to the DISPLAY statement is a string expression, execution of the DISPLAY statement causes the contents of the string specified by the string expression to be displayed on the ODT. The string expression must be of type EBCDIC.

Display messages from programs run in CANDE appear on the user's terminal if the MESSAGES option of the CANDE SO command has been specified.

A maximum of 430 characters can be displayed.

## Examples of DISPLAY Statement

The following example displays the EBCDIC characters stored in array Q, from the beginning of the array to the EBCDIC null character (48"00).

```
DISPLAY(POINTER(Q,8))
```

The following example displays the string created by concatenating *VALUE IS* and the string STR.

```
DISPLAY("VALUE IS " CAT STR)
```

The following example displays the string stored in the string variable MESSAGESTRING.

```
DISPLAY(MESSAGESTRING)
```

## DO Statement

The DO statement causes a statement to be executed until a specified condition is met.

**<do statement>**

```
— DO —<statement>— UNTIL —<Boolean expression>—————|
```

## Evaluation of Boolean Expression

The statement following DO is executed. The Boolean expression is evaluated, and if it is FALSE, the statement is executed again and the Boolean expression is reevaluated. This sequence of operations continues until the value of the Boolean expression is TRUE. At that time, control passes to the statement following the DO statement.



## Statements

---

Note that both <block> and <compound statement> are statements and can be substituted for <statement>.

Figure 4-1 illustrates the DO-UNTIL loop.

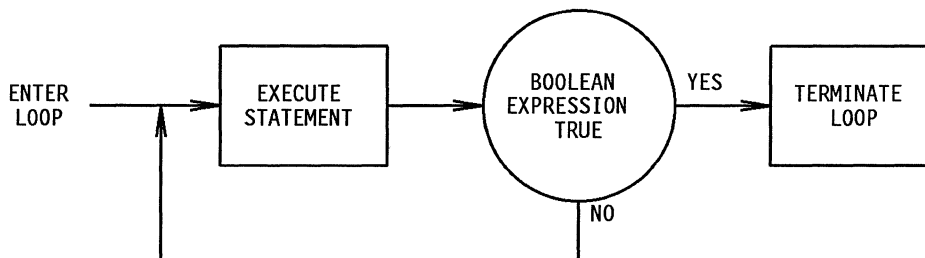


Figure 4-1. DO-UNTIL Loop

## Examples of DO Statement

```
DO
  BEGIN
    PTR := *-4;
    CTR := **4;
  END
UNTIL PTR IN LOOKEDFOR

DO
  J := J/2
UNTIL BUF[J] < JOB
```

## ENABLE Statement

The **ENABLE** statement allows interrupt code to be executed.

<enable statement>

```
— ENABLE [ <interrupt identifier> ]
```

## Enabling Interrupts

Previously disabled interrupts can be enabled with the **ENABLE** statement. If the event associated with the interrupt is caused after an interrupt has been enabled, then the interrupt code is executed.

An **ENABLE** statement that does not specify an interrupt identifier is referred to as a general enable and causes the system to look for, and place in execution, all interrupts that are in the interrupt queue of the task.

If the `ENABLE` statement specifies an interrupt identifier, only that interrupt is enabled. The system executes all occurrences of the interrupt in the interrupt queue.

Disabling or enabling an interrupt is not affected by whether or not the interrupt is attached to an event.

For more information, refer to “`ATTACH Statement`,” “`DETACH Statement`,” and “`DISABLE Statement`” earlier in this section and to “`INTERRUPT Declaration`” in Section 3, “`Declarations`.”

## Examples of `ENABLE` Statement

The following example is a general enable: it enables all previously disabled interrupts.

```
ENABLE
```

The following example enables the interrupt named `THEPHONE`.

```
ENABLE THEPHONE
```

## ERASE Statement

The `ERASE` statement removes all records from a file, leaving the attributes of the file unchanged where possible. The `LASTRECORD` attribute is set to `-1` and all data are lost. For more information on file attributes, see the *A Series File Attributes Programming Reference Manual*.

**<erase statement>**

```
— ERASE — ( —<file designator>— ) _____|
```

The `ERASE` statement can be used as a Boolean primary. When it is used in this way, it returns one of the following enumerated results if an error has occurred:

```
NOTCLOSERETAINED
VALIDONLYFORDISK
DUPLICATEDFILENOTALLOWED
NODISKHEADER
SECURITYERROR
NOTONLYUSEROFFILE
INTERCHANGEFILENOTALLOWED
IADFILENOTALLOWED
```

In using the `ERASE` statement, the following requirements must be met:

- The file specified in the `ERASE` statement must be a local file or a File Transfer, Access, and Management (FTAM) foreign file and the `KIND` attribute must be `disk` or `pack`. For more information on FTAM, see the *A Series I/O Subsystem Programming Guide*.
- The file must be closed with retention.

## Statements

---

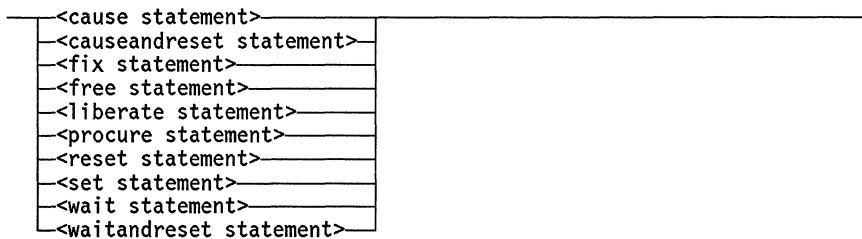
- The open count of the file must be 1.
- The PERMITTEDACTIONS attribute must permit the erase.
- The user must have access to the file.

The user process is discontinued if an error occurs when the ERASE statement is not used as a Boolean primary.

## EVENT Statement

Events have two Boolean characteristics, happened and available. Each characteristic can be in one of two states: TRUE or FALSE. These states can be changed using event statements.

**<event statement>**



The happened and available states of an event can be interrogated using the HAPPENED function and the AVAILABLE function. For more information, see “AVAILABLE Function” and “HAPPENED Function” in Section 5, “Expressions and Functions.”

## EXCHANGE Statement

The EXCHANGE statement is used to exchange rows between two disk files.

**<exchange statement>**

— EXCHANGE — ( —<file designator>— [ —<row/copy numbers>— ] —>  
→ , —<file designator>— [ —<row/copy numbers>— ] — ) —————|

**<row/copy numbers>**

—<row number>— [ , —<copy number>— ] —————|

**<row number>**

—<arithmetic expression>—————|

<copy number>

—<arithmetic expression>—————|

## Conditions for Execution of the EXCHANGE Statement

The two disk files must be closed when the EXCHANGE statement is executed, the two rows must be the same size, the specified row numbers and the specified copy numbers must be valid, and the two files cannot be code files of any kind.

Row numbers begin with zero and copy numbers begin with 1. If there are copies of the file and a copy number is specified, then only the rows of that copy are exchanged.

For the exchange to take place, the referenced files must be closed with retention. For more information, see “CLOSE Statement” earlier in this section.

If the system detects an error, the exchange is not performed and the program resumes execution with the next statement. After the program uses the EXCHANGE statement, the row addresses should be checked by using file attributes to ensure that the exchange was successfully completed.

## Examples of EXCHANGE Statement

The following example exchanges the contents of row ROW6 of FILE1 with the contents of row ROW0 of FILE2.

```
EXCHANGE(FILE1[ROW6],FILE2[ROW0])
```

The following example exchanges row I of MASTERFYLE with row J of REBUILTFYLE.

```
EXCHANGE(MASTERFYLE[I],REBUILTFYLE[J])
```

## FILL Statement

The FILL statement fills an array row with specified values. The FILL statement cannot be used with character arrays.

<fill statement>

— FILL —<array row>— WITH —<value list>—————|

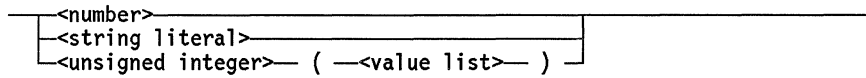
<value list>

—<initial value>—————|

## Statements

---

<initial value>



## Initialization

Each initial value initializes an integral number of words. The number of words initialized depends on the type of the array and the kind of initial value.

Single-precision numbers initialize one word in arrays other than double or complex arrays. In double arrays, this word is extended with a second word of 0 (zero). In complex arrays, this word is normalized and then extended with an imaginary part of 0 (zero).

Double-precision numbers are stored unchanged in two words in double arrays. In complex arrays, the value is rounded and normalized to single precision and then extended with an imaginary part of 0 (zero). For other types of arrays, the second word of the double-precision value is dropped and the first word initializes one word of the array.

String literals more than 48 bits long initialize as many words as are needed to contain the string and are left-justified with trailing zeros inserted in the last word, if necessary. In complex and double arrays, long string literals can initialize an odd number of words, causing the following initial value to start in the middle of a two-word element of the array.

String literals less than or equal to 48 bits long are right-justified within one word with leading zeros, if necessary. This word initializes one word in arrays other than double or complex arrays. In double arrays, this word is extended with a second word of 0 (zero). In complex arrays, this word is normalized and then extended with an imaginary part of 0 (zero).

An initial value of the form <unsigned integer> (<value list>) causes the values in the value list to be repeated the number of times specified by the unsigned integer.

If the value list contains more values than will fit in the array row, filling stops when the array row is full.

If the value list contains fewer values than the array row can hold, the remainder of the array row is left unchanged.

The length of the value list cannot exceed 4095 48-bit words.

## Examples of FILL Statement

The following example fills the first 250 words of the one-dimensional array MATRIX with zeros.

```
FILL MATRIX[*] WITH 250(0)
```

The following example fills the designated row of array GROUP with the value .25, the string ALGOL right-justified with leading zeroes, the character " right-justified with leading zeros, and with the string LONGER STRING, which fills two words and part of a third word. Trailing zeros fill the rest of the third word.

```
FILL GROUP[1,*] WITH .25, "ALGOL", "", "LONGER STRING"
```

## FIX Statement

The FIX statement examines the available state of an event. After the FIX statement executes, the available state of the designated event is always FALSE (not available).

<fix statement>

```
— FIX — ( —<event designator>— ) —————|
```

## FIX Statement as a Boolean Function

The FIX statement can be used as a Boolean function. If the available state of the specified event is TRUE (available), the event is procured, the state is set to FALSE (not available), and FALSE is returned as the value of the function. If the available state of the specified event is FALSE (not available), the FIX statement returns TRUE, and the available state is left unchanged.

The FIX statement is sometimes referred to as the conditional procure function.

When the FIX statement has finished execution, the available state of the event is FALSE (not available).

## Examples of FIX Statement

The following example examines the available state of the event EVNT.

```
FIX(EVNT)
```

The following example examines the available state of the event designated by EVENTARRAY[INDEX].

```
FIX(EVENTARRAY[INDEX])
```

The following example examines the available state of event FILELOCK and stores in GOTIT a value indicating this state.

```
IF GOTIT := FIX(FILELOCK) THEN...
```

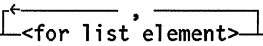
The following example examines the available state of the task's EXCEPTIONEVENT.

```
FIX(MYSELF.EXCEPTIONEVENT)
```

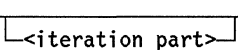
## FOR Statement

The FOR statement constructs a loop consisting of one or more statements that are executed a specified number of times.

**<for statement>**

— FOR —<variable>— := — —<for list element>— DO —<statement>—|




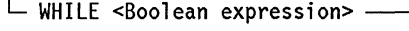
**<for list element>**

—<initial part>— —<iteration part>—|

**<initial part>**

—<arithmetic expression>—|

**<iteration part>**

— STEP <arithmetic expression> — UNTIL <arithmetic expression> —|  
— WHILE <Boolean expression> — UNTIL <arithmetic expression> —|

The number of times a FOR loop is traversed is determined by a variable, called the control variable, which is initialized when the FOR statement is first entered, and which can be updated during each iteration of the loop.

The action of a FOR statement can be described by isolating the following three distinct steps:

- Assignment of a value to the control variable
- Test of the limiting condition
- Execution of the statement following DO

Each type of <for list element> syntax specifies a different process. However, all of these processes have one property in common: the initial value assigned to the control variable is that of the arithmetic expression in the <initial part> construct.

The <for list element> construct establishes which values are assigned to the control variable and which test to make of the control variable to determine whether or not the statement following DO is executed. When a for-list element is exhausted, the next for-list element, if any, is evaluated, progressing from left to right. When all for-list elements have been used, the FOR statement is considered completed, and execution continues with the statement following the FOR statement. The statement following DO can transfer control outside the FOR statement, in which case some for-list elements might not have been exhausted before the FOR statement is exited.

## Forms of the FOR Statement

In the following discussion of the various forms of the FOR statement, the letter V stands for the control variable; AEXP1, AEXP2,... are arithmetic expressions; BEXP is a Boolean expression; and S1 is a statement.

### FOR-DO Loop

Assume that a for-list element consists of only an initial part, such as the following:

```
FOR V := AEXP1, AEXP2, ... DO
```

In this case that for-list element designates only one value to be assigned to the control variable. Because no limiting condition is present, no test is made. After assignment of the arithmetic expression to the control variable, the statement following DO is executed, and the for-list element is considered exhausted.

Figure 4-2 illustrates the FOR-DO loop.

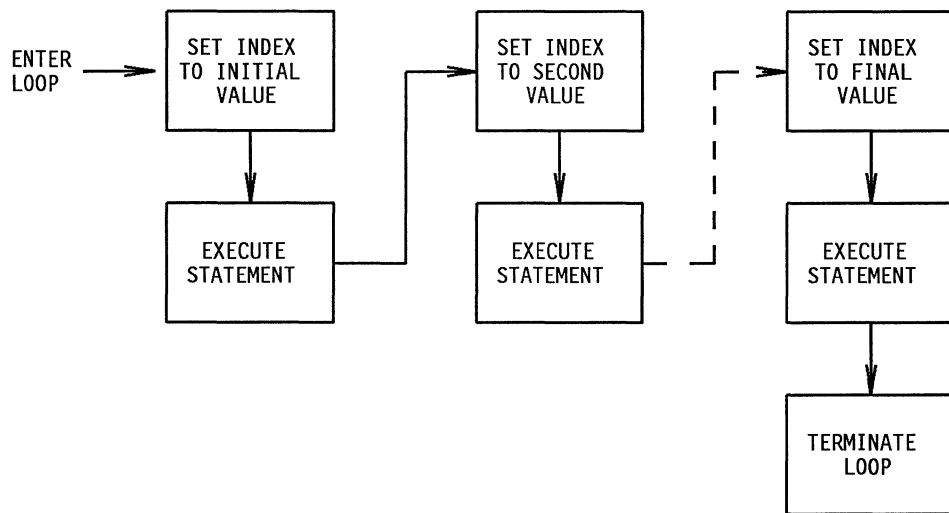


Figure 4-2. FOR-DO Loop

### FOR-STEP-UNTIL Loop

Assume a for-list element is of the form *<initial part> STEP <arithmetic expression> UNTIL <arithmetic expression>*, such as the following:

```
FOR V := AEXP1 STEP AEXP2 UNTIL AEXP3 DO
```

In this case, a new value is assigned to the control variable V before each execution of the statement following DO. First, the initial value, that of AEXP1, is assigned to the control variable. After each execution of the statement following DO, the assignment



$V := V + AEXP2$  is performed. Both  $AEXP2$  and  $AEXP3$  are reevaluated each time through the loop.

A test is made immediately after each assignment of a value to  $V$  to determine whether or not the value of  $V$  has passed the value of  $AEXP3$ . Whether  $AEXP3$  is an upper or a lower limit depends on the sign of  $AEXP2$ ;  $AEXP3$  is an upper limit if  $AEXP2$  is positive and a lower limit if  $AEXP2$  is negative. If  $AEXP3$  is an upper limit, then  $V$  has passed  $AEXP3$  when the expression  $V \leq AEXP3$  is no longer TRUE. If  $AEXP3$  is a lower limit, then  $V$  has passed  $AEXP3$  when the expression  $V \geq AEXP3$  is no longer TRUE. If  $V$  has not passed  $AEXP3$ , the statement following DO is executed; otherwise, the for-list element is exhausted. Figure 4-3 illustrates the FOR-STEP-UNTIL loop.

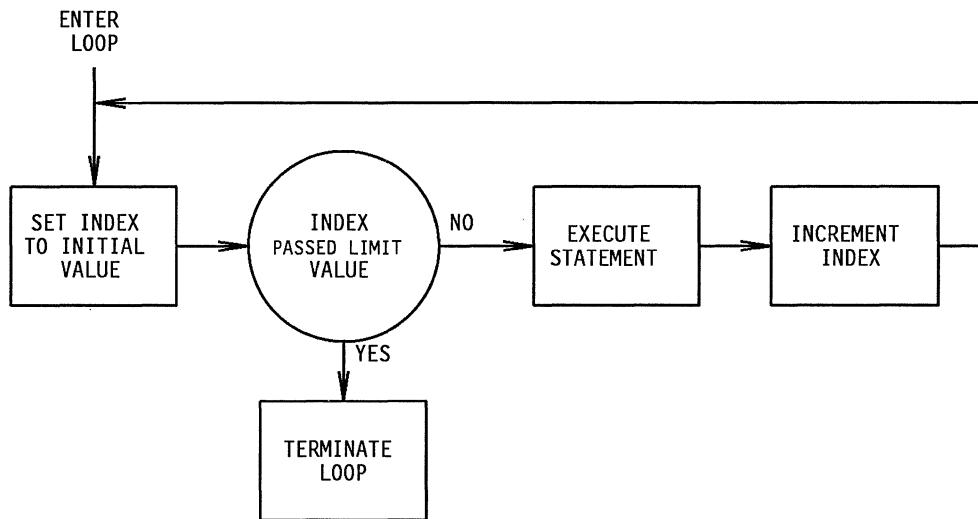


Figure 4-3. FOR-STEP-UNTIL Loop

### FOR-STEP-WHILE Loop

Assume a for-list element is of the form *<initial part> STEP <arithmetic expression> WHILE <Boolean expression>*, such as the following:

```
FOR V := AEXP1 STEP AEXP2 WHILE BEXP DO
```

In this case a new value is assigned to the control variable  $V$  before each execution of the statement following DO. First, the initial value, that of  $AEXP1$ , is assigned to the control variable. After each execution of the statement following DO, the assignment  $V := V + AEXP2$  is performed.  $AEXP2$  is reevaluated each time through the loop. After each assignment to  $V$ , the Boolean expression  $BEXP$  is evaluated and, if  $BEXP$  is TRUE, the statement following DO is executed. If  $BEXP$  is FALSE, this for-list element is exhausted. Figure 4-4 illustrates the FOR-STEP-WHILE loop.

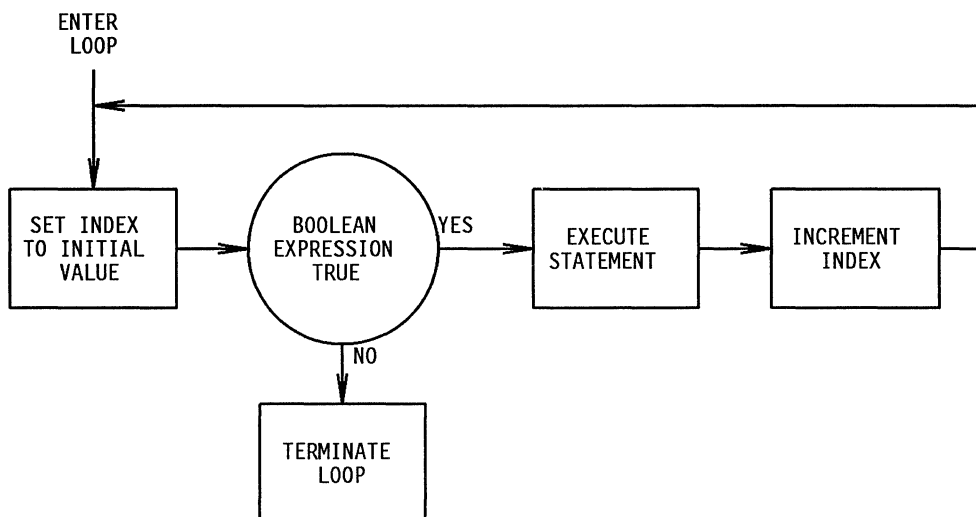


Figure 4-4. FOR-STEP-WHILE Loop

## FOR-WHILE Loop

Assume the for-list element is of the form *<initial part> WHILE <Boolean expression>*, such as the following:

```
FOR V := AEXP1 WHILE BEXP DO
```

In this case the control variable V is assigned the value of AEXP1 before each execution of the statement following DO. AEXP1 is reevaluated for each assignment to V. After each assignment to V, the Boolean expression BEXP is evaluated. If the value of BEXP is TRUE, the statement following DO is executed. If the value of BEXP is FALSE, this for-list element is exhausted. For example, in the following FOR statement if V had the value zero before execution of this statement, S1 would be executed five times:

```
FOR V := V + 1 WHILE V LEQ 5 DO
  S1;
```

Figure 4-5 illustrates the FOR-WHILE loop.

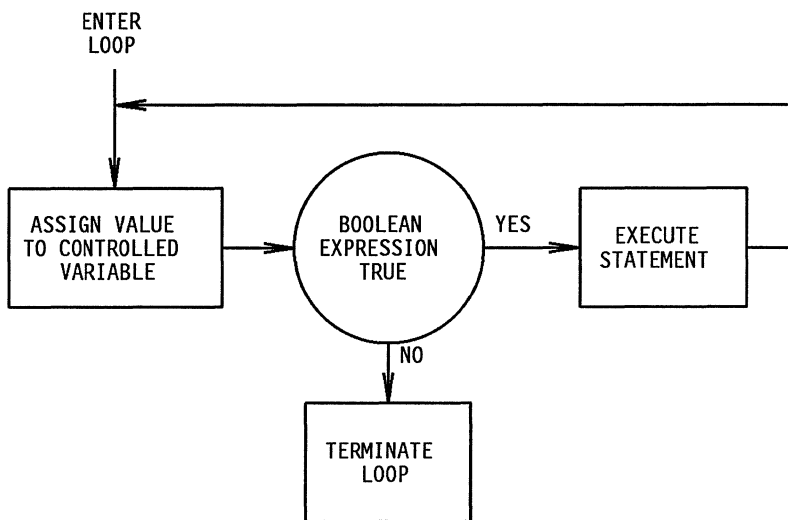


Figure 4-5. FOR-WHILE Loop

### Examples of FOR Statement

The following example executes the statement following DO just once, with I assigned zero.

```
FOR I := 0 DO
```

The following example assigns 1 to elements 0 through 255 of array LOOKEDFOR.

```
FOR J := 0 STEP 1 UNTIL 255 DO
  LOOKEDFOR[J] := 1
```

The following example assigns ITEM to elements 0, 1, 2, 5, 10, 15, 16, and 37 of array BUF.

```
FOR INDEX := 0, 1, 2, 10, 15, 37, 5, 16 DO
  BUF[INDEX] := ITEM
```

The following example calls FETCH repeatedly, passing the values 0, 1, 2, 3, 4, 5, 29, and the values of  $(47 + 3 * X)$  where  $X = 0, 1, 2$ , and so on, as long as  $(47 + 3 * X)$  is less than LIM.

```
FOR X := 0 STEP 1 UNTIL 5, 29, 47 STEP 3 UNTIL LIM DO
  FETCH(X)
```

The following example calls PANHANDLE and assigns to NEXT values equal to BEG, BEG + AMT, BEG + 2\*AMT, and so on, as long as DONE is FALSE.

```
FOR NEXT := BEG STEP AMT WHILE NOT DONE DO
  PANHANDLE
```

The following example increments TARGET by the value IX + 7 as long as TARGET is less than or equal to RANGE.

```
FOR N := IX + 7 WHILE TARGET LEQ RANGE DO
  TARGET := * + N
```

## FREE Statement

The FREE statement sets the available state of the specified event to TRUE (available).

<free statement>

```
— FREE — ( —<event designator>— ) —————|
```

## FREE Statement as a Boolean Function

The FREE statement can be used as a Boolean function that returns FALSE if the available state of the event is already TRUE (available) and TRUE if the available state of the event is FALSE (not available). In either case, the available state of the event is unconditionally set to TRUE (available).

The FREE statement does not activate any task attempting to procure the event, nor does it activate any task waiting on the event.

## Examples of FREE Statement

The following example sets the available state of the event EVNT to TRUE (available).

```
FREE (EVNT)
```

The following example sets the available state of the event designated by EVNTARAY[INDX] to TRUE (available).

```
FREE (EVNTARAY [INDX])
```

The following example assigns to WASPROCURED a value indicating the available state of the event FYLELOCK, and sets the available state of FYLELOCK to TRUE (available).

```
IF WASPROCURED := FREE (FYLELOCK) THEN ...
```

## FREEZE Statement

The FREEZE statement changes the running program into a library.

<freeze statement>

```

— FREEZE — ( [ PERMANENT _____ ] |
               [ TEMPORARY  _____ ] |
               [ CONTROL    _____ ] , —<procedure identifier> ) _____
    
```

For more information on <procedure identifier>, see “PROCEDURE Declaration” in Section 3, “Declarations.”

## FREEZE Statements in Library Procedures

At least one EXPORT declaration must appear in the same block as the FREEZE statement. The procedures affected by a FREEZE statement are the procedures that appear in EXPORT declarations in the same block as the FREEZE statement. After the FREEZE statement is executed, these procedures are library entry points.

The PERMANENT and TEMPORARY specifications of the FREEZE statement control the permanence of the library. A permanent library remains available until it is discontinued. A temporary library remains available as long as there are users of the library. A temporary library that is no longer in use unfreezes (thaws) and resumes running as a regular program. However, a temporary library does not unfreeze until it has been referenced at least once. When a library unfreezes, it cannot execute another FREEZE statement in an attempt to become a library again.

The CONTROL specification of the FREEZE statement controls the nature of the freeze. The program is set up as a permanent library, but after the freeze operation has been performed, control is transferred to the specified procedure, known as the control procedure. The procedure must be untyped and must have no parameters.

Once the control procedure is in control, the library can keep track of the number of its users through the task attribute LIBRARYUSERS.

The library can unfreeze itself by changing the task attribute STATUS to VALUE(GOINGAWAY). After this change, the library is equivalent to a thawing library. When the control procedure is exited, the library unfreezes if there are no users. If there are users, the library becomes an ordinary library, and a warning message is issued.

Because a library program initially runs as a regular program, the flow of execution can be such that the execution of a FREEZE statement is conditional and can occur anywhere in the outer block of the program.

If a calling program causes a library to be initiated and this library does not execute a FREEZE statement (if, for example, it was not a library program and thus had no FREEZE statement), then the attempted linkage to the library entry points cannot be made, and the calling program is discontinued. For more information on libraries, refer to Section 8, “Library Facility.”

## Examples of FREEZE Statement

The following example transfers control to procedure Z after the freeze operation is completed. Procedure Z is untyped and has no parameters. The task attribute STATUS is changed to VALUE(GOINGAWAY) so that the library can unfreeze itself. Once the control procedure is exited, if there are no users, the library unfreezes. If there are users, the library becomes an ordinary library, and a warning message is issued.

```

BEGIN
PROCEDURE X(A,B);
    . . .                               %Procedure to be exported
PROCEDURE Y(P,Q);
    . . .                               %Procedure to be exported
PROCEDURE Z;
BEGIN      %Control procedure - untyped and no parameters
    . . .
MYSELF.STATUS := VALUE(GOINGAWAY);
WHILE MYSELF.LIBRARYUSERS GTR 0 DO
WAITANDRESET (MYSELF.EXCEPTIONEVENT);
    . . .
END;
EXPORT X, Y;
    . . .
FREEZE(CONTROL,Z);
    . . .
END.

```

The following example transfers control to the procedure CTRL\_PROCEDURE after the freeze operation is completed.

```

FREEZE(CONTROL,CTRL_PROCEDURE)

```

## GO TO Statement

The GO TO statement transfers control to the statement in the program with the specified label.

**<go to statement>**

```

— GO ————><designational expression>—————|
    |   |
    |___|
    TO

```

The value of the designational expression specifies the label to which control is transferred.

Because labels must be declared in the innermost block in which they occur as statement labels, a GO TO statement cannot lead from outside a block to a point inside that block. Each block must be entered at the BEGIN so that the declarations associated with that block are invoked. For more information on labels, refer to “LABEL Declaration” in Section 3, “Declarations.”

### Bad GO TO

A bad GO TO occurs when a GO TO statement in an inner block transfers control to a label that is global to that block. A necessary side effect of a bad GO TO is that the block in which it occurs is exited abruptly and local variables are deallocated immediately.

A bad GO TO requires cutting back the lexical (lex) level to a more global block. To perform a bad GO TO, the operating system is invoked to cut back the stack and discard any locally declared items that occupy memory space outside of the stack, sometimes referred to as nonstack items, such as files, arrays, and interrupts.

### Examples of GO TO Statement

In the following example, control is transferred to the statement with the label LABEL1.

```
GO TO LABEL1
```

In the following example, control is transferred to the statement with the label LABEL2.

```
GO LABEL2
```

In the following example, control is transferred to the statement with the label designated by the subscripted switch label identifier SELECTIT[INDX].

```
GO TO SELECTIT[INDX]
```

In the following example, if K is equal to 1, control is transferred to the statement with the label designated by the subscripted switch label identifier SELECT[2]. Otherwise control is transferred to the statement with the label START.

```
GO TO IF K=1 THEN SELECT[2] ELSE START
```

### I/O Statement

An I/O statement causes information to be exchanged between a program and a peripheral device, and allows the programmer to perform certain control functions.

<I/O statement>

<accept statement>
<close statement>
<display statement>
<lock statement>
<open statement>
<read statement>
<rewind statement>
<seek statement>
<space statement>
<write statement>

ALGOL I/O is handled by a part of the operating system called the I/O subsystem. For more information on the I/O subsystem, refer to the *A Series I/O Subsystem Programming Guide*.

The ACCEPT statement and DISPLAY statement are unique in that the file to or from which data is transferred need not be specified. For more information, refer to “ACCEPT Statement” and “DISPLAY Statement” earlier in this section.

The remaining I/O statements reference a file that must be declared by the program. For more information, refer to “FILE Declaration” in Section 3, “Declarations.”

Two distinct methods of I/O are available. The first and typical method is referred to as normal I/O; the second method is called direct I/O. The major differences between normal I/O and direct I/O have to do with buffering, the overlap of program execution, and the overlap of I/O operations. Their effect on a particular I/O statement is presented in the description of the statement.

## Normal I/O

Normal I/O is indicated when direct files and direct arrays are not used. Normal I/O includes many automatic facilities provided by the operating system, such as the following:

- Buffering: the automatic overlap of program processing and I/O traffic to and from the peripheral units
- Blocking: more than one logical record per physical block
- Translation as needed between the character set of the unit and that required by the program

The amount of buffering between the I/O statements and program execution depends on the number of buffers allocated for the file. Refer to “FILE Declaration” in Section 3, “Declarations,” for information on how to specify the number of buffers.

In normal I/O, a READ statement causes the automatic testing of the availability of the needed record. The program is suspended in the READ statement until the record is actually available for use.

In normal I/O, a WRITE statement transfers the specified data to a buffer; the program is immediately released to begin execution of the next statement. If all the buffers are full when the WRITE statement is executed, the program is suspended until a buffer is available.

## Direct I/O

Direct I/O is indicated when direct files and direct arrays are used.

Direct I/O allows more direct control of the actual I/O operations. In certain situations, avoiding suspension of the program is desirable. In other situations, nonstandard



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I/O operations and masking of certain types of error conditions which could arise are desirable.

When direct I/O is used, the program is responsible for the buffering, blocking, and translation.

The syntax for a direct read or direct write operation employs the *< arithmetic expression >*, *< array row >* form of *< format and list part >*. An event designator is the only allowable form of action labels or finished event for direct I/O. The value of the arithmetic expression has the following meaning:

Field	Contains
[16:17]	Number of words to be transferred
[19:3]	Number of trailing characters to be transferred

The array row is called the I/O area of the user. A direct array identifier must be used for the *< array name >* part in the array row construct. Thus, the following statement could be used to perform a direct read of 10 words from file FID into direct array A using the event EVT as the finished event:

```
READ(FID, 10, A[*]) [EVT]
```

The operating system establishes a relationship between the I/O area and the finished event, if one is specified. Before any subsequent use of the I/O area can be made in the program, either for calculations or for further I/O, the direct I/O operation must be finished. The finished event can be inspected by one of the following methods:

- By using the HAPPENED function
- By obtaining the value of the STATE file attribute using the WAIT statement as a Boolean function and specifying a direct array row as a parameter
- By using the WAIT statement on the event to deactivate the process until the event is caused

Once the operation has been completed, the happened state of the event should be set to FALSE (not happened) before reusing it. Refer to “WAIT Statement” later in this section for more information.

The finished event can be associated with a direct array row that is declared in a different block. For example, a formal event can be associated with a local array. Such an association can cause compile-time or run-time up-level event errors if the block containing the finished event can be exited before the block that contains the direct array is exited.

In direct I/O, the I/O operations analogous to the SPACE and REWIND statements are performed as if they were read or write operations, except that the IOCW direct array attribute is specifically assigned the proper hardware instructions for the operation.

When performing direct I/O with the SPACE operation, the device’s spacing limitation overrides any user-specified spacing. In the case of a line printer, this limitation is two.

## IF Statement

The IF statement causes a statement to be executed or not executed based on the value of a Boolean expression.

<if statement>

```
—< if clause>—<statement>—┌ ELSE —<statement>—┐
```

<if clause>

```
— IF —<Boolean expression>— THEN —
```

## Forms of the IF Statement

Assume the IF statement you are using is of the following form:

```
IF BEXP THEN S1
```

If the value of the Boolean expression BEXP is TRUE, the statement S1 is executed. If BEXP is FALSE, then S1 is not executed. In either case, execution continues with the statement following the IF statement.

Assume the IF statement you are using is of the following form:

```
IF BEXP THEN S1 ELSE S2
```

If the value of BEXP is TRUE, the statement S1 is executed and the statement S2 is ignored. If the value of BEXP is FALSE, then the statement S2 is executed, and S1 is ignored. In either case, execution continues with the statement following the IF statement.

Note that both block statements and compound statements can be substituted for <statement> in the IF statement.

IF statements can be nested; that is, the statements following the reserved words THEN or ELSE (or both) can also be IF statements.

When IF statements are nested, the correct correspondence between the reserved words THEN and ELSE must be maintained. The compiler matches the innermost THEN to the first ELSE that follows it and that yields a syntactically correct IF statement. Consider the following IF statement:

```
IF BEXP1 THEN IF BEXP2 THEN S2 ELSE S1
```

The ELSE is paired with the innermost THEN, which is the THEN following BEXP2, as illustrated in the following:

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---

```
IF BEXP1 THEN
  IF BEXP2 THEN
    S2
  ELSE
    S1
```

If the program pairs the ELSE with the THEN following BEXP1, the inner IF statement must be made a compound statement by using BEGIN and END as follows:

```
IF BEXP1 THEN
  BEGIN
    IF BEXP2 THEN
      S2
    END
  ELSE
    S1
```

A GO TO statement can lead to a labeled statement within an IF statement. The subsequent action is equivalent to the action that would result if the IF statement were entered at the beginning and evaluation of the Boolean expression caused execution of the labeled statement.

## Examples of IF Statement

In the following example, if ALLDONE is TRUE, control is transferred to the statement with the label AWAY. If ALLDONE is FALSE, the statement following the IF statement is executed.

```
IF ALLDONE THEN
  GO AWAY
```

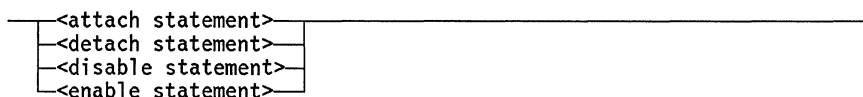
In the following example, if the value of X is greater than the value of LIMIT, procedure ERROR is called. If the value of X is less than or equal to the value of LIMIT, the value of X is incremented by 1. In either case, execution continues with the statement following the IF statement.

```
IF X > LIMIT THEN
  ERROR
ELSE
  X := * + 1
```

## INTERRUPT Statement

Interrupts provide a way to interrupt a process when a specific event occurs. Interrupt statements allow interrupts to be attached to and detached from events, and allow interrupts to be enabled and disabled.

**<interrupt statement>**



The ATTACH statement is used to associate an interrupt with an event.

The DETACH statement is used to sever the association between an interrupt and the event to which it is attached.

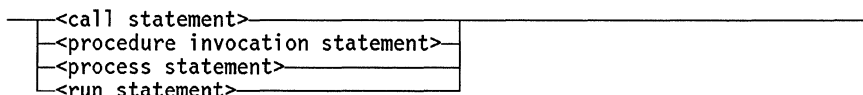
The ENABLE statement and DISABLE statement are used to explicitly enable and disable, respectively, an interrupt.

For more information on interrupts, refer to “INTERRUPT Declaration” in Section 3, “Declarations.”

## INVOCATION Statement

An INVOCATION statement causes a previously declared procedure to be executed as a subroutine, an asynchronous process, a coroutine, or an independent program.

**<invocation statement>**



The CALL statement invokes a procedure to execute as a coroutine. The PROCEDURE INVOCATION statement invokes a procedure to execute as a subroutine. The PROCESS statement invokes a procedure to run as an asynchronous process. The RUN statement invokes a procedure to run as an independent program.

With the exception of the PROCEDURE INVOCATION statement, a separate stack is initiated and the specified procedure cannot be a typed procedure.

With the exception of the RUN statement, parameters can be call-by-name or call-by-value. All parameters passed in the RUN statement must be call-by-value.

## LIBERATE Statement

The LIBERATE statement activates all tasks waiting on the specified event. It can also change the happened state of the event to TRUE (happened).

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---

<liberate statement>

— LIBERATE — ( —<event designator>— ) —————|

### Execution of Implicit CAUSE Statement

The LIBERATE statement causes the execution of an implicit CAUSE statement for the specified event. This implicit CAUSE statement can result in a change to the happened state of the event, if the waiting tasks have used the WAITANDRESET statement. For more information, refer to “CAUSE Statement” and “WAITANDRESET Statement” in this section. The available state of the event is set to TRUE (available).

Although all waiting tasks are activated, they are linked into the ready queue in priority order. At that point, all tasks that were waiting to procure the event are in the ready queue in priority order. For more information about procuring events, refer to “PROCURE Statement” later in this section.

### Examples of LIBERATE Statement

The following example causes the event ANEVENT and sets its available state to TRUE (available).

```
LIBERATE(ANEVENT)
```

The following example causes the event designated by EVENTARRAY[INDEX] and sets its available state to TRUE (available).

```
LIBERATE(EVENTARRAY[INDEX])
```

## LOCK Statement

The LOCK statement causes the specified file to be closed.

<lock statement>

— LOCK — ( —<file designator>—————|  
                  | , —<lock option>—| ) —————|

<lock option>

— CRUNCH —————|  
— \* —————|

### Lock Options

If the specified file is a tape file, it is rewound and the tape unit is made inaccessible to the system until the operator readies it again. If the file is a disk file, it is retained as a permanent file on disk. The file buffer areas are returned to the system.

A LOCK statement with a lock option performs the same action as a CLOSE statement that specifies CRUNCH. Whether CRUNCH or an asterisk (\*) appears as the lock option, the action of the LOCK statement is the same. The file must be a disk file. The unused portion of the last row of disk space, beyond the end-of-file indicator, is returned to the system. The disk file can no longer be expanded without being copied into a new file; however, data can be written to existing records.

## Examples of LOCK Statement

In the following example, if FILEA is a disk file it is retained as a permanent file.

```
LOCK(FILEA)
```

In the following example, the unused portion of the last row of disk file FYLE is returned to the system.

```
LOCK(FYLE,CRUNCH)
```

In the following example, the unused portion of the last row of disk file FYLE is returned to the system.

```
LOCK(FYLE,*)
```

## MERGE Statement

The MERGE statement causes data in the specified files to be combined and returned.

**<merge statement>**

```
— MERGE — ( —<output option>— , —<compare procedure>— , —————>
→<record length>— , —<merging option list>— ) —————|
```

**<merging option list>**

```
—<merging option>—, —<merging option>—, —<merging option>—, —<merging option>—, —<merging option>—, —<merging option>—, —<merging option>—, —<merging option>—|
```

**<merging option>**

```
—<input option>—|
```

## Merge Options

The compare procedure determines the manner in which the data is combined. The output option specifies how the data is to be returned from the merge operation.

The merging option list must contain between two and eight input options, inclusive, which must be files or Boolean procedures.



The result pointer is a call-by-value EBCDIC pointer that points to where the completed output message is to be stored. An EBCDIC null character (48"00") is placed after the last character of the message. The null character is not included in the returned message length.

The result length is an integer or real variable that is assigned the length of the returned output message, not counting the null character that is appended at the end.

## Finding a Requested Message

Each parameter element contains the actual value of a parameter that was specified in the declaration of the requested output message. The first parameter element refers to parameter <1>, the second to parameter <2>, and so on.

The following method is used to find the requested message so that it can be completed.

First, an initial language in which to search for the message must be selected. If a language specification is given as a parameter to the MESSAGESEARCHER statement, that language is selected; otherwise, the language in the language specification of the task requesting the message is used. If the task does not have a language specification, the system default language is used.

If the requested message cannot be found in the initial language and the initial language is not the system default language, the message is searched for in the system default language. If the message still cannot be found, then the message is searched for in the languages that exist in the specified output message array, beginning with the first language, the second language, and so on. If none of the languages in the output message array contains the message, an error message that specifies the message number is produced in place of the message.

## MESSAGESEARCHER Statement as an Arithmetic Function

The MESSAGESEARCHER statement can be used as an arithmetic function that returns an integer result indicating whether or not the message was successfully found and formatted. The possible values for this result are as follows:

Value	Meaning
1	The message is not in the requested language; it is in MYSELF.LANGUAGE or SYSTEMLANGUAGE.
0	The message was found and formatted as requested.
-1	Too few parameters were specified.
-2	No matching <output message case part> was found.
-3	The message is in the first available language.
-4	The array row referenced by the result pointer is too small.
-5	The message was not found.
-6	The version of the output message array is incompatible with th version of the operating system.

*continued*



## Statements

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*continued*

Value	Meaning
-7	The output message array is in error.
-8	A fault occurred while obtaining the output message.
-9	The length passed with a parameter is too long.
-11	The result pointer has a type that is not valid for the MESSAGESEARCHER statement.

### Example of MESSAGESEARCHER Statement

In the following example, the value of RTN, the returned integer, notes whether or not the message was successfully found and formatted. ERRORS is the output message array identifier. The language specification is ENGLISH. POSINTX is the arithmetic expression. MSG is the result pointer and MSG\_LEN is the result length.

```
RTN := MESSAGESEARCHER (ERRORS ["ENGLISH", POSINTX], MSG, MSG_LEN);
```

### MLSACCEPT Statement

The MLSACCEPT statement either displays or prints a message and causes the program to wait for input, or it returns a Boolean value indicating whether or not a message is waiting for the program.

<MLSaccept statement>

```
— MLSACCEPT — ( —<output message array identifier>— [ —————→  
→ —————→ <arithmetic expression>— ] — , —→  
→ —————→ <language specification>— , —————→  
→ —————→ <pointer expression>— , —————→ <arithmetic variable>— , —————→  
→ —————→ <string variable>—  
→ —————→ <subscripted string variable>—  
→ —————→ <integer variable>— ) —————→  
→ —————→ <real variable>— , —————→ <parameter element>—
```

### MLSACCEPT Used for Data Input

When the MLSACCEPT statement is used for data input, it displays a message and causes the program to wait for input. The message that is displayed is in the output message array defined by the output message array identifier.

The input text can be entered at an Operator Display Terminal (ODT) or at a user terminal. If the input text is entered from a user terminal, the user must use the mix number of the task and be logged on to the usercode that originated the job.

The input text is placed in the specified pointer expression, string variable, or subscripted string variable. It is placed left-justified with leading blanks discarded.

The integer or real variable returns the length, in characters, of the input text. No translation is performed on the input text. The program continues execution with the statement following the `MLSACCEPT` statement.

## MLSACCEPT Used as a Boolean Function

The `MLSACCEPT` statement can be used as a Boolean function to determine whether or not a message was entered before the `MLSACCEPT` statement was executed. If a message was entered, the result returned by the `MLSACCEPT` statement is `TRUE` and the message is placed in the pointer expression, string variable, or subscripted string variable. If no message was entered, the result is `FALSE`. In either case, the program does not wait for input.

## Additional MLSACCEPT Options

The language specification defines the language to be used for messages that are displayed or printed.

The arithmetic expression indicates the output message number of the message to be displayed or printed. It cannot be a double-precision value.

The arithmetic variable is an integer or real variable that is assigned the length of the returned response.

Each parameter element contains the actual value of a parameter that was specified in the declaration of the requested output message. The first parameter element refers to parameter 1, the second to parameter 2, and so on.

No more than 430 characters can be displayed or printed. A maximum of 960 characters can be accepted as input. The input response can be entered before the `MLSACCEPT` statement is executed.

For additional information on output messages, refer to “`MESSAGESEARCHER Statement`” earlier in this section.

## Example of MLSACCEPT Statement

In the following example, the message number `POSINDEX` from output message array `ERRORS` is displayed in the `ENGLISH` language. The program waits to accept an input which, when received, is placed in `INPT` for length specified by `INPT_LEN`.

```
MLSACCEPT (ERRORS ["ENGLISH", POSINDEX] INPT, INPT_LEN);
```





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If the input message does not exist in the task language, the system language is used as the input language. If the input message is still not found, an error is returned. The input language must not have a trailing period.

The output language indicates the language into which the message is to be translated. The output language must not have a trailing period.

The input message contains the text to be translated. For the translation to be successful, the input message must be the same as the message contained in the output message array, including blanks. However, the translation is not case-sensitive.

The result message number is an integer or real variable that is assigned the message array index corresponding to the message looked up. This value can be used to acquire text in the language understood by the program through a MESSAGESEARCHER call.

The result message can be either a pointer/length pair of variables or a string variable, providing flexibility for the destination of the translated message.

The result pointer is a call-by-value EBCDIC pointer that points to where the translated message is to be stored. An EBCDIC null character (48"00") is placed after the last character of the message. The null character is not included in the returned message length.

The result length is an integer or real variable that is assigned the length of the returned output message, not counting the null character that is placed at the end.

## MLSTRANSLATE as an Arithmetic Function

The MLSTRANSLATE statement can be used as an arithmetic function that returns an integer result indicating whether or not the message was successfully found in both the input and output languages. The possible values for this result are as follows:

Value	Meaning
1	The message is not in the requested language. It is in MYSELF.LANGUAGE or SYSTEMLANGUAGE.
0	The message was found and returned as requested.
-1	The message was not found in the <input language>.
-2	The message was not found in the <output language>.
-3	The requested <output language> does not exist for this output message array.
-4	The array row referenced by the <result pointer> is too small.
-5	The message was not found in any language tried.
-6	The version of the output message array is incompatible with the version of the operating system.
-7	The output message array is corrupted: cannot obtain output message number <num>.
-8	A fault occurred while obtaining the output message.

*continued*

*continued*

Value	Meaning
-9	The length passed with a parameter is too long.
-11	The <result pointer> has a type that is not valid for the MLSTRANS�ATE statement.
-12	The version of the output message array cannot be used for message translation.
-13	The ccsversion of the input or output language messages is invalid.

## MULTIPLE ATTRIBUTE ASSIGNMENT Statement

The multiple attribute assignment statement is used to assign values at run time to one or more attributes of a specified file.

<multiple attribute assignment statement>

—<file identifier>— ( —<attribute specifications>— ) —————|

### Assignment of Values

If the name of a Boolean file attribute in the attribute specifications is not followed by an equal sign (=) and a value, it is assigned a value of TRUE; that is, the following attribute specifications have the same effect as each other:

```
DEPENDENTSPECS ,KIND = DISK
```

```
DEPENDENTSPECS = TRUE ,KIND = DISK
```

An assignment specified in a MULTIPLE ATTRIBUTE ASSIGNMENT statement occurs at run time and overrides any assignment made to the attribute in a FILE declaration or through file equation.

One intrinsic call is generated to assign all attributes, except when a pointer-valued file attribute name is assigned a pointer expression. In this case, the compiler generates a separate intrinsic call for the pointer-valued attribute assignment.

### Examples of MULTIPLE ATTRIBUTE ASSIGNMENT Statement

In the following example, at run time the BUFFERS attribute of file AFILE is assigned the value 3, the INTMODE attribute is assigned EBCDIC, and the KIND attribute is set to DISK.

```
AFILE(BUFFERS = 3,INTMODE = EBCDIC,KIND = DISK)
```

In the following example, at run time the TITLE attribute of file LINE is assigned the value pointed to by pointer P, and the INTNAME attribute is assigned the value pointed to by pointer Q.

## Statements

---

LINE(TITLE = P,INTNAME = Q)

## ON Statement

The ON statement is used to enable or disable an interrupt for one or more fault conditions.

<on statement>

┌<enabling on statement>┐  
└<disabling on statement>┘

## Enabling ON Statements

<enabling on statement>

— ON —<fault list> ┌<fault information part>┐ ┌ : ┐  
→<fault action>┐

The two forms of enabling ON statements are the implicit call and the implicit branch. The implicit call form causes the fault termination of the block in which it appears. The implicit branch form permits the block in which it appears to continue to run.

Once an interrupt is enabled, it remains enabled until one of the following conditions occurs:

- The procedure or block that contains the ON statement is exited.
- The interrupt is explicitly disabled.
- A new interrupt is enabled for the same fault condition.

Whenever the block that contains an ON statement is exited, the interrupt status (enabled or disabled) for that fault condition reverts to the status it had just before the block was entered.

No call on the block exit intrinsic is required to deactivate the armed faults for a block.

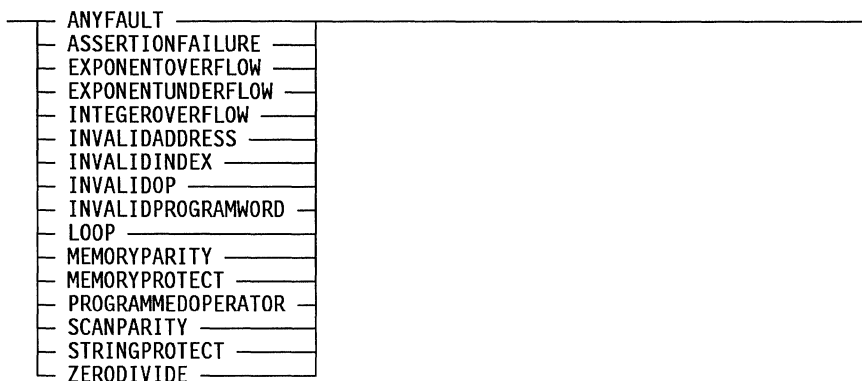
Each execution of an ON statement adds one stack cell to the block in which it is used.

## Fault List

<fault list>

┌<fault name>┐  
└ OR ┘

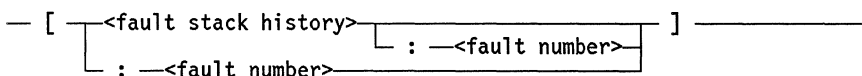
<fault name>



The fault list allows several fault interrupts to be enabled (armed) or disabled (disarmed) at the same time. When it is used to enable several interrupts, they all use the same fault action if any of the faults occur. The occurrence of any one of the faults in the fault list is sufficient to cause transfer of control to the fault action. The fault name ANYFAULT is used to enable or disable all faults.

### Fault Information Part

<fault information part>



The fault information part provides access to the stack history at the time of the occurrence of the fault and to the number corresponding to the fault kind. The fault number is assigned one of the following values when the corresponding fault occurs:

Value	Fault
1	ZERODIVIDE
2	EXPONENTOVERFLOW
3	EXPONENTUNDERFLOW
4	INVALIDINDEX
5	INTEGEROVERFLOW
7	MEMORYPROTECT
8	INVALIDOP
9	LOOP
10	MEMORYPARITY
11	SCANPARITY
12	INVALIDADDRESS
14	STRINGPROTECT
15	PROGRAMMEDOPERATOR
16	ASSERTIONFAILURE

*continued*



## Statements

---

*continued*

Value	Fault
18	INVALIDPROGRAMWORD

## Fault Stack History

<fault stack history>



<fault number>



If the fault stack history option is used, a string of EBCDIC characters representing the stack history is stored into the array row or the array specified by the pointer expression. The stack history information is always stored as EBCDIC characters regardless of the character type of the array row or pointer expression.

The format of the stack history is either of the following:

SSS:AAAA:Y,;SSS:AAAA:Y,;...;SSS:AAAA:Y.

SSS:AAAA:Y;(DDDDDDDD),;...;SSS:AAAA:Y;(DDDDDDDD).

In these formats, the following applies:

EBCDIC Characters	Meaning
SSS	A code segment number
AAAA	A code word address
Y	A code syllable number
1	A blank space
DDDDDDDD	A sequence number (present only if the compiler control option LINEINFO was TRUE during program compilation)

One of these entries is generated for each activation record in the stack when the fault is encountered. Each entry is followed by a comma (,), and the last complete entry is terminated by a period (.). If the user-specified array is sufficiently long, the entire stack history is stored. If it is not long enough, then only a portion of the stack history is stored, with the last complete entry in the array terminated by a period. The code segment number field, SSS, is expanded to four characters, SSSS, for segment numbers greater than 4095; that is, for segment numbers whose hexadecimal representation requires four characters.

The array row or pointer expression that makes up the fault stack history and the variable that makes up the fault number are evaluated once when the ON statement is

executed, and not at the time the fault occurs. Thus, in the following ON statement, array row A[I,\*] is determined by the value of I at the execution of the ON statement and not when a ZERODIVIDE fault actually occurs. This determination is also true for the variables B[J] and J.

```
ON ZERODIVIDE[A[I,*]:B[J]]: GO TO ERROR_HANDLING
```

## Fault Action

<fault action>

—<statement>—————|

The form of the ON statement that includes a comma, instead of a colon (:), before the fault action is the implicit call form. With this form of ON statement, when a specified fault occurs, the program calls the fault action statement as a procedure. If the fault action statement does a bad GO TO, the fault condition is discarded and the program continues running.

When a bad GO TO branches to a label outside the block in which the fault occurred, the block is terminated. When it branches out of the fault action statement into the block in which the fault occurred, the block continues to run.

If the fault action statement exits without doing a bad GO TO, the fault condition for which the fault action statement was called still exists. If an ON statement is enabled for that condition in a more global block, then control is passed to that ON statement; otherwise, the program is discontinued as a result of that fault.

A GO TO statement cannot be executed from outside the fault action statement to a label inside the fault action statement. Undefined results occur when a GO TO statement specifies a label passed as a parameter (a formal label).

The form of the ON statement that includes a colon, instead of a comma, before the fault action is the implicit branch form of the ON statement. With this form of ON statement, the program branches to the statement given as the fault action when a specified fault occurs. The fault condition is discarded, as though it had never happened, and the program continues execution at the first statement of the fault action. When there is no branch out of the fault action statement, the program flow continues with the next statement following it. When the ON statement is in the block in which the fault occurred, it permits that block to continue to run.

## Disabling ON Statement

<disabling on statement>

— ON —<fault list>—————|

The disabling ON statement disables or disarms the interrupts corresponding to the fault names in the fault list. This has the same effect as if none of those interrupts had been enabled in the block in which it appears. It has no effect, however, on any

## Statements

---

interrupts that were enabled by ON statements in more global blocks, once this block is exited.

*Note: Excessive arming and disarming of faults within a single activation of the block can cause the stack limit of the program to be exceeded and the program to be terminated.*

### Examples of ON Statement

In the following example, if either a divide-by-zero fault or an invalid index fault occurs at run time, the fault condition is discarded and control transfers to the compound statement in this ON statement. The stack history information is written to the array row FAULTARRAY, and the fault number of the fault that occurred is stored in FAULTNO.

```
ON ZERODIVIDE OR INVALIDINDEX [FAULTARRAY:FAULTNO]:
  BEGIN
    REPLACE FAULTARRAY[8] BY FAULTNO FOR * DIGITS;
    WRITE(LINE, 22, FAULTARRAY);
    REPLACE FAULTARRAY BY " " FOR 22 WORDS;
    CASE FAULTNO OF
      BEGIN
        1: DIVISOR := 1;
        4: INDEX := 100;
      END;
    GO BACK;
  END
```

In the following example, if either of the specified faults occurs at run time, the fault condition is discarded and control is transferred to the assignment statement in the ON statement. After execution of the assignment statement, execution continues with the statement following the ON statement.

```
ON MEMORYPROTECT OR LOOP: Q := 2
```

The following example disables the interrupt associated with the exponent underflow fault.

```
ON EXPONENTUNDERFLOW % Disabling ON Statement
```

In the following example, if any fault occurs, the statement HANDLEFAULTS(Z) is called as a procedure. The stack history information is written to the location indicated by the pointer expression *POINTR* + 2, and the fault number of the fault that occurred is stored in Z.

```
ON ANYFAULT [POINTR + 2:Z], HANDLEFAULTS(Z)
```

## OPEN Statement

The OPEN statement causes the referenced file or subfile to be opened.

**<open statement>**

```
— OPEN — ( —<open file part> —<open options> — ) —
```

**<open file part>**

```
—<file designator> — [ — SUBFILE —<subfile index>— ] —
—<task designator>— . —<file-valued task attribute name>—
```

The OPEN statement can be used as an arithmetic function. For information on the values returned, see the *A Series File Attributes Programming Reference Manual*.

The subfile index specifies the subfile to be opened. For more information on the subfile index, see “CLOSE Statement” earlier in this section. For more information on the file designator, see “SWITCH FILE Declaration” in Section 3, “Declarations.” For more information on the task designator, see “TASK and TASK ARRAY Declarations” in Section 3, “Declarations.”

## OPEN Options

**<open options>**

```
— , —<open control option> — , —<associateddata option> —
— , —<connecttimelimit option> —
```

**<open control option>**

```
— ATEND —
— AVAILABLE —
— AVAILATEND —
— DONTWAIT —
— OFFER —
— WAIT —
```

If no open control option is specified, the WAIT option is assumed. Any control option can be used with any type of file. However, DONTWAIT and OFFER are meaningful only for port files. For other kinds of files, DONTWAIT and OFFER are ignored and an OPEN with WAIT is performed. With the open control options, the default for the position parameter is ATFRONT. For the control options WAIT and AVAILABLE, the position parameter can be set to ATEND by using the ATEND option for WAIT and the AVAILATEND option for AVAILABLE.

The ASSOCIATEDDATA option and CONNECTTIMELIMIT option are meaningful only for port files. The ASSOCIATEDDATA option can be used to send associated data with the OPEN request. If a string expression is specified, the length is automatically

calculated and used as the ASSOCIATEDDATALENGTH value. Otherwise, the ASSOCIATEDDATALENGTH option specifies the number of characters to be sent. If the ASSOCIATEDDATA value is of type HEX, the ASSOCIATEDDATALENGTH option indicates the number of HEX characters, otherwise the number of EBCDIC characters. If the ASSOCIATEDDATALENGTH value is not a single-precision integer, it is integerized. The ASSOCIATEDDATA option is valid only for certain port file services. For more information on the ASSOCIATEDDATA option and CONNECTTIMELIMIT option, see "CLOSE Statement" earlier in this section.

The CONNECTTIMELIMIT option can be used to specify the maximum amount of time (in minutes) that the system will allow for a successful OPEN operation on the subfile. The default value for this option is to wait indefinitely. If the value specified is negative, an error result is returned. A value of zero indicates that no time limit is placed on the wait. If the value is not a single-precision integer, it is integerized.

### Examples of OPEN Statement

The following example opens file FILEID. Execution of the program is suspended until FILEID is open.

```
OPEN(FILEID)
```

The following example opens subfile I of port file FILEID and offers it for matching. Control is returned to the program when it is determined whether the host can be reached.

```
OPEN(FILEID[SUBFILE I],OFFER)
```

The following example opens subfile I of port file FILEID and a dialog request is sent. The program is suspended until dialog establishment is complete.

```
OPEN(FILEID[SUBFILE I],WAIT)
```

The following example opens subfile I of port file FILEID. The AVAILABLE control option is a nonpreferred way of verifying OPEN WAIT with AVAILABLEONLY = TRUE. When AVAILABLEONLY = TRUE, the OPEN attempt fails if the correspondent endpoint cannot be reached immediately. If dialog can currently be established, the subfile is opened, the result returned by the OPEN statement is 1, and PROCESSOPEN is called; otherwise, an error result is returned and PROCESSOPEN is not called.

```
IF OPEN(FILEID[SUBFILE I],AVAILABLE) = 1 THEN PROCESSOPEN
```

The following example opens subfile 1 of port file FILEID. The program is suspended until a dialog is established or until T minutes have elapsed.

```
OPEN (FILEID [SUBFILE 1], WAIT, CONNECTTIMELIMIT = T)
```

The following example opens subfile 1 of port file FILEID. When the dialog request is sent, the information "MYDATA" is sent to the correspondent process as associated data.

```
OPEN (FILEID [SUBFILE 1], ASSOCIATEDDATA = "MYDATA")
```

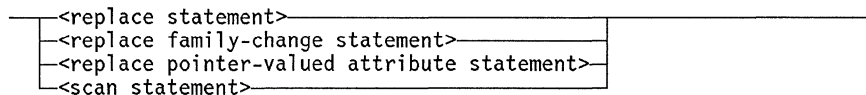
The following example opens subfile I of port file FILEID. Control returns to the program as soon as the open process has begun, because the DONTWAIT option is included. When a matching subfile is found, 14 characters of information are taken, beginning at the location pointed to by PTR; the 14 characters are sent to the correspondent process as associated data.

```
OPEN (FILEID [SUBFILE I], DONTWAIT, ASSOCIATEDDATALENGTH = 14,
      ASSOCIATEDDATA = PTR)
```

## POINTER Statement

Pointer statements are used to examine, transfer, and edit character data stored in arrays.

<pointer statement>



## POINTER Statement Options

The REPLACE statement can be used to move character data into an array row. Within a single REPLACE statement, the character data to be moved can be taken from several sources. Each of these sources can be one of several different types. A source can be another array row, a string literal, the value of an arithmetic expression, the value of a string expression, or the value of a pointer-valued attribute. Furthermore, as the character data is moved from a source to the destination, the characters can be translated or edited. Also, an arithmetic expression source can be treated as a binary value and converted into the equivalent decimal number expressed as a string of numeric characters.

The REPLACE FAMILY-CHANGE statement is the language construct provided to add datacomm stations to or remove datacomm stations from a family of stations.

The REPLACE POINTER-VALUED ATTRIBUTE statement is the language construct provided to assign character data to pointer-valued file and task attributes.

The SCAN statement can be used to examine character data located in an array row.

POINTER statements process character data from left to right.

## Temporary Storage

Many of the operations performed by POINTER statements require the use of temporary storage for intermediate results. In describing the actions of a POINTER statement, a discussion of how this temporary storage is initialized, changed, and

## Statements

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disposed of is necessary. These discussions use the following names for these temporary storage locations:

- Stack-source-pointer
- Stack-destination-pointer
- Stack-auxiliary-pointer
- Stack-integer-counter
- Stack-test-character
- Stack-source-operand

The prefix, `stack`, denotes that none of these parameters correspond to any program variables. They exist only until execution of the `POINTER` statement is completed.

The `stack-source-pointer`, the `stack-destination-pointer`, and the `stack-auxiliary-pointer` have the same internal structure as a pointer variable that can be declared in a program. These temporary storage locations are initialized either from pointer expressions in the pointer statement or from previous corresponding temporary storage locations.

### Stack-Source-Pointer

The initial value of the `stack-source-pointer` points to the first source character to be used by the associated operation. As the execution of the instruction progresses, the `stack-source-pointer` is modified to point to each successive source character. When the operation is complete, the `stack-source-pointer` points to the first unprocessed character in the source data (the process is determined by the particular form of the `POINTER` statement). This final value can be stored into a pointer variable, or it can be discarded.

### Stack-Destination-Pointer

The initial value of the `stack-destination-pointer` points to the first destination character position to be used by the associated operation. As the execution of the operation progresses, the `stack-destination-pointer` is modified to point to each successive destination character position. When the operation is complete, the `stack-destination-pointer` points to the first unfilled character position in the destination. If more than one source is to be processed, the `stack-destination-pointer` value corresponding to the completed processing of one element in the source list is used as the initial value for the subsequent source. If no more sources are to be processed, this final value can be stored into a pointer variable, or it can be discarded.

### Stack-Auxiliary-Pointer

The initial value of the `stack-auxiliary-pointer` points to the first entry in a table of data to be used by the operation in its execution. This table can be a translate table if the operation to be performed is extracting characters from the source data, translating the characters to different characters (possibly containing a different number of bits per character), and storing the translated characters in the destination. This table can be a truth set describing a particular set of characters if the operation to be performed

requires a membership test. Finally, this table can be a picture: a table that contains instructions of a special type describing how the source data is to be edited before being stored in the destination.

### Stack-Integer-Counter

The stack-integer-counter, when required by a POINTER statement, is initialized by an arithmetic expression supplied in the POINTER statement. The value of this arithmetic expression is integerized before it is used. The stack-integer-counter has different meanings depending on the type of POINTER statement involved. In some cases, the number of characters in a source string to be processed is dictated solely by this parameter. The number of numeric characters to be placed in the destination while converting the value of an arithmetic expression to character form is also dictated by the stack-integer-counter.

In some forms of the POINTER statement, two controlling factors exist that dictate how many characters are to be processed from a source string. One factor depends on the source data and is called a condition. The other factor is a maximum count contained in the stack-integer-counter and is provided by an arithmetic expression in the POINTER statement. For example, with such a POINTER statement, the following instructions could be written: *Translate characters from the source string to the destination until either 14 characters have been transferred or a period is encountered in the source string, whichever comes first.* The final value of the stack-integer-counter is available for storage, or it is discarded.

### Stack-Test-Character

The stack-test-character is initialized by an arithmetic expression usually, but not necessarily, of the form of a single-character string, such as B. Although the stack-test-character parameter is one entire word of memory that contains the single-precision value of the arithmetic expression, only the rightmost character position of the word is used. When a condition employing a relational operator is used in a POINTER statement, the stack-test-character must contain the character against which the individual characters in the source string are to be compared.

### Stack-Source-Operand

The stack-source-operand is used when the source data is given by the value of an arithmetic expression rather than a value located in an array row into which the stack-source-pointer points. The stack-source-operand is initialized by the arithmetic expression.

## PROCEDURE INVOCATION Statement

A procedure invocation statement causes a previously declared procedure to be executed as a subroutine.



## Statements

---

**<procedure invocation statement>**

—<procedure identifier> —┌──┐  
                                  └─<actual parameter part>─┘

**<actual parameter part>**

— ( ┌──┐ ) ───────────────────────────────────┘  
     └─<actual parameter>─┘  
          └─<parameter delimiter>─┘

When a procedure is invoked, program control is transferred from the point of the PROCEDURE INVOCATION statement to the referenced procedure. When the procedure is completed, program control is transferred back to the statement following the PROCEDURE INVOCATION statement, unless a bad GO TO is executed in the referenced procedure. Bad GO TO statements are described in “GO TO Statement” earlier in this section.

A typed procedure returns a value. However, when a typed procedure is used in a PROCEDURE INVOCATION statement, this value is discarded.

## Calling Procedures with Parameters

**<actual parameter>**

<expression>
<array designator>
<string array designator>
<direct file identifier>
<direct switch file identifier>
<event designator>
<event array designator>
<file designator>
<switch file identifier>
<format designator>
<switch format identifier>
<label identifier>
<switch label identifier>
<list designator>
<switch list identifier>
<picture identifier>
<procedure identifier>
<procedure reference array designator>
<procedure reference array element>
<task designator>
<task array designator>

The actual parameter part of a procedure invocation statement must have the same number of entries as the formal parameter list in the declaration of the procedure. Correspondence between the actual parameters and formal parameters is obtained by matching the parameters that occur in the same relative position in the two lists. Corresponding formal and actual parameters must be of compatible types. Parameters can be call-by-name or call-by-value.

For more information on procedures and formal parameters, refer to “PROCEDURE Declaration” in Section 3, “Declarations.”

If a formal parameter is a call-by-name `INTEGER` or `REAL` simple variable, then the actual parameter can be either an `INTEGER` or a `REAL` expression; no type conversion is performed. If a formal parameter is a call-by-value `INTEGER`, `REAL`, or `DOUBLE` simple variable, then the actual parameter can be either an `INTEGER`, a `REAL`, or a `DOUBLE` expression, and automatic type conversion is performed on the actual parameter at the time the procedure is invoked.

If the formal parameter of a nonformal procedure is a simple variable of type `COMPLEX`, then the corresponding actual parameter can be of type `INTEGER`, `REAL`, `DOUBLE`, or `COMPLEX`. However, if the `COMPLEX` formal parameter is call-by-name and the corresponding actual parameter is not of type `COMPLEX`, an assignment to that formal parameter within the procedure body causes the program to be discontinued with a fault.

The types of actual and formal parameters must match exactly for all cases not mentioned above. For more information, see “Type Coercion of One-Word and Two-Word Operands” in Appendix C, “Data Representation.”

## Examples of PROCEDURE INVOCATION Statement

The following example invokes the procedure `SIMPL`, which has no parameters.

```
SIMPL
```

The following example invokes the procedure `HEAVY` and passes it four parameters: `X`, `Y`, the array row `A[*]`, and the expression `SQRT(BINGO + BASE)`.

```
HEAVY(X,Y,A[*],SQRT(BINGO+BASE))
```

## PROCEDURE REFERENCE ARRAY Statement

A `PROCEDURE REFERENCE ARRAY` statement causes the procedure referenced by the specified procedure reference array element to be executed as a procedure invocation.

```
<procedure reference array statement>
```

```
—<procedure reference array element>—┌──────────────────────────────────┐
                                     │<actual parameter part>│
```

## Using Procedure Reference Arrays

If the procedure reference array element has not been assigned a procedure reference in a procedure reference array assignment, the program is terminated with the message *INVALID STACK ARGUMENT*.

When a typed procedure reference array is used in a `PROCEDURE REFERENCE ARRAY` statement, the value returned by the procedure reference array element is discarded.

The actual parameter part of a PROCEDURE REFERENCE ARRAY statement must have the same number of entries as the formal parameter list in the declaration of the procedure reference array. The formal and actual parameters are compared in the manner in which the formal and actual parameters are compared in a PROCEDURE INVOCATION statement. For more information on formal parameters and procedure reference array elements, see “PROCEDURE REFERENCE ARRAY Declaration” in Section 3, “Declarations.”

Invoking a procedure through a procedure reference array element in a PROCEDURE REFERENCE ARRAY statement is equivalent to invoking the procedure directly in a PROCEDURE INVOCATION statement. For more information, see “PROCEDURE INVOCATION Statement” earlier in this section.

### Example of PROCEDURE REFERENCE ARRAY Statement

The following example assigns a reference to procedure SWAPPER into the first element of procedure reference array PROCARRAY and then invokes SWAPPER through PROCARRAY.

```
BEGIN
  .
  .
  .
  REAL
    SORT1,
    SORT2;

  PROCEDURE REFERENCE ARRAY PROCARRAY[0:9] (A,B);
                                REAL  A,B;
                                NULL;

  PROCEDURE SWAPPER(X,Y);
    REAL  X,Y;

  BEGIN
    X :=: Y;
  END;

  PROCARRAY[0] := SWAPPER;
  READ(MYFILE,*,SORT1,SORT2);
  IF SORT2 > SORT1 THEN
    PROCARRAY[0] (SORT1,SORT2);
  END.
```

## PROCESS Statement

The PROCESS statement initiates a procedure as an asynchronous process.

<process statement>

```

— PROCESS —<procedure identifier> —————>
                                     |<actual parameter part>|
→- [ —<task designator>— ] —————|

```

### Initiation of an Asynchronous Process

Initiation of an asynchronous process consists of setting up a separate stack for the process, passing any parameters (call-by-name or call-by-value), and beginning the execution of the procedure. The initiating program continues execution, and both the initiating program and the initiated procedure run in parallel.

The specified procedure cannot be a typed procedure.

If the procedure identifier is a system supplied process, such as an intrinsic, the library GENERALSUPPORT must be declared using a library entry point specification. The procedure identifier must be declared in the program or the syntax error *PROCEDURE MUST BE USER DECLARED* results.

The actual parameter part must agree in number and type with the formal parameter part in the declaration of the procedure; otherwise, a run-time error occurs.

The task designator associates a task with the process at initiation; the values of the task attributes of that task, such as COREESTIMATE, STACKSIZE, and DECLARED PRIORITY, can be used to control execution of the process. For information about assigning values to task attributes, refer to “Task Assignment,” <arithmetic task attribute> under “Arithmetic Assignment,” and <Boolean task attribute> under “Boolean Assignment” earlier in this section. Many task attributes can be interrogated while the process is running.

### Critical Block

An asynchronous process depends on its initiator for global variables and call-by-name actual parameters. Thus, for each process, a critical block is present in the initiator that cannot be exited until the process is terminated. The critical block is the block of highest lexical level that contains one or more of the following items:

- The declaration of the procedure itself
- The declarations of the actual parameters passed to the call-by-name formal parameters
- The declaration of the task designator
- Any compiler-generated code for evaluating arithmetic expressions passed to call-by-name parameters

## Statements

---

The critical block can be the block that contains the PROCESS statement, the outer block of the program, or a block in between. An attempt by the initiator to exit the critical block before the process is terminated causes the initiator and all tasks it has initiated through CALL or PROCESS statements to be terminated.

A process is terminated by exiting its own outermost block or by execution in the initiator of the following statement where the task designator specifies the task associated with the process to be terminated:

```
<task designator>.STATUS := VALUE(TERMINATED)
```

*Note:* A processed procedure must not declare an OWN array or reference another procedure that declares an OWN array. An attempt to do so results in a run-time error. A string expression cannot be passed as an actual parameter to a call-by-name parameter of a procedure in a PROCESS statement.

## Examples of PROCESS Statement

In the following example, the procedure AGENT, which has no parameters, is invoked as an asynchronous process. The task TSK is associated with the process.

```
PROCESS AGENT [TSK]
```

In the following example, the procedure ACHILD is invoked as an asynchronous process and passed the three parameters OUTARRAY, YOUREVENT[INDX], and COUNT. The task designated by TSKARAY[INDX] is associated with the process.

```
PROCESS ACHILD(OUTARRAY, YOUREVENT[INDX], COUNT) [TSKARAY[INDX]]
```

## PROCURE Statement

The PROCURE statement tests the available state of an event.

```
<procure statement>
```

```
— PROCURE — ( —<event designator>— ) —————|
```

## Testing the Available State

If the available state of the event is FALSE (not available), the program is suspended and put in the procure list until some other task executes the LIBERATE statement for that event. If the available state of the event is TRUE (available), the available state is set to FALSE (not available), and the program continues execution with the statement following the PROCURE statement.

## Sharing Resources Among Programs

The PROCURE statement provides a means for different programs to share resources. For example, a convention could be established that a certain shared resource that is available for use by more than one program is not to be used by a program unless that program has procured the event that is used as the interlock. When the program has completed its use of the resource, it should execute a LIBERATE statement on the event.

## Examples of PROCURE Statement

In the following example, if the available state of EVNT is TRUE (available), EVNT is procured by setting its available state to FALSE (not available). Otherwise, the program is suspended until EVNT is made available.

```
PROCURE (EVNT)
```

In the following example, if the available state of the event designated by EVNTARAY[INDX] is TRUE (available), then that event is procured by setting its available state to FALSE (not available). Otherwise, the program is suspended until the event designated by EVNTARAY[INDX] is made available.

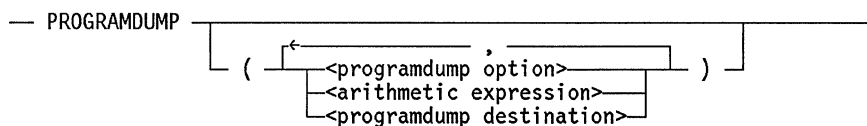
```
PROCURE (EVNTARAY [INDX])
```

## PROGRAMDUMP Statement

The PROGRAMDUMP statement can be used to generate a program dump. After the dump is taken, the program continues and executes the next statement.

A program dump is an expanded listing of the internal stack as it existed when the dump was requested. Several options are available to specify which items of the stack are to be included in the dump.

<programdump statement>



The information produced by the PROGRAMDUMP statement is written to the file specified by the TASKFILE task attribute of the program, unless the TODISK destination option is specified. See the discussion of the TODISK destination option later in this section.

## PROGRAMDUMP Options

<programdump option>

ARRAY
ARRAYS
PRESENTARRAY
PRESENTARRAYS
BASE
CODE
DBS
FILE
FILES
LIBRARIES
PRIVATELIBRARIES
ALL

The information included in the dump depends on the options specified. If no program dump options are specified, the stack is dumped according to the specifications in the task attribute **OPTION** of the program. The following table describes the results of specifying each program dump option:

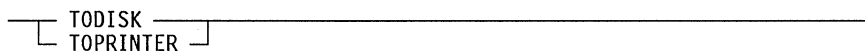
Option	Result
ARRAY or ARRAYS	Causes the contents of all arrays declared in the program to be dumped.
PRESENTARRAY or PRESENTARRAYS	Causes only the arrays in the present state (at the time the program dump is taken) to be dumped. If the ARRAY or ARRAYS program dump option is set along with the PRESENTARRAY or PRESENTARRAYS program dump option, all arrays will be dumped.
BASE	Causes the base of the stack to be dumped. The operating system uses a portion of each stack to contain various words needed to control, identify, and log the program. If the TODISK option is also specified, the base of the stack and the program information block (PIB) are always dumped for any stack dumped.
CODE	Causes segment dictionary information to be included in the dump. The actual code is dumped only for segments that have been referenced by the program when the program dump occurs. Value arrays in the segment dictionary are dumped when both the CODE option and either the ARRAY or ARRAYS option are specified.
DBS	Causes the output of database stacks to be dumped.
FILE or FILES	Causes information about each file declared in the program to be dumped. For each file, each word of the file information block (FIB) is separately named and, in some cases, analyzed.
LIBRARIES	Causes the stacks of all libraries that are being used by the program to be dumped.
PRIVATELIBRARIES	Causes the stacks of all private libraries that are being used by the program to be dumped.
ALL	Equivalent to specifying all the other options. The ALL option has no effect on the program dump destination. If the TODISK or TOPRINTER destination options are needed, they must be explicitly mentioned.

If the arithmetic expression option is used, the value in the arithmetic expression corresponds to the bit values in the OPTION word. The value of the expression is interpreted as follows:

Value	Meaning
[ 7:1] = 1	The base of the user stack is dumped.
[ 8:1] = 1	Array contents are dumped.
[ 9:1] = 1	The segment dictionary is dumped.
[10:1] = 1	Files are dumped.
[11:1] = 1	Present array contents are dumped.
[15:1] = 1	Database stacks are dumped.
[19:1] = 1	Stacks for libraries that the program is linked to are dumped.
[20:1] = 1	Stacks for private libraries are dumped.
[23:1] = 1	Destination of the dump is the printer.
[24:1] = 1	Destination of the dump is the disk.

## Programdump Destination Options

<programdump destination>



When the TODISK option is specified and a program dump is taken, a disk file is created in a format acceptable to DUMPANALYZER. The listing normally produced by PROGRAMDUMP is suppressed.

The program dump file name is as follows. The portion of the task name included in the program dump file name is limited to eight nodes. The date format is YYMMDD, and the time format is HHMMSS.

PDUMP/<task name>/<date>/<time>/<mix number>

In a program dump to disk, the base of the stack and the PIB are always dumped. All other program dump option settings work the way they work in a dump to the printer.

If the TODISK option and the TOPRINTER option are set, a program dump to the printer is taken after the disk file program dump has been produced. The two dumps might not be identical because the dump to disk has some side effects that might change the contents of memory.

The current destination option can be overridden by either destination option.

The default destination option is TOPRINTER.



### Relation to OPTION Task Attribute

Options specified in the PROGRAMDUMP statement apply only to the program dump taken at that time and temporarily override the values specified in the OPTION word of the program. The bits of the OPTION word are set with the OPTION task attribute for the program. Refer to the *A Series Task Attributes Programming Reference Manual* for information about the OPTION task attribute.

A program dump taken with the PROGRAMDUMP statement has an advantage over a program dump taken with the OPTION task attribute. A program dump can be taken with the OPTION task attribute only upon a fault or discontinue condition. A program dump taken with the PROGRAMDUMP statement can be taken at any time, and the program can continue after the dump is taken. For example, the PROGRAMDUMP statement might be useful as part of an ON statement, within an INTERRUPT statement, or within a piece of newly developed code.

The PROGRAMDUMP statement displays identifier name and compiler class information along with the stack variables when binding information (bindinfo) is present in the code file. ALGOL generates binding information by default unless the program is compiled with the compiler control option NOBINDINFO set to TRUE.

### Retrieval of Binding Information

When the BEGINSEGMENT and ENDSEGMENT compiler control options are used, a situation can occur where the binding information cannot be retrieved. This situation is related to two factors:

- Two or more variables have the same address. Normally there is no conflict when this happens because the addresses relate to different code segments.
- Procedures that are encountered between a BEGINSEGMENT and ENDSEGMENT option are placed in the same code segment.

When these two conditions occur, and multiple variables have the same address within the same code segment, the compiler cannot retrieve the binding information for those variables.

Diagnostic and debugging information also can be written to the TASKFILE so that the program dump and the information can be coordinated.

### Examples of PROGRAMDUMP Statement

The following example analyzes and prints the program stack according to the value of the OPTION task attribute of the program.

```
PROGRAMDUMP
```

The following example analyzes and prints the basic information plus the contents of all arrays.

```
PROGRAMDUMP (ARRAYS)
```

The following example analyzes and prints the contents of arrays, value arrays, the base of the stack, the segment dictionary, referenced code segments, and files.

```
PROGRAMDUMP (ARRAYS,BASE,CODE,FILE)
```

The following example analyzes the maximum amount of information about the program stack. The program dump is written to the printer.

```
PROGRAMDUMP (ALL, TOPRINTER)
```

The following example analyzes and prints the program stack according to the value of DUMPPARAM.

```
PROGRAMDUMP (DUMPPARAM)
```

The following example is equivalent to the statement PROGRAMDUMP(FILE). This statement analyzes and prints the contents of files of the program.

```
PROGRAMDUMP (Ø & 1 [1Ø:1])
```

Analyzes the basic information plus the contents of all arrays and data base stacks. The information is written to a disk file.

```
PROGRAMDUMP (ARRAYS,DBS,TODISK)
```

The following example analyzes the information specified in the OPTION word of the program because no program dump option was specified in the statement. The dump is written first to the disk file and then to the printer file.

```
PROGRAMDUMP (TODISK, TOPRINTER)
```

## READ Statement

The READ statement allows data to be read from files and assigned to program variables.

**Note:** *The syntax of the READ statement and the syntax of the WRITE statement are nearly identical. Differences in the semantics are discussed following the syntax for each statement.*

<read statement>

```
— READ — ( —<file part> ┌──────────────────────────────────┐ ) ───────────>
                    └─<format and list part>─┘
→ ┌──────────────────────────────────────────────────────────┐
  └─<action labels or finished event>─┘
```

The action of the READ statement depends on the form of the <file part> element and on the form of the <format and list part> element.

The READ statement can be used as a Boolean function. When the read operation fails, the value TRUE is returned. When the read operation succeeds, the value FALSE is

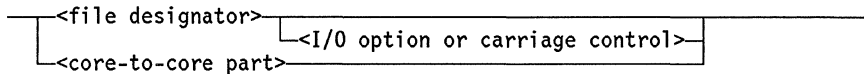
## Statements

---

returned. The READ statement returns a value identical to that returned by the file attribute STATE. For more information, refer to the discussion of the STATE attribute in the *A Series File Attributes Programming Reference Manual*.

## File Part

<file part>

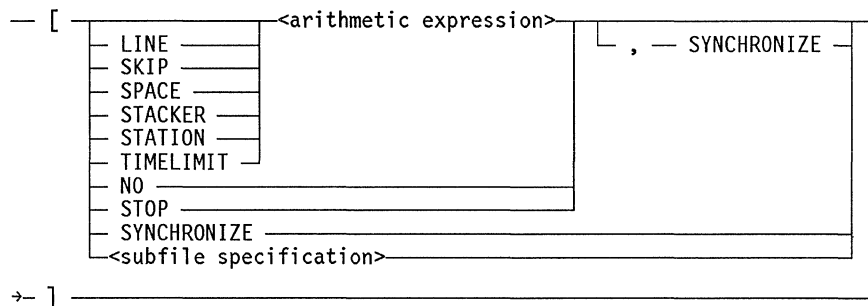


The file part specifies the location of the data to be read.

The file designator specifies the file to be read. For more information on the file designator, refer to “SWITCH FILE Declaration” in Section 3, “Declarations.”

## I/O Option or Carriage Control

<I/O option or carriage control>



If the I/O option or carriage control element is not specified, the record currently addressed by the record pointer is read, and the record pointer is adjusted to point to the next record in the file.

If the I/O option or carriage control element is invalid for the physical file associated with the file designator, it is ignored.

If the I/O option or carriage control element is an arithmetic expression, its value indicates the zero-relative record number of the record in the file that is to be read. The record pointer is adjusted to point to the specified record before the read is performed, and the record pointer is adjusted after the read operation to point to the next record.

If the I/O option or carriage control element is NO, then the record pointer is not adjusted following the read operation. That is, the record can be read again. This I/O option or carriage control element has no effect if the KIND attribute of the file being read is equal to REMOTE.

If the I/O option or carriage control element is of the form [*SPACE* <arithmetic expression>], then the number of records specified by the value of the arithmetic

expression are skipped. Spacing is forward if the arithmetic expression has a positive value and backward if the arithmetic expression has a negative value.

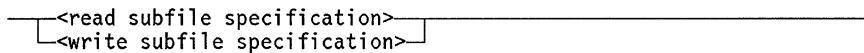
The *[TIMELIMIT < arithmetic expression >]* construct, which is meaningful only for remote files, assigns the value of the arithmetic expression to the TIMELIMIT attribute of the file. Refer to the *A Series File Attributes Programming Reference Manual* for information on the TIMELIMIT attribute. The value of this attribute applies to all subsequent READ and WRITE statements on that file. If the value of the TIMELIMIT attribute is greater than zero and if no input is received within that number of seconds (the value can be fractional), then a time-out error is reported.

The *[STATION < arithmetic expression >]* construct is meaningful only for remote files. The value of the arithmetic expression is assigned to the LASTSUBFILE attribute of the file. Refer to the *A Series File Attributes Programming Reference Manual* for information on the LASTSUBFILE attribute.

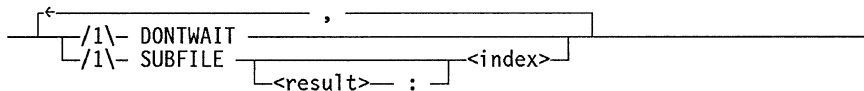
The *[SYNCHRONIZE]* construct is meaningful for the WRITE statement only.

## Subfile Specification

<subfile specification>



<read subfile specification>



<result>



If the file to be read is a port file (a file for which the KIND attribute is equal to PORT), an array row read containing a subfile specification must be used. For more information, refer to “Array Row Read” later in this section.

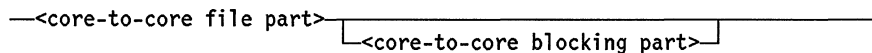
The subfile specification is meaningful only for port files. It is used to specify the subfile to be used for the read operation and the type of read operation to be performed.

If the subfile index is used, the value of the subfile index is assigned to the LASTSUBFILE attribute of the file. It specifies the subfile to be used for the read operation. If the subfile index is zero, a nonselective read is performed. If the subfile index is nonzero, then a read from the specified subfile is performed. The result variable, if any, is assigned the resultant value of the LASTSUBFILE attribute. For more information on the LASTSUBFILE attribute, refer to the *A Series File Attributes Programming Reference Manual*.

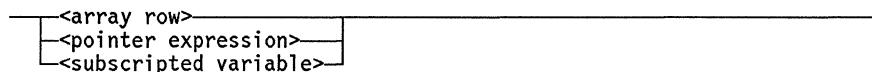
If DONTWAIT is specified in a READ statement, and if no input is available, no data is returned and the program is not suspended.

## Core-to-Core Part

<core-to-core part>



<core-to-core file part>



If the file part consists of a core-to-core part, then a core-to-core read is performed. A core-to-core read operation reads from a location in memory, not from a physical device; therefore, it is much faster than a physical read. Editing is performed exactly as it is performed when reading from a physical device.

If the core-to-core file part is a hexadecimal, BCL, or EBCDIC array row or pointer, then the default record size (the number of characters considered to be in the record) depends on the character size of the array row or pointer and is determined by the actual length of the designated string.

The maximum size of the core-to-core file part for BCL and hexadecimal arrays is 65,535 words. Core-to-core I/O on BCL and hexadecimal arrays longer than 65,535 words is permitted only if the core-to-core file part is indexed far enough into the array such that the length between that point and the end of the array does not exceed 65,535 words. If an attempt is made to use an array or array segment more than 65,535 words long, a run-time error occurs.

For single-precision and double-precision array rows or subscripted variables, the default record size is computed by multiplying the length of the array row (or remaining length of the array row when a subscripted variable is used) by the number of characters per word, where characters per word is derived from the following table:

	Default Character Type	
	BCL	EBCDIC
Single Precision	8	6
Double Precision	16	12

## Core-to-Core Blocking Part

<core-to-core blocking part>

— ( —<core-to-core record size> \_\_\_\_\_ , —<core-to-core blocking> \_\_\_\_\_ ) —

<core-to-core record size>

—<arithmetic expression> \_\_\_\_\_

<core-to-core blocking>

—<arithmetic expression> \_\_\_\_\_

To specify a record size smaller than the default size, a value can be provided for core-to-core record size. This value is in terms of characters. By supplying a value for core-to-core blocking, the file can be blocked into more records than the default number, which is one.

With formatted I/O, if the format requires more records than indicated by the core-to-core blocking value, a run-time error is given. Also, the format can require more characters than the core-to-core file part contains; this situation also results in a run-time error. In such cases, the number of characters indicated in the core-to-core blocking part (this number is computed by multiplying the core-to-core record size by the core-to-core blocking) can appear to be large enough to satisfy the format, but the core-to-core blocking part can indicate more characters than the core-to-core file part actually contains. The core-to-core file part, the core-to-core blocking part, and the format must be compatible or run-time errors occur.

For example, the following statements result in errors:

```
BEGIN
  ARRAY A[0:9];
  REAL B,C;
  READ (A(80), <T50,A6,I10>,B,C);      % Example 1
  WRITE(A(15,3), <X5,I15>,1,2,3);      % Example 2
  WRITE(A(20,2), <X5,I15>,1,2,3);      % Example 3
  B := " ITEM";
  WRITE(A(15,4), <".",X2,A6,I2,X4>,B,1,B,2,B,3,B,4); % Example 4
END.
```

The statement labeled “Example 1” in the preceding program results in a run-time error (format error 217), because the format requires 65 characters, but the file part (array A) contains only 60 characters.

The statement labeled “Example 2” results in a run-time error (format error 117), because the format requires 20-character records, but 15-character records were specified in the blocking part.

The statement labeled “Example 3” results in a run-time error (format error 120), because the three list elements require three repetitions of the format. Thus, three records are required, but only two records were specified in the blocking part.

## Statements

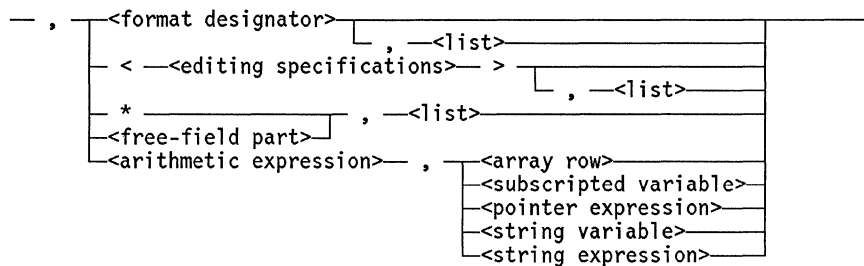
---

The statement labeled “Example 4” fills array A with the following EBCDIC data (“|” denotes the end of the data):

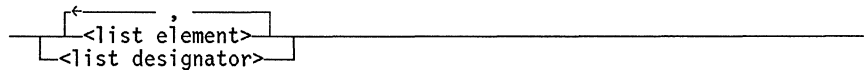
```
.   ITEM 1   .   ITEM 2   .   ITEM 3   .   ITEM 4   |
```

## Format and List Part

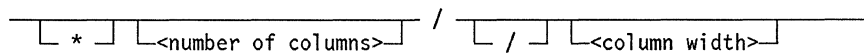
<format and list part>



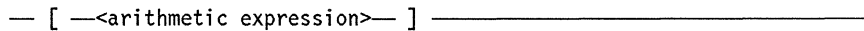
<list>



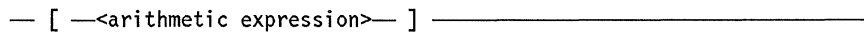
<free-field part>



<number of columns>



<column width>



The format and list part element indicates the interpretation of the data in the file and the variables to which the data is assigned.

If the format and list part element does not appear, the input record is skipped.

## Formatted Read

A READ statement that contains a format designator, editing specifications, or a free-field part is called a formatted read.

A format designator without a list indicates that the referenced format contains a string literal into which corresponding characters of the input data are to be placed. The string literal in the FORMAT declaration is replaced by the string literal in the input data.

A format designator with a list indicates that the input data is to be edited according to the specifications of the format and assigned to the variables of the list.

Editing specifications can appear in place of a format designator and have the same effect as if they had been declared in a FORMAT declaration and had been referenced through a format designator. For more information, refer to “FORMAT Declaration” in Section 3, “Declarations.”

On any formatted I/O statement (excluding core-to-core I/O), the number of characters allowed in the record is determined solely by the value of the file attribute MAXRECSIZE of the file. If the format requires more characters than are contained in the record, a format error occurs at run time.

The free-field part is discussed under “Data Format for Free-field Input” later in this section.

## Binary Read

A READ statement of the following form is called a binary read:

```
READ(<file part>,*,<list>)
```

An asterisk (\*) followed by a list specifies that the input data is to be processed as full words and assigned to the elements of the list without being edited. The number of words read is determined by the number of elements in the list or the maximum record size, whichever is smaller.

When data is read into character arrays, only full words are read. If there is a partial word left at the end of the data, it is ignored. For example, if A is an EBCDIC array and FILEID contains the string 12345678, the following statement reads only the characters 123456:

```
READ(FILEID,*,A)
```

When a string is read into a string variable using a binary READ statement, the first word read from the record is assumed to specify the length of the string. This word is evaluated, and the resulting value is the number of characters read beginning with the next word of the record. The binary WRITE statement automatically writes a word of length information before the text of each string variable; therefore, the following WRITE statement can later be read by the following READ statement:

```
WRITE(F,*,STR,STRARRAY[5],STR || "ABC")
```

```
READ(F,*,STR1,STR2,STRARRAY[0])
```

For more information, see “Binary Write” under “WRITE Statement” later in this section.

The results are undefined for binary READ statements that attempt to read data not containing length information into string variables.



### Array Row Read

A READ statement of any of the following forms is called an array row read:

```
READ(<file part>,<arithmetic expression>,<array row>)
READ(<file part>,<arithmetic expression>,<subscripted variable>)
READ(<file part>,<arithmetic expression>,<pointer expression>)
READ(<file part>,<arithmetic expression>,<string variable>)
```

The first three forms of the array row read specify that input data is to be read without editing and assigned left-justified to the array specified by the array row, subscripted variable, or pointer expression. The arithmetic expression specifies the number of words or the number of characters, depending on the value of the FRAMESIZE attribute for the file, to be read. Refer to the *A Series File Attributes Programming Reference Manual* for information on the FRAMESIZE attribute. The number of words or characters actually read equals whichever of the following values is smallest:

- The MAXRECSIZE attribute of the file being read
- The length of the array row (or portion of the array to the right of where the pointer expression points or to the right of the element specified by the subscripted variable)
- The absolute value of the arithmetic expression

A READ statement of the following form specifies that input data is to be read without editing and assigned to the string variable:

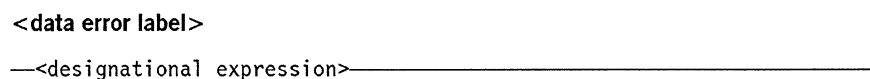
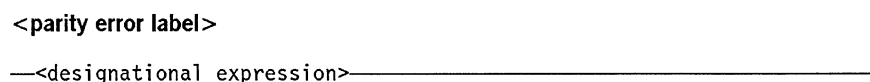
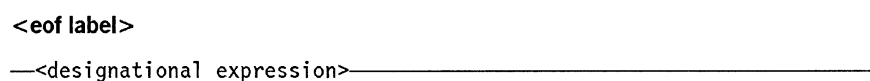
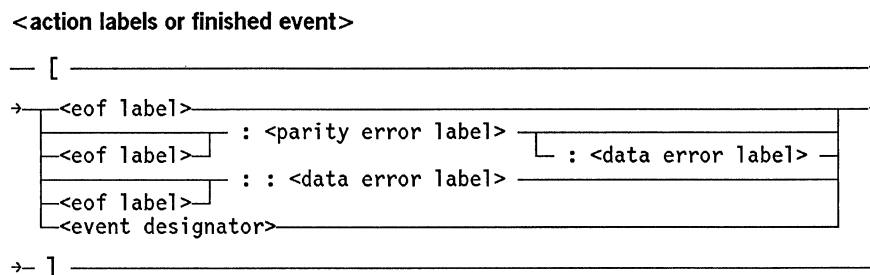
```
READ (<file part>,<arithmetic expression>,<string variable>)
```

The number of characters read is the smaller of the value of the MAXRECSIZE attribute of the file being read or of the absolute value of the arithmetic expression. The value of the arithmetic expression always specifies the number of characters (not words) to be read.

The following is an example of an array row read:

```
BEGIN
  FILE IN(TITLE="TEST.", UNITS=CHARACTERS, MAXRECSIZE=20);
  STRING S1,S2;
  READ(IN,15,S1); % READS 15 CHARACTERS INTO S1
  READ(IN,50,S2); % READS 20 CHARACTERS INTO S2
END.
```

## Action Labels or Finished Event



The action labels or finished event element provides a means of transferring control from a READ statement, WRITE statement, or SPACE statement when exception conditions occur. A branch to the eof label takes place when an end-of-file condition occurs. A branch to the parity error label takes place if an irrecoverable parity error is encountered. A branch to the data error label takes place if a conflict exists between the format and the data. If the appropriate label is not provided when an exception condition occurs, the program is terminated.

The [ <event designator> ] syntax can be used only for direct I/O. The event is caused when the I/O operation is finished. For more information, refer to “Direct I/O” under “I/O Statement” earlier in this section.

Exception conditions occurring during a READ statement can also be handled without the use of the action labels or finished event syntax. The READ statement can be used as a Boolean function, and the value returned can be tested to determine if any exception conditions exist. For more information, refer to the discussion of the STATE attribute in the *A Series File Attributes Programming Reference Manual*. When exception conditions are handled in this manner, the action labels or finished event syntax cannot be used. The user assumes all responsibility for handling exception conditions. Core-to-core I/O statements of the following forms cannot be used with the action labels or finished event syntax and cannot be used as Boolean functions.

```

READ(<array row>,<arithmetic expression>,<array row>)
WRITE(<array row>,<arithmetic expression>,<array row>)
  
```

Attempting to do either results in a syntax error.

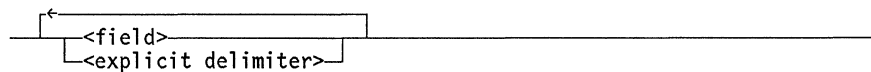
## Data Format for Free-field Input

The use of a free-field part element in a READ statement allows input to be performed with editing but without using editing specifications. The appropriate format is selected automatically.

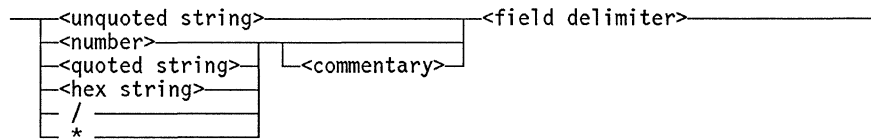
On input, only the simplest forms of the free-field part, a single slash (/) or double slash (/ /), can be used. These formats allow input from records in the form of free-field data records. A single slash indicates that data items are delimited by a comma; a double slash indicates that data items are delimited by one or more blanks.

### Free-field Data Format

The format of a free-field input data record is as follows:



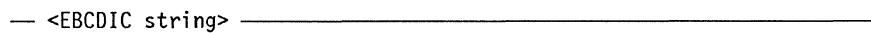
#### <field>



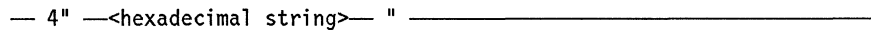
#### <unquoted string>

Any string not containing an < explicit delimiter > .

#### <quoted string>



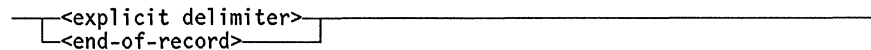
#### <hex string>



#### <commentary>

Any string not containing an < explicit delimiter > .

#### <field delimiter>



#### <explicit delimiter>

Comma (,) for the single-slash form or one or more blanks for the double-slash form. An empty record is not considered an explicit delimiter.

**<end-of-record>**

The end of the input record.

Each record of free-field input data must be in the form described above.

Empty records are ignored. The commentary option is ignored.

Each field except the slash is associated with the list element to which it corresponds by position.

### Fields

The single-slash format interprets a field that contains only a comma or a comma preceded by blanks as a null field. Such a field is skipped along with its associated list element, which is left unaltered.

The different types of fields are described in the following paragraphs.

### Unquoted String

If an unquoted string is read into a list element of type string or pointer, all characters preceding the explicit delimiter (including quotation marks if present) are transferred to the list element. The end-of-record is not recognized as a delimiter.

If an unquoted string is read into a list element of type string, characters are read until an explicit delimiter is detected or until the maximum string length ( $2^{*}5 - 2$ ) is reached.

If an unquoted string is read into a list element of type pointer, characters are read until an explicit delimiter is detected or until the end of the array is reached.

If an unquoted string is read into a list element of type Boolean, the value TRUE is assigned to the list element if the first character of the string is T. If the first character is not the letter T, the value FALSE is assigned to the list element. The unquoted string is read until a field delimiter is detected.

If an unquoted string is read into a list element of any type other than string, pointer, or Boolean, it is treated as commentary.

### Number

A number that is represented as an integer is treated as type INTEGER unless it is larger than the largest allowable integer, in which case it is treated as type REAL. Numbers that contain a decimal fraction are treated as type REAL. However, when the list element is double precision, results are treated as type DOUBLE. When the field delimiter is a comma, blanks within numbers are ignored.

Complex values are divided into real and imaginary values. When a complex variable or complex subscripted variable appears in the list of a free-field READ statement,

## Statements

---

two fields are necessary to complete the read operation. The value in the first field is assigned to the real part, and the value in the second field is assigned to the imaginary part.

### Quoted String

A quoted string of any length can be read into single-precision or double-precision list elements. Each single-precision EBCDIC or BCL list element receives six characters or eight characters, respectively (12 or 16 characters, respectively, for double-precision list elements), until either the list or the string is exhausted. If the number of characters in the string is not a multiple of six (for EBCDIC) or eight (for BCL), then the last list element receives the remaining characters of the string. The string characters are stored, right-justified, in the list elements.

### Hex String

A hexadecimal string can be read into a single-precision or double-precision list element. If fewer than 12 hexadecimal digits are read into a single-precision variable (or fewer than 24 hexadecimal digits into a double-precision variable), the string is stored right-justified in the variable. If a minus sign precedes the string (for example, -4"A"), bit 46 of the resulting value is complemented.

### Slash (/)

The slash field causes the remainder of the current buffer to be ignored. The buffer following the slash is considered the beginning of a new field. The slash is a field by itself and must not be placed within another field or between a field and its explicit delimiter.

### Asterisk (\*)

The asterisk field terminates the READ statement. The program continues with the statement following the READ statement. The list element corresponding to the asterisk remains unchanged, as do any subsequent elements in the list.

### Examples of Fields

```
1,  
2.5, / anything to the right of a slash is ignored  
2.48 @ -2Ø, / blanks are ignored if using single-slash editing  
3 4 / two data elements if the delimiter is a blank  
3,4, / two data elements if the delimiter is a comma  
"THIS IS A QUOTED STRING"
```

THIS IS AN UNQUOTED STRING AND THE DELIMITER IS A COMMA, 123

THIS-IS-AN-UNQUOTED-STRING-AND-THE-DELIMITER-IS-A-BLANK 456

2.5 ANY COMMENT OR NOTE NOT CONTAINING A COMMA,

4"AB" / A HEX STRING

-4"400000000000A" / BIT 46 IS COMPLEMENTED, THE RESULT = +10

,,, / null fields; the three corresponding list elements are  
/ skipped with no alteration to their contents.

4, ,5 / null field is ignored

\* THIS DATA RECORD TERMINATES THE READ STATEMENT

### Examples of READ Statement

```
READ(FILEID)
READ(FILEID,FMT)
READ(FILEID,FMT,LISTID)
READ(FILEID,*,LISTID)
READ(SPOFILE,FMT,A,B,C)
READ(SPOFILE,/,SIZE,LENGTH,MASS)
READ(FILEID,FMT,7,2,A,B,C,ARRAY[A],B+C,F)
READ(FILEID,/,J,FOR I := 0 STEP 1 UNTIL J DO ARRAY[I])
READ(FILEID,*,A,B,C,FOR A := B*A STEP C UNTIL J DO ARY[I])
READ(SWFILEID[IF X > N THEN X+N ELSE 0],25,ARRAY[2,*])
READ(FILEID,/,SWLISTID[I])
READ(FILEID,FMT,SWLISTID[I])
READ(SPOFILE,SWFMT[16],A,B,C)
READ(FILEID,50,STR)
READ(FILEID,/,L,M,N,ARRAY[2]) [EOFL]
READ(FILEID[3][NO]) [:PARL]
READ(SWFILEID[14][NO],FMT,A+EXP(B),ARRAY[I,J,*]) [:PARSWL[M]]
READ(FILEID[NO],SWFMT[6+J],LISTID) [EOFSWL[Q*3]::DATAERRORL]
READ(SWFILEID[A+B],*,SWLISTID[2+H/K]) [EOFL:PARL]
READ(FILEID[NO]) [EOFSWL[I]:PARSWL[J]]
READ(FYLE) [EOFL:PARL:DATAERRL]
READ(DIRFYLE) [EVNT]
READ(DIRFYLE,30,DIRARRAY) [EVNT]
```

## REMOVEFILE Statement

The REMOVEFILE statement removes files without opening them.

<removefile statement>

— REMOVEFILE — ( —<directory element>— ) —————|

### Directory Element

The syntax and semantics of the directory element appear under “CHANGEFILE Statement” earlier in this section.

If the directory element is a directory name, all files in that directory are removed. If the directory element is both a file name and a directory name, that file and all files in the directory are removed.

A directory element of the form <file name>/= removes only files in that directory. It does not remove a file named <file name>.

If a pointer expression is used as a directory element, it must point to an array that contains the name of the file or directory to be removed.

### REMOVEFILE Statement as a Boolean Function

The REMOVEFILE statement can be used as a Boolean function, in which case it returns a value of TRUE if an error occurs. The value in field [39:20] of the result defines the failure as follows:

Value	Meaning
10	File name or directory name is in error.
30	Files have not been removed.

### Family Substitution

Family substitution is used if the task has an active family specification and the family name involved in the REMOVEFILE statement is the target family name that the FAMILY specification substitutes.

If a family substitution specification is in effect, the REMOVEFILE statement affects only the substitute family, not the alternate family.

### Example of REMOVEFILE Statement

The following statement removes the file MYTEST and, if the remove is successful, assigns FALSE to the variable BOOL.

```
BOOL := REMOVEFILE("MYTEST ON PACKFOUR.")
```



## REPLACE Statement

The REPLACE statement causes character data from one or more sources to be stored in a designated portion of an array row.

**<replace statement>**

— REPLACE —<destination>— BY —<source part list>—————|

**<destination>**

—————|<pointer expression>—————|  
 └──<update pointer>┘

**<update pointer>**

—<pointer variable>— : —————|

The REPLACE statement stores character data from one or more data sources into a designated portion of an array row. The array row and the starting character position within the array row are both determined by the pointer expression part of the destination syntax. The value of this pointer expression initializes the stack-destination-pointer. As each character is moved into the destination array row, the stack-destination-pointer is correspondingly incremented one character position. When the last character has been stored in the destination array row, the corresponding final value of the stack-destination-pointer is stored in the pointer variable of the update pointer, if specified; otherwise, it is discarded. For more information on temporary storage locations, see “POINTER statement” earlier in this section.

## Source Part List

**<source part list>**

┌──┐  
 └──<source part>┘—————|

**<source part>**

<string literal>	└──<unit count>┘
<arithmetic expression>	└──<unit count>┘
<digit convert part>	
<numeric convert part>	
<source>—<transfer part>	
<translate part>	
<pointer-valued attribute>	
<string expression>	

**<unit count>**

— FOR —<arithmetic expression> └── WORDS ┘—————|





## Source Part Combinations

The formal syntax of the source part can be reduced to the following combinations:

```

<string literal>
<string literal> FOR <arithmetic expression>
                    FOR <arithmetic expression> WORDS

<arithmetic expression>
<arithmetic expression> FOR <arithmetic expression>
                        FOR <arithmetic expression> WORDS
                        FOR <arithmetic expression> DIGITS
                        FOR * DIGITS
                        FOR <arithmetic expression> SDIGITS
                        FOR * SDIGITS
                        FOR <count part> NUMERIC
                        FOR * NUMERIC

<source> FOR <arithmetic expression>
          FOR <arithmetic expression> WORDS
          FOR <arithmetic expression> WITH <translate table>

<source> WITH <picture identifier>

<source> WHILE <relational operator> <arithmetic expression>
          UNTIL <relational operator> <arithmetic expression>
          WHILE IN <truth set table>
          UNTIL IN <truth set table>

<source> FOR <count part> WHILE <relational operator>
                                     <arithmetic expression>
<source> FOR <count part> UNTIL <relational operator>
                                     <arithmetic expression>

<source> FOR <count part> WHILE IN <truth set table>
          FOR <count part> UNTIL IN <truth set table>

<pointer-valued attribute>

<string expression>

```

Each of these combinations is discussed in turn in the sections that follow. In all examples, P and Q are 8-bit pointers and the default character type is EBCDIC.

## String Literal Source Parts

A string literal of 96 bits or less is a short string literal. A short string literal is evaluated at compilation time and stored, left-justified, in a one-word or two-word operand. Character size information is discarded.

## Statements

---

A string literal of more than 96 bits is a long string literal. A long string literal is evaluated at compilation time and stored in a portion of an array called a pool array. The character size and address of the string literal are stored in a pointer called a pool array pointer.

The compiler calculates the number of characters in a string literal in terms of the largest character size specified by the string literal. The following are calculations for various string literals:

String Literal	Number of Characters
4"C1"	2
8"AB"	2
48"01"	1
4"01""A"	2 (if the default character type is EBCDIC)

### <string literal>

If the source part is a short string literal, it is processed as follows:

1. At compilation time, the number of characters in the string is calculated.
2. At run time, the string literal is stored, left-justified with zero fill, in a one- or two-word stack-source-operand.
3. The stack-integer-counter is assigned the value for the string length calculated at compilation time (see step 1).
4. Characters are copied from the stack-source-operand to the destination specified by the stack-destination-pointer. The stack-integer-counter specifies the number of characters copied, and the stack-destination-pointer specifies the character size. If the destination is specified by a non-character array row or array element, the character size is eight bits.

If the source part is a long string literal, it is processed as follows:

1. At compilation time, the number of characters in the string is calculated.
2. At run time, the stack-source-pointer is assigned the value of the pool array pointer to the long string literal, which includes the character size and address.
3. The character sizes of the stack-source-pointer and the stack-destination-pointer are compared. If they are not equal, the program is discontinued with a fault.
4. The stack-integer-counter is assigned the value for the string length calculated at compilation time (see step 1).
5. The number of characters specified by the stack-integer-counter are copied from the pool array to the destination specified by the stack-destination-pointer.

### Examples of <string literal>

In the following example, the three EBCDIC characters ABC are copied to the destination pointed to by P.

REPLACE P BY "ABC"

In the following example, the 20-character EBCDIC string is copied to the destination pointed to by P. At the end of the statement, P is left pointing to the first character position after the last character copied.

REPLACE P:P BY "A MUCH LONGER STRING"

In the following example, because the source, a string literal, is only four 4-bit characters long, it is evaluated as a single word; the character size is not retained. Because the destination is an 8-bit pointer, and four characters are to be replaced, four 8-bit characters are copied to the destination. At the end of the statement, the destination contains 4"12340000", which are the leftmost 32 bits of the stack-source-operand 4"123400000000".

REPLACE P BY 4"1234"

**<string literal> FOR <arithmetic expression>**

If the source part is a short string literal, it is processed as follows:

1. At compilation time, the string literal is stored in a one- or two-word operand. If the string literal is less than or equal to 48 bits long, it is stored, left-justified, and repeated for fill in a one-word operand. If the string literal is more than 48 bits long, it is stored, left-justified with zero fill, in a two-word operand.
2. At run time, this operand is assigned to the stack-source-operand.
3. If the arithmetic expression yields a positive value, this value is rounded to an integer, if necessary, and assigned to the stack-integer-counter; otherwise, zero is assigned to the stack-integer-counter.
4. The number of characters specified by the stack-integer-counter are copied to the destination specified by the stack-destination-pointer. If the stack-source-operand contains fewer than the specified number of characters, it is reused as many times as necessary. The character size is specified by the stack-destination-pointer. If the destination is specified by a non-character array row or array element, the character size is eight bits.

In the following examples, the first column shows a source part, and the second column shows the resulting string. A question mark (?) represents a null character.

Source Part	Result
"A" FOR 20	AAAAAAAAAAAAAAAAAAAA
"AB" FOR 20	ABABABABABABABABAB
"ABC" FOR 20	ABCABCABCABCABCABC
"ABCD" FOR 20	ABCDABABCDABABCDAB
"ABCDEF" FOR 20	ABCDEFABCDEFABCDEF
"ABCDEFGH" FOR 20	ABCDEFGH????ABCDEFGH

If the source part is a long string literal, it is processed as follows:

## Statements

---

1. The `stack-source-pointer` is assigned the value of the pool array pointer to the long string literal, which includes the character size and address.
2. The character sizes of the `stack-source-pointer` and the `stack-destination-pointer` are compared. If they are not equal, the program is discontinued with a fault.
3. If the arithmetic expression yields a positive value, this value is rounded to an integer, if necessary, and assigned to the `stack-integer-counter`; otherwise, zero is assigned to the `stack-integer-counter`.
4. The number of characters specified by the `stack-integer-counter` are copied to the destination specified by the `stack-destination-pointer`.

The `<string literal> FOR <arithmetic expression>` syntax is undefined for a long string literal if the integerized value of the arithmetic expression is greater than the length of the string literal in characters. For example, the result of the following statement is undefined:

```
REPLACE POINTER(A) BY "ABCDEFGHJKLMNO" FOR 30
```

### **<string literal> FOR <arithmetic expression> WORDS**

If the source part is a short string literal, it is processed as follows:

1. At compilation time, the string literal is stored in a one- or two-word operand. If the string literal is less than or equal to 48 bits long, is stored, left-justified and repeated for fill, in a one-word operand. If the string literal is more than 48 bits long, it is stored, left-justified with zero fill, in a two-word operand.
2. At run time, this operand is assigned to the `stack-source-operand`.
3. If the arithmetic expression yields a positive value, this value is rounded to an integer, if necessary, and assigned to the `stack-integer-counter`; otherwise, zero is assigned to the `stack-integer-counter`.
4. The `stack-destination-pointer` is moved forward, if necessary, to the nearest word boundary.
5. The number of words specified by the `stack-integer-counter` are copied from the `stack-source-operand` to the destination specified by the `stack-destination-pointer`. If the `stack-source-operand` contains fewer than the specified number of words, it is reused as often as necessary.

In the following examples, the first column shows a source part, and the second column shows the resulting string. A question mark (?) represents a null character.

Source Part	Result
"ABCD" FOR 2 WORDS	ABCDABABCDAB
"ABCDEFGH" FOR 2 WORDS	ABCDEFGH????
"ABCDEFGH" FOR 3 WORDS	ABCDEFGH????ABCDEF

If the source part is a long string literal, it is processed as follows:

1. The stack-source-pointer is assigned the value of the pool array pointer to the long string literal, which includes the character size and address.
2. The character sizes of the stack-source-pointer and the stack-destination-pointer are compared. If they are not equal, the program is discontinued with a fault.
3. If the arithmetic expression yields zero or a positive value, this value is rounded to an integer, if necessary, and assigned to the stack-integer-counter; otherwise, zero is assigned to the stack-integer-counter.
4. The stack-destination-pointer is moved forward, if necessary, to the nearest word boundary.
5. The number of words specified by the stack-integer-counter are copied from the stack-source-operand to the destination indicated by the stack-destination-pointer.

The *<string literal> FOR <arithmetic expression> WORDS* syntax is undefined for a long string literal if the integerized value of the arithmetic expression is greater than the length of the string literal in 48-bit words. For example, the result of the following statement is undefined:

```
REPLACE POINTER(A) BY "ABCDEFGHJKLMNO" FOR 6 WORDS
```

## Arithmetic Expression Source Parts

When a string literal is to be interpreted as an arithmetic expression, it must be enclosed in parentheses. Without the parentheses, the compiler interprets it as a string literal and generates code or issues syntax errors accordingly. For example the following is an invalid statement and results in a syntax error:

```
REPLACE POINTER(A) BY "A" FOR 3 DIGITS
```

On the other hand, the following statement is valid:

```
REPLACE POINTER(A) BY ("A") FOR 3 DIGITS
```

### <arithmetic expression>

A source part of this form is processed as follows:

1. The arithmetic expression is evaluated and assigned to a one-word stack-source-operand.
2. The stack-source-operand is copied once to the destination specified by the stack-destination-pointer.

The character size of the stack-destination-pointer is irrelevant. This means that it is not used to determine the default *<unit count>*, the number of characters to be transferred. In the absence of a specified unit count part, a default is established based on a full word of the default character bit size. The default character bit size is eight, unless otherwise established by the *<ASCII option>* or *<BCL option>* compiler control options.



### Examples of Arithmetic Expression

In the following examples, the first column shows a REPLACE statement, and the second column shows, in hexadecimal format, the resulting string.

Statement	Result
REPLACE P BY 7.5	267800000000
REPLACE P BY 3	000000000003
REPLACE P BY 1.68@@2	248540000000
REPLACE P BY ("A")	0000000000C1

### <arithmetic expression> FOR <arithmetic expression>

A source part of this form is processed as follows:

1. The first arithmetic expression is evaluated and assigned to a one-word stack-source-operand.
2. If evaluation of the second arithmetic expression yields a positive value, this value is rounded to an integer, if necessary, and assigned to the stack-integer-counter; otherwise, zero is assigned to the stack-integer-counter.
3. The number of characters specified by the stack-integer-counter are copied from the stack-source-operand to the destination specified by the stack-destination-pointer. If the stack-source-operand contains fewer than the specified number of characters, it is reused as often as necessary. The character size is specified by the stack-destination-pointer. If the destination is specified by a non-character array row or array element, the character size is eight bits.

### Examples of <arithmetic expression> FOR <arithmetic expression>

The following example copies the character 48"00" to P. The stack-source-operand is 4"000000000003", and the leftmost character of this operand is copied to P.

```
REPLACE P BY 3 FOR 1
```

The following example copies the character 48"03" to P.

```
REPLACE P BY (3).[7:48] FOR 1
```

The following example copies the EBCDIC character A to P.

```
REPLACE P BY ("A").[7:48] FOR 1
```

### <arithmetic expression> FOR <arithmetic expression> WORDS

A source part of this form is processed as follows:

1. If the evaluation of the first arithmetic expression yields a double-precision value, this double-precision value is assigned to a two-word stack-source-operand. Otherwise, the value of the first arithmetic expression is assigned to a one-word stack-source-operand.
2. If evaluation of the second arithmetic expression yields a positive value, this value is rounded to an integer, if necessary, and assigned to the stack-integer-counter; otherwise, zero is assigned to the stack-integer-counter.
3. The stack-destination-pointer is moved forward, if necessary, to the nearest word boundary.
4. The number of words specified by the stack-integer-counter is copied from the stack-source-operand to the destination specified by the stack-destination-pointer. If the stack-source-operand is double-precision, it is copied to the destination one word at a time (first word first, second word second) with TAGs. If the stack-integer-counter specifies more than one word (when the stack-source-operand is single precision) or more than two words (when the stack-source-operand is double precision), then the stack-source-operand is reused until the number of words specified by the stack-integer-counter has been copied.

**Example of <arithmetic expression> FOR <arithmetic expression> WORDS**

The following example copies a single-precision zero into every element of array A.

```
REPLACE POINTER(A) BY 0 FOR SIZE(A) WORDS
```

**<arithmetic expression> FOR <arithmetic expression> DIGITS**

A source part of this form is processed as follows:

1. The absolute value of the first arithmetic expression is rounded to an integer value, if necessary, and assigned to the stack-source-operand.
2. If evaluation of the second arithmetic expression yields a positive value, this value is rounded to an integer, if necessary, and assigned to the stack-integer-counter; otherwise, zero is assigned to the stack-integer-counter.
3. A string of 12 hexadecimal characters that represents the decimal value of the stack-source-operand is generated. If the value of stack-source-operand can be expressed in fewer than 12 digits, the string is filled on the left with zeros.
4. The N rightmost hexadecimal characters, where N is the number specified by the stack-integer-counter, are copied from this hexadecimal string to the destination. If the character size of the stack-destination-pointer is four bits, the characters are copied without change; if it is six or eight bits, the appropriate zone field is supplied.

If the value of the stack-integer-counter is greater than 12, the program is discontinued with a fault.

### Examples of <arithmetic expression> FOR <arithmetic expression> DIGITS

In the following examples, the first column shows the source part, the second column shows the resulting string when the destination is an 8-bit pointer, and the third column shows the resulting string when the destination is a 4-bit pointer.

Source Part	8-Bit Destination	4-Bit Destination
1234 FOR 6 DIGITS	8"001234"	4"001234"
7.5 FOR 3 DIGITS	8"008"	4"008"
-10 FOR 3 DIGITS	8"010"	4"010"
1234 FOR 3 DIGITS	8"234"	4"234"

### <arithmetic expression> FOR \* DIGITS

This source part functions similarly to a source part of the following form except that the stack-integer-counter is assigned a value equal to the minimum number of characters required to express accurately the value of the stack-source-operand.

<arithmetic expression> FOR <arithmetic expression> DIGITS

### Examples of <arithmetic expression> FOR \* DIGITS

In the following examples, the first column shows the source part, the second column shows the resulting string when the destination is an 8-bit pointer, and the third column shows the resulting string when the destination is a 4-bit pointer.

Source Part	8-Bit Destination	4-Bit Destination
1234 FOR * DIGITS	8"1234"	4"1234"
7.5 FOR * DIGITS	8"8"	4"8"
-10 FOR * DIGITS	8"10"	4"10"

### <arithmetic expression> FOR <arithmetic expression> SDIGITS

This source part functions similarly to a source part of the following form except that the sign of the first arithmetic expression is also recorded.

<arithmetic expression> FOR <arithmetic expression> DIGITS

If the character size of the stack-destination-pointer is four bits, then a 4"D" (1"1101") character, indicating a negative value, or a 4"C" (1"1100") character, indicating a positive value, is copied before the first digit. If the character size is eight bits, the zone field of the rightmost digit is changed to 1"1101" for negative values or 1"1100" for positive values.

When the character size of the stack-destination-pointer is four bits, the 4"C" or 4"D" character, indicating the sign of the value, is not counted as a digit.

For example, the statement REPLACE POINTER(A,4) BY -123 FOR 3 SDIGITS yields D123. Four, not three, characters are copied to the destination.

Strings produced by this form of source part can later be converted to an integer value with the correct sign using the INTEGER function. For example, the statement in the above example could be followed by the following statement, after which integer I would contain the value -123:

```
I := INTEGER(POINTER(A,4),3)
```

**Examples of < arithmetic expression > FOR < arithmetic expression > SDIGITS**

In the following examples, the first column shows the source part, the second column shows the resulting string when the destination is an 8-bit pointer, and the third column shows the resulting string when the destination is a 4-bit pointer.

Source Part	8-Bit Destination	4-Bit Destination
1234 FOR 6 SDIGITS	4"F0F0F1F2F3C4"	4"C001234"
-1234 FOR 6 SDIGITS	4"F0F0F1F2F3D4"	4"D001234"

**< arithmetic expression > FOR \* SDIGITS**

This source part functions similarly to a source part of the following form, except that the stack-integer-counter is assigned a value equal to the minimum number of characters required to express accurately the value of the stack-source-operand:

```
< arithmetic expression > FOR < arithmetic expression > SDIGITS
```

**Examples of < arithmetic expression > FOR \* DIGITS**

In the following examples, the first column shows the source part, the second column shows the resulting string when the destination is an 8-bit pointer, and the third column shows the resulting string when the destination is a 4-bit pointer.

Source Part	8-Bit Destination	4-Bit Destination
1234 FOR * SDIGITS	4"F1F2F3C4"	4"C1234"
-1234 FOR * SDIGITS	4"F1F2F3D4"	4"D1234"

**< arithmetic expression > FOR < count part > NUMERIC**

A source part of this form is processed as follows:

## Statements

---

1. If the arithmetic expression in the count part yields a positive value, this value is rounded to an integer, if necessary, and assigned to the stack-integer-counter; otherwise, zero is assigned to the stack-integer-counter.
2. The first arithmetic expression is evaluated, and an internal procedure is called. This procedure generates an EBCDIC character string representing the decimal value of the arithmetic expression as precisely and concisely as possible given the field width specified by the stack-integer-counter.
3. If the character size of the stack-destination-pointer is eight bits, the string is copied to the destination without translation. If the character size is six bits, the string is copied with EBCDIC-to-BCL translation. If the character size is four bits, the program is discontinued with a fault.

If a residual count does not appear in the count part, the string is copied to the destination, right-justified with blank fill, in a field with a width equal to the value of the stack-integer-counter. If a residual count does appear in the count part, the string is copied to the destination, left-justified, and the simple variable is assigned the difference between the initial value of the stack-integer-counter and the number of characters copied.

The form of the decimal representation is determined by the operand type (single or double precision), whether or not the operand value is an integer, the magnitude of the operand, the number of significant digits in its decimal representation, and the field width. The basic rule is that the number is represented as compactly as possible using integer, simple decimal, or exponential notation, as appropriate.

For example, the following source parts generate the decimal representations shown:

Source Part	Decimal Representation
12345678 FOR 8 NUMERIC	12345678
12345678 FOR 6 NUMERIC	1.23+7
123/100 FOR N:6 NUMERIC	1.23 (N := 2)

### <arithmetic expression> FOR \* NUMERIC

This source part functions similarly to a source part of the following form except that no maximum field width is specified:

```
<arithmetic expression> FOR <count part> NUMERIC
```

Thus, the internal procedure that generates the string is allowed to use as many as 36 characters to represent the decimal value of the arithmetic expression.

For example, the following source parts generate the decimal representations shown:

Source Part	Decimal Representation
123 FOR * NUMERIC	123
1/3 FOR * NUMERIC	0.333333333333333333333333333333

---

## Pointer Expression (<source>) Source Parts

### <source> FOR <arithmetic expression>

A source part of this form is processed as follows:

1. The pointer expression in the source is evaluated and assigned to the stack-source-pointer.
2. If the arithmetic expression yields a positive value, this value is rounded to an integer, if necessary, and assigned to the stack-integer-counter; otherwise, zero is assigned to the stack-integer-counter.
3. The character sizes of the stack-source-pointer and the stack-destination-pointer are compared. If they are not equal, the program is discontinued with a fault. If both the source and the destination are specified by non-character array rows or array elements, the character size of both the stack-source-pointer and the stack-destination-pointer is eight bits.
4. The number of characters specified by the stack-integer-counter are copied from the location specified by the stack-source-pointer to the destination specified by the stack-destination-pointer.

### Example of <source> FOR <arithmetic expression>

In the following example, the 20 EBCDIC characters pointed to by Q are copied to the location pointed to by P.

```
REPLACE P BY Q FOR 20
```

### <source> FOR <arithmetic expression> WORDS

A source part of this form is processed as follows:

1. The pointer expression in the source is evaluated and assigned to the stack-source-pointer.
2. If the arithmetic expression yields a positive value, this value is rounded to an integer, if necessary, and assigned to the stack-integer-counter; otherwise, zero is assigned to the stack-integer-counter.
3. The stack-source-pointer and the stack-destination-pointer are moved forward, if necessary, to the nearest word boundary.
4. The number of 48-bit words specified by the stack-integer-counter are copied from the location specified by the stack-source-pointer to the destination specified by the stack-destination-pointer.

The character sizes of the source and destination pointer expressions are irrelevant.

### **Example of <source> FOR <arithmetic expression> WORDS**

Both P and Q are advanced to the nearest word boundary, if necessary, and 20 words are copied from the location pointed to by Q to the location pointed to by P.

REPLACE P BY Q FOR 20 WORDS

### **<source> FOR <arithmetic expression> WITH <translate table>**

This construct retrieves characters from a source location, translates each character (through the use of the specified translate table) into a possibly different character with a possibly different character size, and stores each resulting character in the location indicated by the stack-destination-pointer.

The value of the pointer expression in the source points to the first character to be translated. The stack-source-pointer is initialized to this value. The stack-destination-pointer and the stack-source-pointer need not have the same character size. Instead, the stack-source-pointer must have a character size equal to that of the characters being translated, and the stack-destination-pointer must have a character size equal to that of the resulting translated characters.

The value of the arithmetic expression indicates the number of characters to be translated and written to the destination. This value is integerized, if necessary, and assigned to the stack-integer-counter. The stack-auxiliary-pointer is initialized to point to the first character of the first word of the translate table, and its character size is absent. Normally, when a pointer is used and its character size is absent, a default value of six or eight is used, depending on the default character type. However, the character size of the pointer used to initialize the stack-auxiliary-pointer is irrelevant. The translate table is not examined sequentially (one character at a time); instead, the data in the table is accessed by special indexing techniques implemented in the hardware, as follows:

#### **<intrinsic translate table>**

If the translate table is of this form, the stack-auxiliary-pointer is initialized to point to the appropriate intrinsic translate table. The function of each translate table can be deduced from its name. For example, the HEXTOEBCDIC table is used to translate characters from hexadecimal to EBCDIC.

#### **<translate table identifier>**

If the translate table is of this form, a translate table must have been declared in a TRANSLATETABLE declaration. For a detailed discussion regarding the construction of a translate table, refer to “TRANSLATETABLE Declaration” in Section 3, “Declarations.”

**<subscripted variable>**

If the translate table is of this form, the programmer is responsible for creating a properly structured translate table that is contained entirely in the array row and begins with the word in the array row indicated by the subscripted variable. From the subscripted variable to the end of the array row there must be enough words for the entire translate table: 4, 16, or 64 words, depending on whether the character type is 4 bit, 6 bit, or 7 or 8 bit, respectively. If there are not enough words for the translate table, an invalid index error can result at run time. For more information on translate table indexing, refer to "Translate Table Indexing" under "TRANSLATETABLE Declaration" in Section 3, "Declarations."

**Examples of <source> FOR <arithmetic expression> WITH <translate table>**

```
REPLACE POINTER(B,4) BY POINTER(A,8) FOR 20 WITH EBCDICTOHEX
```

```
A = 8"0123456789ABCDEFGHIJ"
```

```
B = 4"0123456789ABCDEFFFFF"
```

```
REPLACE POINTER(B,7) BY POINTER(A,8) FOR 14 WITH EBCDICTOASCII
```

```
A = 4"F0F1F2F3F4F5F6F7F8F9C1C2C3C4"
```

```
B = 4"3031323334353637383941424344"
```

```
REPLACE POINTER(B,8) BY POINTER(A,4) FOR 12 WITH HEXTOEBCDIC
```

```
A = 8"012345" = 4"F0F1F2F3F4F5"
```

```
B = 8"F0F1F2F3F4F5"
```

**<source> WITH <picture identifier>**

The character data specified by the source (which must be a pointer) is processed under control of the picture specified by the picture identifier. The source and destination pointers must be 4-bit, 8-bit, or word-oriented. If the source is a word-oriented pointer, it is changed to a 4-bit pointer if the destination is a 4-bit pointer; otherwise, it is changed to an 8-bit pointer. If the destination is a word-oriented pointer, it is changed to a 4-bit pointer if the source is a 4-bit pointer; otherwise, it is changed to an 8-bit pointer. If neither the source nor the destination pointer is a word-oriented pointer, the source and destination pointers must either both be 4-bit pointers or both be 8-bit pointers. Details regarding the formation and action of pictures are described under "PICTURE Declaration" in Section 3, "Declarations."

**Source Parts with Boolean Conditions**

The next eight forms of the source part copy characters from the source to the destination until a source character fails or passes the specified test. The number of characters copied can also be limited by an optional count part. For more information on the use of these Boolean conditions, refer to "SCAN Statement" later in this section.



## Statements

---

In the source parts containing a condition of either of the following forms the source characters are tested against bits [7:8], [5:6], or [3:4] of the arithmetic expression, depending on the character size of the source:

```
WHILE <relational operator> <arithmetic expression>
UNTIL <relational operator> <arithmetic expression>
```

In all cases, the stack-source-pointer is left pointing to the character that failed or passed the test.

The count part consists of an arithmetic expression and, optionally, a residual count. The value of the arithmetic expression specifies the maximum number of characters to be copied. The residual count, when it appears, is a simple variable in which is stored the difference between the value of the arithmetic expression and the number of source-part characters copied.

### **<source> WHILE <relational operator> <arithmetic expression>**

The stack-source-pointer is initialized to the source pointer. Characters are then copied from the source to the destination as long as source characters pass the test.

A paged (segmented) array error fault could occur at run time if all of the following conditions occur:

- The stack-destination-pointer references the first character beyond the end of the destination array.
- The stack-source-pointer references the first character to fail the test.
- The stack-integer-counter is nonzero.

**Example of <source> WHILE <relational operator> <arithmetic expression>**

```
REPLACE P BY Q WHILE NEQ " "
    Q = "LONG STRING"
    P = "LONG"
```

### **<source> UNTIL <relational operator> <arithmetic expression>**

The stack-source-pointer is initialized to the source pointer. Characters are then copied from the source to the destination until a source character passes the test.

A paged (segmented) array error fault could occur at run time if all of the following conditions occur:

- The stack-destination-pointer references the first character beyond the end of the destination array.
- The stack-source-pointer references the first character to pass the test.
- The stack-integer-counter is nonzero.

**Example of <source> UNTIL <relational operator> <arithmetic expression>**

```

REPLACE P BY Q UNTIL = "."
      Q = "FILE/TITLE ON PACK.XXX"
      P = "FILE/TITLE ON PACK"

```

**<source> WHILE IN <truth set table>**

The stack-source-pointer is initialized to the source pointer. Characters are then copied from the source to the destination as long as the source characters are members of the truth set. For further information on truth sets, see "TRUTHSET Declaration" in Section 3, "Declarations."

**Example of <source> WHILE IN <truth set table>**

```

REPLACE P BY Q WHILE IN ALPHA8
      Q = "ABCD1234.56"
      P = "ABCD1234"

```

**<source> UNTIL IN <truth set table>**

The stack-source-pointer is initialized to the source pointer. Characters are then copied from the source to the destination until a source character is encountered that is a member of the truth set. For further information on truth sets, see "TRUTHSET Declaration" in Section 3, "Declarations."

**Example of <source> UNTIL IN <truth set table>**

```

REPLACE P BY Q UNTIL IN ALPHA8
      Q = ", *,$1234"
      P = ", *,$"

```

**<source> FOR <count part> WHILE <relational operator> <arithmetic expression>**

The stack-source-pointer is initialized to the source pointer. The stack-integer-counter is initialized to the value of the arithmetic expression in the count part. Characters are then copied from the source to the destination and the stack-integer-counter is decremented for each character copied as long as the stack-integer-counter is not zero and the source characters pass the test.

A paged (segmented) array error fault could occur at run time if all of the following conditions occur:

## Statements

---

- The stack-destination-pointer references the first character beyond the end of the destination array.
- The stack-source-pointer references the first character to fail the test.
- The stack-integer-counter is nonzero.

**Example of <source> FOR <count part> WHILE <relational operator> <arithmetic expression>**

```
REPLACE P BY Q FOR N:11 WHILE NEQ " "
```

```
Q = "LONG STRING"  
P = "LONG"          (and N = 7)
```

**<source> FOR <count part> UNTIL <relational operator> <arithmetic expression>**

The stack-source-pointer is initialized to the source pointer. The stack-integer-counter is initialized to the value of the arithmetic expression in the count part. Characters are then copied from the source to the destination and the stack-integer-counter is decremented for each character copied until either the stack-integer-counter is zero or a source character passes the test.

A paged (segmented) array error fault could occur at run time if all of the following conditions occur:

- The stack-destination-pointer references the first character beyond the end of the destination array.
- The stack-source-pointer references the first character to pass the test.
- The stack-integer-counter is nonzero.

**Example of <source> FOR <count part> UNTIL <relational operator> <arithmetic expression>**

```
REPLACE P BY Q FOR N:22 UNTIL = "."
```

```
Q = "FILE/TITLE ON PACK.XXX"  
P = "FILE/TITLE ON PACK"      (and N = 4)
```

**<source> FOR <count part> WHILE IN <truth set table>**

The stack-source-pointer is initialized to the source pointer. The stack-integer-counter is initialized to the value of the arithmetic expression in the count part. Characters are then copied from the source to the destination and the stack-integer-counter is decremented for each character copied as long as the stack-integer-counter is not zero and the source characters are members of the truth set. For further information on truth sets, see "TRUTHSET Declaration" in Section 3, "Declarations."

**Example of <source> FOR <count part> WHILE IN <truth set table>**

```
REPLACE P BY Q FOR N:11 WHILE IN ALPHAB
```

```
Q = "ABCD1234.56"
P = "ABCD1234"      (and N = 3)
```

**<source> FOR <count part> UNTIL IN <truth set table>**

The stack-source-pointer is initialized to the source pointer. The stack-integer-counter is initialized to the value of the arithmetic expression in the count part. Characters are then copied from the source to the destination and the stack-integer-counter is decremented for each character copied until either the stack-integer-counter is zero or a source character is a member of the truth set. For further information on truth sets, see "TRUTHSET Declaration" in Section 3, "Declarations."

**Example of <source> FOR <count part> UNTIL IN <truth set table>**

```
REPLACE P BY Q FOR N:10 UNTIL IN ALPHAB
```

```
Q = ", *,$1234"
P = ", *,$"      (and N = 4)
```

**Other Source Parts****<pointer-valued attribute>**

The string of characters that forms the value of the pointer-valued attribute is copied to the location indicated by the stack-destination-pointer. The string of characters is formatted in the destination array row in a form suitable to serve in a replace pointer-valued attribute statement that assigns a value to the same attribute. The character string ends with an EBCDIC period (8".). For example, if P is a pointer identifier and F1 and F2 are file identifiers, then the following sequence of statements is valid:

```
REPLACE P BY F1.TITLE;
REPLACE F2.TITLE BY P;
```

All pointer-valued attributes have a character size of eight bits. At run time, if the destination pointer does not also have a character size of eight bits, the program is discontinued with a fault.

If a pointer-valued attribute appears as the source part in a REPLACE statement, a call is made on an operating system procedure to perform this part of the REPLACE statement.

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---

### <string expression>

When a string expression appears as the source part in a REPLACE statement, it is evaluated and stored in a pool array. The stack-source-pointer is initialized to point to the first character of the string in the pool array. The entire string is copied to the destination.

#### Example of String Expression

The following example copies the EBCDIC string ABCDEFG to the location pointed to by P.

```
STR := "ABCDEFGG";  
REPLACE P BY STR;
```

### Examples of REPLACE Statement

```
REPLACE PTR BY "A"  
REPLACE PTR:PTR BY "*" FOR 75  
REPLACE PTR BY ITEM  
REPLACE PTR BY (4"Ø3").[7:48] FOR 1  
REPLACE PTR BY " " FOR N WORDS  
REPLACE PTR:PTR BY PST FOR 18  
REPLACE PTR BY PST:PST FOR NUM WORDS  
REPLACE PTR BY PINFO WITH PIC  
REPLACE PTR:PTR BY PST WHILE NEQ " "  
REPLACE PTR BY PST WHILE IN ALPHA  
REPLACE P BY X FOR * DIGITS  
REPLACE P BY X FOR 5Ø NUMERIC  
REPLACE P BY X FOR * NUMERIC  
REPLACE PTR BY PST WHILE IN MYTRUTHTABLE  
REPLACE PTR BY PST UNTIL = ", "  
REPLACE PTR:PTR BY PST:PST UNTIL IN ALPHA8  
REPLACE PTR BY PST FOR THELENGTH WHILE > "Ø"
```

```

REPLACE PTR BY PST FOR LEFT:25 WHILE IN ACCEPTABLE
REPLACE PTR BY PST FOR 120 UNTIL NEQ " "
REPLACE PTR BY PST FOR M:N UNTIL IN ALPHA
REPLACE PTR:PTR BY SUMTOTAL FOR 6 DIGITS, "."
REPLACE PTR BY FYLE.TITLE
REPLACE PTR BY PST:PST FOR L WITH XLATABLE
REPLACE PTR BY STR
REPLACE PTR BY SARRAY[4,J]
REPLACE P BY S1 || S2
REPLACE P BY PTR:PTR FOR 10
REPLACE P BY TAKE(S,2) || SA[4]
REPLACE P BY HEAD(S,ALPHA)

```

## REPLACE FAMILY-CHANGE Statement

The REPLACE FAMILY-CHANGE statement adds stations to, or deletes stations from, the family of an open, remote file.

**<replace family-change statement>**

```
— REPLACE —<family designator>— BY —<up or down>—<simple source>—|
```

**<family designator>**

```
—<file designator>— . — FAMILY —————|
```

**<up or down>**

```
— * [ + ] —————|
   [ - ]
```

**<simple source>**

```
—<string literal>—|
 [ <pointer expression> ]
```

The file designator specifies the file whose FAMILY file attribute is to be changed. For more information on the file designator, see “SWITCH FILE Declaration” in Section 3, “Declarations.” If a station is to be added to the family, <up or down> is \*+. If a station is to be deleted from the family, <up or down> is \*- . The simple source specifies

the title of the station involved. Because the simple source is a value for a pointer-valued attribute, its value must end with a period (.). For more specific information, refer to “REPLACE POINTER-VALUED ATTRIBUTE Statement” later in this section.

### Specification of Valid Stations

If the simple source does not reference a valid station title, as specified for the current network in the Network Definition Language II (NDLII) description, then the REPLACE FAMILY-CHANGE statement has the following effects:

- < file designator > .FAMILY is unchanged.
- < file designator > .ATTERR is given the value TRUE, and < file designator > .ATTYPE is set to the appropriate value.
- An appropriate error message is displayed on the Operator Display Terminal (ODT).
- The program continues.

If < up or down > is \*- and the simple source specifies a valid station as defined by the current NDLII description, but the specified station is not currently a member of the family, then the REPLACE FAMILY-CHANGE statement makes no change to the specified family. No error condition is indicated (such a situation is not considered to be an error) and control passes to the next statement of the program.

If, after execution of a REPLACE FAMILY-CHANGE statement, the remote file is closed with release and later reopened, the family reverts to its NDLII-specified value. However, if the remote file is closed with retention and later reopened, the family retains its changed value.

When the REPLACE FAMILY-CHANGE statement is executed, a call is made on an operating system procedure to perform the desired function.

### Examples of REPLACE FAMILY-CHANGE Statement

The following example adds the station with the title "ACCT7" to the family of the remote file NETWORK.

```
REPLACE NETWORK.FAMILY BY *+ "ACCT7."
```

The following example deletes the station with the title given by the pointer STATIONNAMEPTR from the family of the remote file DATACollectors.

```
REPLACE DATACollectors.FAMILY BY *- STATIONNAMEPTR
```

## REPLACE POINTER-VALUED ATTRIBUTE Statement

The REPLACE POINTER-VALUED ATTRIBUTE statement changes the value of a pointer-valued attribute.

**<replace pointer-valued attribute statement>**

```
— REPLACE —<pointer-valued attribute>— BY —————>
→ [ <simple source> —————> ]
  [ <pointer-valued attribute> ]
```

**<pointer-valued attribute>**

```
— [ <pointer-valued file attribute> —————> ]
  [ <pointer-valued task attribute> —————> ]
  [ <string-valued library attribute> ]
```

**<pointer-valued file attribute>**

```
—<file designator> [ <attribute parameter specification> ] . —————>
→ <pointer-valued file attribute name> —————>
→ [ ( —<arithmetic variable>— ) ]
```

The attribute error number returned from the operating system can be captured in the <arithmetic variable>.

**<pointer-valued task attribute>**

```
—<task designator>— . —<pointer-valued task attribute name>—————|
```

**<pointer-valued task attribute name>**

```
— [ ACCESSCODE —————> ]
  [ BACKUPPREFIX —————> ]
  [ CHARGECODE —————> ]
  [ FILECARDS —————> ]
  [ NAME —————> ]
  [ USERCODE —————> ]
```

**<string-valued library attribute>**

```
—<library identifier>— . —<string-valued library attribute name>—————|
```

When the REPLACE POINTER-VALUED ATTRIBUTE statement is executed, a call is made on an operating system procedure to perform the desired function.

## Specification of the Simple Source

The simple source specifies the string of characters that is to become the new value of the pointer-valued attribute.

If the simple source is a string literal, the last character of the string literal must be a period (.). The effective part of the string literal is terminated by the first period in the string. A maximum string length is associated with each pointer-valued attribute. If the effective part of the string literal has a string length that is greater than the maximum length allowed for the pointer-valued attribute, then the new value of the pointer-valued attribute is the value of the string literal truncated on the right to the required length.



If the simple source is a pointer expression, the pointer expression must point to the string of characters that is to become the new value of the pointer-valued attribute. Starting with the first character pointed to by the pointer expression, characters are copied as the new value of the pointer-valued attribute until a period is encountered, the maximum number of characters for the attribute are copied, or the end of the array row is encountered. The last case results in a run-time error.

If a pointer-valued task attribute is used as the destination and the source is a pointer-valued attribute, the source attribute and the destination attribute must be the same attribute. If a pointer-valued file attribute is used as the destination, the source must be a simple source. If a string-valued library attribute is used as the destination, the source can be either a simple source or another string-valued library attribute.

### Examples of REPLACE POINTER-VALUED ATTRIBUTE Statement

In the following example, the TITLE attribute of file FYLE is assigned "MASTER/PAYROLL."

```
REPLACE FYLE.TITLE BY "MASTER/PAYROLL."
```

In the following example, the NAME attribute of the task TSK is assigned "SECOND/STACK."

```
REPLACE TSK.NAME BY "SECOND/STACK."
```

In the following example, the NAME attribute of task T is assigned the value of the NAME attribute of task TS.

```
REPLACE T.NAME BY TS.NAME
```

In the following example, the NAME attribute of the task TSK is assigned the value of the NAME attribute of the task T.PARTNER.

```
REPLACE TSK.NAME BY T.PARTNER.NAME
```

In the following example, the INTNAME attribute of library L is assigned "INTLIB."

```
REPLACE L.INTNAME BY "INTLIB."
```

In the following example, the TITLE attribute of library LIB\_A is assigned the value of the TITLE attribute library LIB\_B.

```
REPLACE LIB_A.TITLE BY LIB_B.TITLE
```

### RESET Statement

The RESET statement sets the happened state of the designated event to FALSE (not happened).





shorter than the array segmentation start size, then it is unpagged, and resizing it larger without using the PAGED option does not cause it to become pagged.

An array that is initially declared to be shorter than the array segmentation start size and is, therefore, an unpagged array can be resized to become a pagged array by using the PAGED option. The new pagged array is considered to be touched after the resize is complete.

The PAGED option is useful in cases where the desired size of a pagged array is not known at the time the array is declared. The PAGED option offers an alternative to declaring an array larger than the array segmentation start size and avoiding references to the array until the desired size is known. The PAGED option achieves the same results and makes errors less likely. The only restriction on the use of the PAGED option is that the new size of the resized array must be larger than the array segmentation start size.

If the new array row size is less than the old, any pointer variable that now points beyond the end of the array row is set to the uninitialized state.

The value of the new size is integerized with rounding, if necessary, to specify a new size,  $S_n$ , which is interpreted as a number of elements for the resized array row. If the array row is an original array, then its size is changed to  $S_n$ . If the array row is a referred array and the original array has a different element size, the original array is resized to have just enough elements to hold  $S_n$  elements of the referred array row.

When an original array is resized, any referred arrays with element widths different from those of the original array are assigned the size they would have had if the original array had been declared at its new size and the referred array had been created from the original by array equivalence or array reference assignment.

When a resize of a referred array causes a resize of an original array, the size calculations are performed with the element widths  $W_n$  for the resized referred array and  $W_o$  for the original array. The new size of the original array,  $S_o$ , is the following:

$$S_o := (S_n * W_n + W_o - 1) \text{ DIV } W_o$$

$S_o * W_o$  can exceed  $S_n * W_n$ . The new size,  $S_r$ , of any referred array with element width  $W_r$  that is based on the resized original array is the following:

$$S_r := (S_o * W_o) \text{ DIV } W_r$$

$W_r$  is equal to  $W_n$  for the explicitly resized referred array, and the net calculation is the following, which can exceed  $S_n$ .

$$S_r := (((S_n * W_n + W_o - 1) \text{ DIV } W_o) * W_o) \text{ DIV } W_n$$

The explicitly resized array row can be slightly larger than requested, if the original array has a wider element width. For example, if arrays RA and EA are declared as follows then EA contains 36 elements:

```
REAL ARRAY RA[0:5];
EBCDIC ARRAY EA[0] = RA;
```

## Statements

If the statement `RESIZE(EA,50,RETAIN)` is executed, the original array, `EA`, is resized to a new size of 9 words, calculated from the following:

$$S_o = (50 * 8 + 48 - 1) \text{ DIV } 48 = 9$$

The actual new size of the referred array, `EA`, is then 54, calculated from the following:

$$S_r = (9 * 48) \text{ DIV } 8 = 54$$

Because the second calculation truncates,  $S_r * W_r$  can be less than  $S_o * W_o$ , just as with array row equivalence or array reference assignment.

For example, consider the following statement, where `H` is a hexadecimal array row:

```
RESIZE(H,29,DISCARD)
```

The following table shows the size assigned to referred arrays for several combinations of referred and original classes. The diagonal of the table shows the size assigned to each original.

Original	Referred			
	Hexadecimal	EBCDIC	Real	Double
Hex	29	14	2	1
EBCDIC	30	15	2	1
Real	36	18	3	1
Double	48	24	4	2

## Special Array Resize Parameters

<special array resize parameters>

```

┌──────────<multidimensional array designator>──────────┐ , ──<new size>── , ───────────>
├──────────<event array designator>──────────┘
├──────────<string array designator>──────────┘
└──────────────────────────────────────────────────────────┘
→- RETAIN ───────────────────────────────────────────────────┘

```

In this form of `RESIZE` statement, the first parameter is an array whose elements do not have an array class. Events and strings are special classes of objects. A multidimensional array can be considered an array of arrays.

The `RESIZE` statement sets the size of the parameter array to the new size, unless the new size is less than the existing size, in which case the `RESIZE` statement is ignored and the warning message *ATTEMPTED DOWNWARD RESIZE IGNORED* is generated.

If the first parameter includes a subarray selector, the dimension corresponding to the first asterisk (\*) is changed; otherwise, the first dimension of the designated array is changed. Whenever a higher-order dimension of an array is enlarged, new subarrays are created with the same dimensions as in the original ARRAY declaration. Any existing subarrays are unaffected by the resize operation. For example, given the declaration `DOUBLE ARRAY A[1:2,0:5,-4:4]` the statement `RESIZE(A[1,*],8,RETAIN)` increases the size of `A[1,*]` from 6 to 8 (new bound pair = 0:7). The statement causes array rows `A[1,6,*]` and `A[1,7,*]` to be established as one-dimensional double arrays of size 9, even if all existing rows of A had already been resized to some other size.

## Multidimensional Array Designator

A multidimensional array designator is an array designator or a procedure reference array designator with dimensionality greater than one; that is, a multidimensional array name or procedure reference array identifier, optionally suffixed by a subarray selector with at least two asterisks (\*).

If the array to be resized is specified by a multidimensional array designator, then the new subarrays have the same type as the original array; their contents are undefined.

## Event Array Designator

If the array to be resized is specified by an event array designator, then enlarging the low-order dimension creates new events with the happened state equal to `FALSE` (not happened) and the available state equal to `TRUE` (available); existing elements are unaffected.

## String Array Designator

If the array to be resized is specified by a string array designator, then enlarging the low-order dimension creates new empty strings; existing elements are unaffected.

## Run-Time Error Messages

When an illegal resize is attempted on an array, one of the following messages is displayed at run time:

### **BAD RESIZE/DEALLOCATE – NOT AN ARRAY**

An attempt was made to resize something that is not an array, such as an uninitialized array reference.

### **BAD RESIZE/DEALLOCATE – ARRAY NOT MULTI-DIMENSIONAL**

An attempt was made to resize a one-dimensional array when a multidimensional array was expected.

### **BAD RESIZE/DEALLOCATE – RESIZING IMMOVABLE INSTACK ARRAY**

An attempt was made to resize an immovable instack array.

### **BAD RESIZE/DEALLOCATE – RESIZING READONLY ARRAY**

An attempt was made to resize a value array.

### **ILLEGAL DOWNWARD RESIZE ON A PAGED ARRAY**

An attempt was made to resize a paged array to a length smaller than its initial length. A segmented array that has been referenced can be resized only on a system that runs the operating system.

### **RESIZE ABORTED – INSUFFICIENT MEMORY**

The job performing the resize has been terminated because there is insufficient memory to complete the resize.

### **BAD RESIZE/DEALLOCATE – RESIZE PAGED TO INVALID LENGTH**

An attempt was made to resize a long array and make it a paged array where the new size is not greater than the current size.

## Examples of RESIZE Statement

In the following example, the size of one-dimensional array A is changed to NEWSZ, and the previous contents of A are discarded.

```
RESIZE(A,NEWSZ,DISCARD)
```

In the following example, the size of one-dimensional array ARAY is changed to NEWSZ, and ARAY is changed to a paged array. The contents of ARAY are retained.

```
RESIZE(ARAY,NEWSZ,PAGED)
```

In the following example, the size of one-dimensional array INPUTDATA is changed to equal the value of the MAXRECSIZE attribute of file F. The previous contents of INPUTDATA are discarded.

```
RESIZE(INPUTDATA,F.MAXRECSIZE,DISCARD)
```

In the following example, the size of the specified row of array A is changed to 5, and the previous contents of that row are discarded. The other rows of A are not affected.

```
RESIZE(A[2,*],5,DISCARD)
```

In the following example, the size of one-dimensional array A is increased by 100 elements, and the previous contents of A are retained.

```
RESIZE(A,SIZE(A)+100,RETAIN)
```

In the following example, the size of the one-dimensional event array `EVENTARRAY` is changed to 20, and the previous contents of the array are retained. Note that `RETAIN` must be specified for event arrays.

```
RESIZE(EVENTARRAY,20,RETAIN)
```

In the following example, the size of the second dimension of array `STUFF` is changed to `M`. New array rows are created for the new size of the second dimension. The previous contents of the array are retained.

```
RESIZE(STUFF[I,*,*],M,RETAIN)
```

In the following example, the size of the specified row of array `STUFF` is changed to `N`, and the previous contents of that row are retained.

```
RESIZE(STUFF[I,J,*],N,RETAIN) % RESIZE an array row
```

## RESPOND Statement

The `RESPOND` statement is used to enable a program to issue a positive or negative response to an offer for subfile dialog establishment or a request for orderly termination. Networks that support this function can be found in the *A Series I/O Subsystem Programming Guide*. The program is notified of requests for dialog establishment or termination through the `CHANGEEVENT` and `FILESTATE` attributes.

**<respond statement>**

```
— RESPOND — ( —<respond file part>— , —<respond options>— ) —|
```

**<respond file part>**

```
—<file designator>—|
| [SUBFILE —<subfile index>— ] |
```

**<respond options>**

```
—<respondtype option>—|
| , —<associateddata option>—|
```

**<respondtype option>**

```
— RESPNDTYPE — = |
| ACCEPTOPEN |
| REJECTOPEN |
| ACCEPTCLOSE |
```

The `RESPOND` statement can be used only when the `KIND` of the file designator is `PORT` and only when the `SERVICE` file attribute is set to a network type that supports this feature.



### RESPOND Statement Options

The subfile index, if present, specifies the subfile to which the RESPOND statement applies. If 0 (zero) is specified, the RESPOND is invoked on all subfiles in a FILESTATE that are awaiting a response.

The RESPONDTYPE option indicates the type of the response. The type of the response must be consistent with the FILESTATE. The ACCEPTOPEN and ACCEPTCLOSE options indicate that a positive response is to be generated and issued for an open indication or close indication received from the correspondent application. The REJECTOPEN option indicate that a negative response is to be generated and issued for an open indication.

The ASSOCIATEDDATA option can be used to send associated data to the correspondent endpoint with the response. If a string expression is used, the length of the expression is calculated automatically and used for the ASSOCIATEDDATALENGTH value. Otherwise, the ASSOCIATEDDATALENGTH option indicates how many characters are to be sent as the ASSOCIATEDDATA value.

If the ASSOCIATEDDATA value is of type HEX, the ASSOCIATEDDATALENGTH option indicates the number of HEX characters, otherwise the number of EBCDIC characters. If the ASSOCIATEDDATALENGTH is not a single-precision integer it is integerized.

The RESPOND statement can be used as an arithmetic function. It returns the same values as the file attribute AVAILABLE. For a description of these values, see the *A Series File Attributes Programming Reference Manual*. If the result of this statement is not interrogated by the program, the program terminates if the respond action fails.

### Examples of RESPOND Statement

The following program responds affirmatively to a request to close from the correspondent endpoint for the subfile of port file FILEID.

```
RESPOND (FILEID, RESPONDTYPE = ACCEPTCLOSE)
```

The following program responds to an offer for subfile I on port file FILEID by accepting the offer.

```
RESPOND (FILEID [SUBFILE I], RESPONDTYPE = ACCEPTOPEN)
```

The following program responds to an offer for subfile 1 on port file FILEID by rejecting the offer. The associated data that is stored in the string STR is sent with the response.

```
RESPOND (FILEID [SUBFILE 1], RESPONDTYPE = REJECTOPEN,  
        ASSOCIATEDDATA =STR)
```

The following program responds to an offer for subfile I on port file FILEID by accepting the offer. Twelve characters of associated data are taken from the array RA, beginning at index 0, and are sent with the response.

RESPOND (FILEID [SUBFILE I], RESPONDTYPE = ACCEPTOPEN,  
ASSOCIATEDDATALENGTH = 12, ASSOCIATEDDATA = RA [Ø])

## REWIND Statement

The REWIND statement causes the designated file to be closed and the file buffer areas to be returned to the system.

<rewind statement>

— REWIND — ( —<file designator>— ) \_\_\_\_\_|

## Effects on Designated Files

If the file is a paper tape or magnetic tape file, it is rewound. For disk files, the record pointer is set to the first record of the file. For more information on the file designator option, see “SWITCH FILE Declaration” in Section 3, “Declarations.”

Card reader, card punch, and line printer units are released from program control. When the REWIND statement is used for a magnetic tape file that is positioned past the first reel of a multireel file, the second and subsequent reels are released from program control. Other kinds of units remain under program control.

For paper tape files, the REWIND statement can be used only on input.

For random access files, if the file is to be reused immediately, the statement *SEEK(<file designator>[0])* positions the file at its first record while avoiding the overhead of closing the file and then reopening it. For more information, refer to “SEEK Statement” later in this section.

## Example of REWIND Statement

In the following example, if FILEA is a disk file, the file is closed and the record pointer is set to the first record of the file. If FILEA is a magnetic tape file, the file is closed and the tape is rewound.

REWIND(FILEA)

## RUN Statement

The RUN statement initiates a procedure as an independent program.

<run statement>

— RUN —<procedure identifier> \_\_\_\_\_|  
  └<actual parameter part>┘

→ [ —<task designator>— ] \_\_\_\_\_|

### Initiating Procedures

Initiation of a procedure as an independent program consists of setting up a separate stack, passing any parameters (call-by-value only), and beginning the execution of the initiated procedure. For more information on the procedure identifier, see “PROCEDURE Declaration” in Section 3, “Declarations.”

The initiating program continues execution, and both the initiated procedure and the initiating program run in parallel. The initiated procedure must be compiled separately and declared EXTERNAL in the initiating program.

A procedure initiated by a RUN statement, as opposed to a PROCESS statement, is independent of the initiating program. No critical block exists for the initiated procedure, and the initiating program can finish processing while the external procedure continues running.

The contents of the designated task are copied by the operating system so that the initiated procedure has its own task variable. Before initiation, the values of the task attributes of the task, such as COREESTIMATE, STACKSIZE, and DECLARED PRIORITY, can be used to control the execution of the procedure. For information about assigning values to task attributes, refer to <arithmetic task attribute> under “Arithmetic Assignment,” <Boolean task attribute> under “Boolean Assignment,” and “Task Assignment” earlier in this section. For information about the task designator, see “TASK and TASK ARRAY Declarations” in Section 3, “Declarations.”

Because array and file parameters cannot be call-by-value, procedures with array or file parameters cannot be invoked with a RUN statement. Also, a procedure that has a pointer or string as a parameter, whether or not it is specified as call-by-value, cannot be invoked with a RUN statement.

If the procedure identifier is a system supplied process, such as an intrinsic, the library GENERALSUPPORT must be declared using a library entry point specification. The procedure identifier must be declared in the program or the syntax error PROCEDURE MUST BE USER DECLARED results.

### Examples of RUN Statement

The following example invokes procedure SIMPL, which has no parameters, as an independent program. The task TSK is copied by the operating system for SIMPL to use as its task variable.

```
RUN SIMPL [TSK]
```

The following example invokes procedure DOOER as an independent program, passing the four parameters X, Y, Z, and the string literal "ABCD". Though the value "ABCD" appears as a string literal, it is passed to a call-by-value REAL parameter. The task designated by TSKARRAY[INDEX] is used by DOOER as its task variable.

```
RUN DOOER(X,Y,Z,"ABCD") [TSKARRAY[INDEX]]
```

## SCAN Statement

The SCAN statement examines a contiguous portion of character data in an array row, one character at a time, in a left-to-right direction.

**<scan statement>**

```
— SCAN —<source>—<scan part>—————|
```

For more information on <source> and <scan part>, see “REPLACE Statement” earlier in this section.

The source is always a pointer expression, and at the completion of the SCAN statement the final value of the stack-source-pointer can be stored in a pointer variable.

The scan part is basically a testing operation that determines when the SCAN statement is to stop. The scan part can specify that scanning is to stop after a given number of source characters, or when a source character fails or passes a specified test.

The count part is used in a scan part when a limited number of source characters are to be scanned. A residual count can be used, in which case the value of the remaining count is stored in the specified simple arithmetic variable at the completion of the SCAN statement.

The relational operator in the condition option specifies the comparison to be made between the arithmetic expression and the source characters. The arithmetic expression can be of any valid form, but most often takes the form of a one-character string literal.

Before the scan operation begins, the arithmetic expression in the condition option is evaluated and the value of bits [7:8], [5:6], or [3:4] (depending on the character size of the source pointer) of the arithmetic expression is assigned to the stack-source-operand.

## Scan Part Combinations

The formal syntax of the <scan part> can be reduced to the following combinations:

```
WHILE <relational operator> <arithmetic expression>
UNTIL <relational operator> <arithmetic expression>
```

```
WHILE IN <truth set table>
UNTIL IN <truth set table>
```

```
FOR <count part> WHILE <relational operator> <arithmetic expression>
FOR <count part> UNTIL <relational operator> <arithmetic expression>
```

```
FOR <count part> WHILE IN <truth set table>
FOR <count part> UNTIL IN <truth set table>
```

Each of these combinations is discussed in the following separate sections. Because all combinations of the SCAN statement begin with <source>, each description of

## Statements

---

a combination begins with the assumption that the stack-source-pointer has been initialized to the source pointer.

The scan parts that contain a count part examine, or scan, source characters until either the number of characters specified by the arithmetic expression in the count part have been examined or a source character fails or passes the test specified by the condition syntax. The scan parts that do not contain a count part examine source characters until either a source character fails or passes the test specified by the condition syntax or the end of the array is reached. If the end of the array is reached, the program is discontinued with a paged (segmented) array error.

### Scan Parts Without Count Parts

#### **WHILE <relational operator> <arithmetic expression>**

Characters are scanned as long as they pass the test. For example, the following statement scans the characters pointed to by P as long as a period (.) is not encountered:

```
SCAN P WHILE NEQ "."
```

#### **UNTIL <relational operator> <arithmetic expression>**

Characters are scanned until a source character passes the test. For example, the following statement scans the characters pointed to by P until a blank character is encountered:

```
SCAN P:P UNTIL = " "
```

P is updated to point to the blank character that passed the test.

#### **WHILE IN <truth set table>**

Characters are scanned as long as they are members of the truth set. For example, the following statement scans the characters pointed to by P as long as they are members of the truth set ALPHA8:

```
SCAN P:P WHILE IN ALPHA8
```

P is updated to point to the first character that is not a member of ALPHA8.

#### **UNTIL IN <truth set table>**

Characters are scanned until a source character is found that is a member of the truth set. For example, the following statement scans the characters pointed to by P until a member of the truth set ALPHA8 is encountered:

```
SCAN P:P UNTIL IN ALPHA8
```

P is updated to point to the first character that is a member of ALPHA8.

## Scan Parts with Count Parts

### FOR <count part> WHILE <relational operator> <arithmetic expression>

The stack-integer-counter is initialized to the value of the arithmetic expression in the count part. Characters are then scanned and the stack-integer-counter is decremented for each character as long as the stack-integer-counter is not zero and a source character passes the test. For example, the following statement scans the first 20 characters pointed to by P as long as a period (.) is not encountered:

```
SCAN P FOR N:20 WHILE NEQ "."
```

Because N reflects how many of the 20 characters have yet to be scanned, it can be used to determine whether a period was encountered and, if so, where the period is.

### FOR <count part> UNTIL <relational operator> <arithmetic expression>

The stack-integer-counter is initialized to the value of the arithmetic expression in the count part. Characters are then scanned and the stack-integer-counter is decremented for each character until either the stack-integer-counter is zero or a source character passes the test. For example, the following statement scans the first N characters pointed to by P until the first nonblank character is encountered:

```
SCAN P:P FOR N:N UNTIL NEQ " "
```

If, when the statement is invoked, the value of N is the number of characters between P and the end of the array row, then because both P and N are updated in this statement, at the completion of the statement, N gives the number of characters between the updated P and the end of the array row.

### FOR <count part> WHILE IN <truth set table>

The stack-integer-counter is initialized to the value of the arithmetic expression in the count part. Characters are then scanned and the stack-integer-counter is decremented for each character as long as the stack-integer-counter is not zero and source characters are members of the truth set. For further information on truth sets, see "TRUTHSET Declaration" in Section 3, "Declarations."

For example, the following statement scans the first 20 characters pointed to by P as long as they are members of the truth set ALPHA8:

```
SCAN P:P FOR N:20 WHILE IN ALPHA8
```

P is updated to point to the first character that is not a member of ALPHA8, or, if all of the 20 characters scanned are members of ALPHA8, to the character that is 20 characters beyond the initial position of P. N is assigned the number of characters yet to be scanned.

### FOR <count part> UNTIL IN <truth set table>

The stack-integer-counter is initialized to the value of the arithmetic expression in the count part. Characters are then scanned and the stack-integer-counter is decremented for each character until either the stack-integer-counter is zero or a source character is a member of the truth set. For further information on truth sets, see "TRUTHSET Declaration" in Section 3, "Declarations."

For example, the following statement scans the first 20 characters pointed to by P until a member of the truth set ALPHA8 is encountered:

```
SCAN P:P FOR 20 UNTIL IN ALPHA8
```

P is updated to point to the first character that is a member of ALPHA8, or, if none of the 20 characters scanned are members of ALPHA8, to the character that is 20 characters beyond the initial position of P.

### Examples of SCAN Statement

```
SCAN PTR WHILE = " "  
SCAN PTR UNTIL NEQ 48"00"  
SCAN PTR:PTR WHILE IN ALPHA  
SCAN PTR UNTIL IN ALPHA8  
SCAN PTR:PTR WHILE IN ACCEPTABLE[0]  
SCAN PTR FOR 50 WHILE > "Z"  
SCAN PTR:PTR FOR X:80 UNTIL = "."  
SCAN PTR FOR RMNDR:960 WHILE NEQ 48"1D"  
SCAN PTR:PTR FOR ZED:ZED WHILE IN ALPHA8  
SCAN PTR FOR 80 UNTIL IN GOODSTUFF[5]
```

## SEEK Statement

The SEEK statement positions the record pointer for the designated file at the specified record. This record is read or written by the next serial I/O operation.

<seek statement>

```
— SEEK — ( —<file designator>— [ —<record number>— ] — ) ———|
```

<record number>

—<arithmetic expression>—————|

A serial I/O operation is a READ statement or WRITE statement that does not include a record number in the record number or carriage control part. The SEEK statement does not affect any nonserial I/O statements. The value of the record pointer is not saved when the file is closed.

## SEEK Statement as a Boolean Function

The SEEK statement can be used as a Boolean function. When the statement fails, the value TRUE is returned. When the statement is successful, the value FALSE is returned. Specifically, the SEEK statement returns a value identical to that returned by the file attribute STATE. For more information, refer to the discussion of the STATE attribute in the *A Series File Attributes Programming Reference Manual*.

The file designator must not reference a direct file or a direct switch file.

When the record number is less than one, the record pointer points at the first record.

## Example of SEEK Statement

The following example positions the record pointer of file FILEA to record number  $X + 2 * Y$ .

```
SEEK(FILEA[X+2*Y])
```

## SET Statement

The SET statement sets the happened state of the designated event to TRUE (happened).

<set statement>

— SET — ( —<event designator>— ) —————|

## SET Statement Options

For more information on the event designator, see “EVENT and EVENT ARRAY Declarations” in Section 3, “Declarations.” The SET statement does not activate any tasks waiting on the event.

To set the happened state of an event to TRUE (happened) and activate the tasks waiting on the event, use the CAUSE statement. For more information, see “CAUSE Statement” earlier in this section.



### Examples of SET Statement

The following example sets the happened state of EVNT to TRUE (happened).

```
SET(EVNT)
```

The following example sets the happened state of the event designated by EVNTARAY[INDX] to TRUE (happened).

```
SET(EVNTARAY[INDX])
```

### SORT Statement

The SORT statement invokes the sort intrinsic, which provides a means for designated data to be sorted and placed in a file or returned to a procedure.

**<sort statement>**

```
— SORT — ( —<output option>— , —<input option>— , —————→  
→<number of tapes>— , —<compare procedure>— , —<record length>————→  
→ [ <size specifications> ] ) [ <restart specifications> ]
```

The data to be sorted is indicated by the input option. The output option indicates where the sorted data is to be placed. The order in which the data is sorted is determined by the compare procedure.

### Output Option

**<output option>**

```
— [ <file designator> ] —————→  
  [ <output procedure> ]
```

**<output procedure>**

```
—<procedure identifier>—————→
```

If a file designator is specified as the output option, the sort intrinsic writes the sorted output to this file. When sorting is completed, the sort intrinsic closes the file. If the file is a disk file for which the file attribute SAVEFACTOR has a nonzero value, it is closed and locked. The output file must not be open when it is passed to the sort intrinsic by the program.

If an output procedure is specified as the output option, the sort intrinsic calls the output procedure once for each sorted record and once to allow end-of-output action. This procedure must be untyped, must not be declared EXTERNAL, and must have two parameters. The first parameter must be a call-by-value Boolean variable, and the second parameter must be a one-dimensional array with a lower bound of zero. The Boolean parameter is FALSE as long as the second parameter contains a sorted record.

When all records are returned, the first parameter is TRUE and the second parameter must not be accessed.

The following is an example of an output procedure:

```

PROCEDURE OUTPROC(B,A);
VALUE B;
BOOLEAN B;
ARRAY A[0];
BEGIN
  IF B THEN
    CLOSE(FILEID,PURGE)
  ELSE
    WRITE(FILEID,RECSIZE,A[*]);
END OUTPROC;

```

## Input Option

<input option>

— { <file designator> | <input procedure> } —

<input procedure>

— <procedure identifier> —

If a file designator is used as the input option, the file supplies input records to the sort intrinsic. This file is closed after the last record is read. Disk files are closed with regular close action, and non-disk files are closed with release action. The input file must not be open when it is passed to the sort intrinsic by the program. The input file cannot be a file that is declared to be DIRECT.

If an input procedure is used as the input option, the procedure is called to furnish input records to the sort intrinsic. The input procedure must be a Boolean procedure, must not be declared EXTERNAL, and must have a one-dimensional array with a lower bound of zero as its only parameter. This procedure, on each call, either inserts the next record to be sorted into its array parameter or returns the value TRUE, which indicates the end of the input data.

When TRUE is returned by the input procedure, the sort intrinsic does not use the contents of the array parameter and does not call the input procedure again.

The following is an example of an input procedure that can be used when sorting N elements of array Q:

## Statements

---

```
BOOLEAN PROCEDURE INPROC(A);
ARRAY A[0];
BEGIN
  N := *-1;
  IF N GEQ 0 THEN
    A[0] := Q[N]
  ELSE
    INPROC := TRUE;
  END INPROC;
```

*Note:* The sort intrinsic maintains a logical record structure in memory. Be careful not to exceed the length of the record when manipulating records; data corruption might occur.

## Number of Tapes

<number of tapes>

—<arithmetic expression>—————|

The value of < number of tapes > specifies the number of tape files that can be used, if necessary, in the sorting process. If the value of the arithmetic expression is zero, no tapes are used. If the value of the arithmetic expression is between 1 and 3, inclusive, three tapes are used. If the value of the arithmetic expression is between 3 and 8, the specified number of tapes are used. If the value of the arithmetic expression is 8 or more, a maximum of eight tapes are used.

## Compare Procedure

<compare procedure>

—<procedure identifier>—————|

The compare procedure is called by the sort intrinsic to apply the appropriate sort criteria to a pair of input records. The procedure must be a Boolean procedure, must not be declared EXTERNAL, and must have exactly two parameters. Each of the parameters must be a one-dimensional array with a lower bound of zero. Every time two input records are to be compared, the sort intrinsic calls the compare procedure and passes the two records to the compare procedure through the array parameters. If the compare procedure returns TRUE, the record passed to the first array precedes, in the sorted output, the record passed to the second array. If the compare procedure returns FALSE, the record passed to the second array precedes the record passed to the first array.

The following is an example of a compare procedure that can be used to sort arithmetic data in ascending sequence:



## Statements

---

**<memory size>**

—<arithmetic expression>—————|

**<disk size>**

—<arithmetic expression>—————|

**<pack size>**

— PACK —┌—————>—————|  
          └<arithmetic expression>┘

The size specifications allow the programmer to specify the maximum amount of main memory and disk storage to be used by the sort intrinsic.

The memory size specifies the maximum amount, in words, of main memory that is to be used. If the memory size is unspecified, a value of 12,000 is assumed.

The disk size specifies the maximum amount, in words, of disk storage that can be used. If the disk size is unspecified, a value of 600,000 is assumed.

If the pack size is specified, temporary files created by the sort intrinsic have PACK, instead of DISK, as the value of their FAMILYNAME attribute. For an explanation of the FAMILYNAME attribute, refer to the *A Series File Attributes Programming Reference Manual*. If the arithmetic expression option does not appear in the pack size element, a value of 600,000 words is assumed.

## Restart Specifications

**<restart specifications>**

— [ — RESTART — = —<arithmetic expression>— ] —————|

The restart specifications allow the sort intrinsic to resume processing at the most recent checkpoint after discontinuation of a program. The program must provide logic to restore and maintain variables, arrays, files, pointers, and so forth, which are defined for, and by, the program. In other words, the program must provide the means to restore everything that is necessary for the program to continue from the point of interruption. The restart capability is implemented only for disk sorts.

The sort intrinsic inspects the least significant (rightmost) five bits of the value of the arithmetic expression in the restart specifications to determine the course of action it is to take. To control the sort, these bits can be set by the program. The meanings of these bits are explained in the following table.

Bit	Value	Description
0	1	The program is restarting a previous sort. The sort intrinsic tries to open its two disk files and obtain restart information. If it is successful in obtaining this information, the sort intrinsic tries to continue from the most recent restart point.
0	0	The sort is starting from the beginning. If the sort is restartable, and previous sort files with identical titles exist, they are removed and replaced by new sort files.
1	1	The program is requesting a restartable sort. The sort intrinsic saves its two internal files and can be restarted on program request. If bit 2 is 1, bit 1 is set to 1 by default.
1	0	A normal sort is requested, and no sort files are saved (unless bit 2 is 1, which sets bit 1 to 1 by default).
2	1	The program is requesting a restartable sort and desires extensive error recovery from I/O errors. If bit 2 is 1, the sort intrinsic attempts to backtrack and remerge strings, as necessary, when I/O errors occur during the accessing of either of the two sort files. To use this option, the program must provide at least three times as much disk space as required to contain the input data. If less disk space is provided, the sort intrinsic emits an error message, changes to restartable-only mode, and continues the sort without further use of backtracking capability.
2	0	Recovery from internal errors is not requested.
3	–	Bit 3 has meaning only if a restartable sort is requested. The use of this option controls the sort during the stringing phase as the user input is being read by the sort intrinsic. Use of this bit determines how the sort restarts (when a restart is requested) only if the restart occurs while the sort is in the stringing phase.
3	1	The program requires that the sort restart at the beginning of the user input. This restart is the equivalent of starting an entirely new sort. In case the restarted sort passes from the stringing phase into the merge phase, it continues from the merge phase. This bit can be set to 1 during a restart, even if it is not 1 initially. Once set to 1, it cannot be set to 0 by subsequent restarts.
3	0	The program requires the ability to restart at the last restart point that occurred during the stringing phase. If the sort is still in the stringing phase, it skips over the records already processed and continues from the last restart point. If the sort is in the merge phase, it continues from the last merge phase restart point. If bit 3 is 0, the sort is normally less efficient because more strings are created during the stringing phase.
4	–	This bit is reserved for expansion and is not currently used by the sort intrinsic.

### Arrays in Sort Procedures

The array parameters used by the input procedure, output procedure, and compare procedure must be similarly specified. For example, if one procedure declares its array parameter as an EBCDIC array, then all must declare their array parameters as EBCDIC arrays.

When character arrays are used in the procedures passed to the sort intrinsic, the record length parameter is interpreted as a length in characters.

When a pointer expression is used to assign a value to a sort procedure on a non-ASD system, and the pointer expression points out of the array, it does not cause a segment array error at run time. This means that you must keep track of the end of the array within the program to assure the validity of the procedure.

For more detailed information about the sort intrinsic, refer to "SORT" in the *A Series System Software Utilities Operations Reference Manual*.

### SORT Mode

The combination of the disk size and number of tapes determines the sort mode as follows:

Number of Tapes	Disk Size	Sort Mode
NEQ 0	0	Tape Only
NEQ 0	NEQ 0	Integrated-Tape-Disk (ITD)
0	NEQ 0	Disk Only
0	0	Core Only

### Examples of SORT Statement

The following example sorts the records of file FILEIN according to compare procedure COMPARE and writes the sorted data to file FILEOUT. Three tapes are used in the sort and the record length is 10.

```
SORT(FILEOUT,FILEIN,3,COMPARE,10)
```

The following example sorts the records provided by procedure INPROC according to compare procedure COMPARER, and writes sorted data out according to procedure OUTPROC. The number of tapes is given by NUMOFTAPES, and the record size is given by DSKSZ. A restart specification is given by PARAM.

```
SORT(OUTPROC,INPROC,NUMOFTAPES,COMPARER,DSKSZ) [RESTART = PARAM]
```

## SPACE Statement

The SPACE statement is used to bypass records in a file without reading those records.

**<space statement>**

```
— SPACE — ( —<file designator>— , —<arithmetic expression>— ) —>
→ └────────────────────────────────────────────────────────────────────────────────┘
  <action labels or finished event>
```

The value of the arithmetic expression determines the number of records to be spaced and the direction of the spacing. If the value of the arithmetic expression is positive, the records are spaced in a forward direction; if it is negative, the records are spaced in the reverse direction.

### SPACE Statement as a Boolean Function

The SPACE statement can be used as a Boolean function. When the statement fails, the value TRUE is returned. When the statement is successful, the value FALSE is returned. The SPACE statement returns a value identical to that returned by the file attribute STATE. For more information, refer to the discussion of the STATE attribute in the *A Series File Attributes Programming Reference Manual*.

The file designator must not reference a direct file or a direct switch file. For more information on the file designator see “SWITCH FILE Declaration” in Section 3, “Declarations.”

### Examples of SPACE Statement

The following example spaces file FYLE forward 50 records.

```
SPACE (FYLE,50)
```

The following example spaces file FILEID a number of records and a direction given by the value of N. If an end-of-file condition occurs, the program continues execution with the statement associated with the label LEOF.

```
SPACE(FILEID,N) [LEOF]
```

The following example spaces file FILEID backward 3 records. A value is assigned to B indicating the success or failure of the spacing. If an end-of-file condition occurs, the program continues execution with the statement associated with the label LEOF.

```
B := SPACE(FILEID,-3) [LEOF]
```



## SWAP Statement

The SWAP statement assigns the value of the variable on the right side of the swap operator (:=) to the variable on the left side of the swap operator, and assigns the value of the variable on the left side of the swap operator to the variable on the right side of the swap operator.

**<swap statement>**

<b>&lt;integer variable&gt;</b>	<b>:=</b>	<b>&lt;integer variable&gt;</b>
<b>&lt;real variable&gt;</b>	<b>:=</b>	<b>&lt;real variable&gt;</b>
<b>&lt;double variable&gt;</b>	<b>:=</b>	<b>&lt;double variable&gt;</b>
<b>&lt;Boolean variable&gt;</b>	<b>:=</b>	<b>&lt;Boolean variable&gt;</b>
<b>&lt;complex variable&gt;</b>	<b>:=</b>	<b>&lt;complex variable&gt;</b>
<b>&lt;array reference variable&gt;</b>	<b>:=</b>	<b>&lt;array reference variable&gt;</b>
<b>&lt;pointer variable&gt;</b>	<b>:=</b>	<b>&lt;pointer variable&gt;</b>

**<integer variable>**

A variable of type INTEGER.

**<real variable>**

A variable of type REAL.

**<double variable>**

A variable of type DOUBLE.

## Variable Type Matching

The declared types of the variables on either side of the swap operator (:=) must be the same. Partial word swaps are not permitted.

Descriptions of the processes of an assignment are found under “ASSIGNMENT Statement” earlier in this section.

## Example of SWAP Statement

This example program uses the SWAP statement to sort a real array.

```
BEGIN
  FILE REM(KIND=DISK,TITLE="SORT/OUT.",PROTECTION=SAVE);
  BOOLEAN SWAP_DONE;
  INTEGER I,J;
  DEFINE LASTONE = 5;;
  INTEGER ARRAY ARY[0:LASTONE];

  PROCEDURE SORTER;
    BEGIN

      BOOLEAN PROCEDURE NEED_TO_SWAP(A,B);
      VALUE A,B;
      INTEGER A,B;
      BEGIN
        IF (A < B) THEN
          NEED_TO_SWAP := TRUE
        ELSE
          NEED_TO_SWAP := FALSE;
        END NEED_TO_SWAP;

      SWAP_DONE := TRUE;
      FOR I := 0 STEP 1 WHILE (I < LASTONE AND SWAP_DONE) DO
        BEGIN
          SWAP_DONE := FALSE;
          FOR J := I+1 STEP 1 UNTIL LASTONE DO
            IF (NEED_TO_SWAP(ARY[I],ARY[J])) THEN
              BEGIN
                SWAP_DONE := TRUE;
                ARY[I] := ARY[J];
              END;
            END FORLOOP;
          END SORTER;

          ARY[0] := " SAM";
          ARY[1] := " AL";
          ARY[2] := " HAL";
          ARY[3] := " BOB";
          ARY[4] := " TOM";
          ARY[5] := " SID";
          SORTER;
          FOR I := 0 STEP 1 UNTIL LASTONE DO
            WRITE(REM,<A6>,ARY[I]);
          END.
        END.
      END.
```

## THRU Statement

The THRU statement executes a statement a specified number of times.

<thru statement>

— THRU —<arithmetic expression>— DO —<statement>—

### Value of the Arithmetic Expression

The absolute value of the arithmetic expression is evaluated and rounded to an integer, if necessary. This value determines the number of times the statement following DO is executed. The upper limit of this value is  $2^{*}39 - 1$ . Figure 4-6 illustrates the THRU loop.

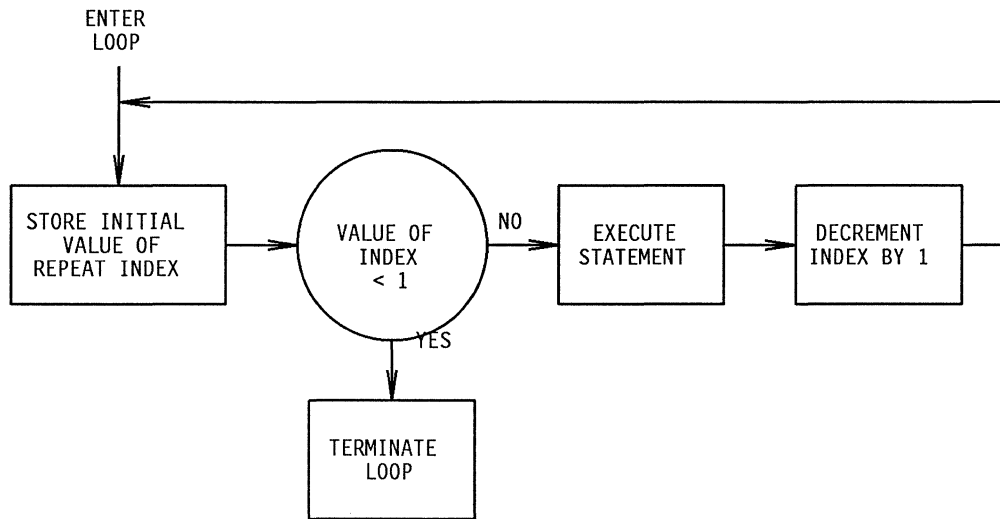


Figure 4-6. THRU Loop

### Examples of THRU Statement

In the following example, the statement LOADCHAR is executed 255 times.

```
THRU 255 DO
LOADCHAR
```

In the following example, the REAL function is evaluated, the value is assigned to MAXI, and the statement SKIP1 is executed MAXI times.

```
THRU MAXI := REAL(PTR,3) DO
SKIP1
```



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---

the following statement the value of T is 1 if elapsed time caused the program to be activated:

```
T := WAIT((.ØØ1),E1,E2)
```

In the following statement the value of T is 2 if a cause operation on event E2 activated the program:

```
T := WAIT(E1,E2,E3)
```

Only one parameter activates the program.

The WAIT statement with a wait parameter list and the WAITANDRESET statement are identical, except for the state to which the caused event is set during the cause process. If a program is waiting on an event because of the WAIT statement, then the happened state of the event is set to TRUE (happened). If a program is waiting on an event because of a WAITANDRESET statement, then the happened state of the event is set to FALSE (not happened).

The form *WAIT(<direct array row>)* is one of the ways in which a program can determine if a previously initiated direct I/O statement has finished. This form can be used as a Boolean function. When the I/O statement fails, the value TRUE is returned. When the statement is successful, the value FALSE is returned. Specifically, this form of the WAIT statement returns a value similar to that returned by the file attribute IORESULT, with certain exceptions. Refer to the discussion of the IORESULT attribute in the *A Series File Attributes Programming Reference Manual*.

## Examples of WAIT Statement

In the following example, if the happened state of event EVNT is TRUE (happened), the program continues with the next statement. Otherwise, the program is suspended until EVNT is caused, and the happened state of EVNT is set to TRUE (happened).

```
WAIT(EVNT)
```

In the following example, if the happened state of event EVNT1, EVNT2, or EVNT3 is TRUE (happened), the program continues with the next statement. Otherwise, the program is suspended until one of the events EVNT1, EVNT2, or EVNT3 is caused, and the happened state of that event is set to TRUE (happened).

```
WAIT(EVNT1,EVNT2,EVNT3)
```

In the following example, if the happened state of WAKEUP or GOAWAY is TRUE (happened), the program continues with the next statement. Otherwise, the program is suspended until NAPTIME seconds have elapsed or until event WAKEUP or GOAWAY is caused. If WAKEUP or GOAWAY is caused, its happened state is set to TRUE (happened). The value stored in X is 1, 2, or 3, indicating which of the three items reactivated the program.

```
X := WAIT((NAPTIME),WAKEUP,GOAWAY)
```

In the following example, if DIRINPUT is a direct array row, the program is suspended until the direct I/O operation associated with DIRINPUT is completed. If the I/O operation fails, the value TRUE is assigned to RSLT. If the operation is successful, the value FALSE is assigned to RSLT.

```
RSLT := WAIT(DIRINPUT)
```

In the following example, the program is suspended until an attached and enabled interrupt is invoked as a result of the associated event being caused.

```
WAIT
```

## WAITANDRESET Statement

The WAITANDRESET statement suspends a program until a designated condition occurs.

<waitandreset statement>

```
— WAITANDRESET — ( —<wait parameter list>— ) —————|
```

The WAITANDRESET statement and the WAIT statement with a wait parameter list are identical, except for the state to which the caused event is set during the cause process. If a program is waiting on an event because of a WAITANDRESET statement, then the happened state of the event is set to FALSE (not happened). If a program is waiting on an event because of the WAIT statement, then the happened state of the event is set to TRUE (happened).

## WAITANDRESET Statement as an Arithmetic Function

The WAITANDRESET statement can be used as an arithmetic function that returns an integer value, starting at 1, that represents the position in the wait parameter list of the item that caused the program to be activated. For example, in the following statement the value of T is 1 if elapsed time caused the program to be activated:

```
T := WAITANDRESET((.001),E1,E2)
```

In the following statement the value of T is 2 if a cause operation on event E2 activated the program:

```
T := WAITANDRESET(E1,E2,E3)
```

Only one parameter activates the program.

Note that the <direct array row> syntax is not allowed as a parameter to the WAITANDRESET statement.

### Examples of WAITANDRESET Statement

In the following example, if the happened state of event EVNT is TRUE (happened), the program continues with the next statement. Otherwise, the program is suspended until EVNT is caused, and the happened state of EVNT is set to FALSE (not happened).

```
WAITANDRESET (EVNT)
```

In the following example, if the happened state of event EVNT1, EVNT2, or the event designated by EVNTARAY[INDX] is TRUE (happened), the program continues with the next statement. Otherwise, the program is suspended until one of the three events is caused, and the happened state of that event is set to FALSE (not happened).

```
WAITANDRESET (EVNT1, EVNT2, EVNTARAY [INDX])
```

In the following example, if the happened state of event FINI or GOAWAY is TRUE (happened), the program continues with the next statement. Otherwise, the program is suspended until .5 second has elapsed or until event FINI or GOAWAY is caused. If FINI or GOAWAY is caused, its happened state is set to FALSE (not happened).

```
WAITANDRESET ((.5), FINI, GOAWAY)
```

In the following example, if the happened state of event WAKEUP or LOOKAROUND is TRUE (happened), the program continues with the next statement. Otherwise, the program is suspended until SLEEPMAX seconds have elapsed or until event WAKEUP or LOOKAROUND is caused. The value stored in REASON is 1, 2, or 3, indicating which of the three items reactivated the program. If WAKEUP or LOOKAROUND is caused, its happened state is set to FALSE (not happened).

```
REASON := WAITANDRESET ((SLEEPMAX), WAKEUP, LOOKAROUND)
```

### WHEN Statement

The WHEN statement suspends processing of a program for the specified number of seconds.

<when statement>

```
— WHEN — ( —<time>— ) —————|
```

### Characteristics of the Time Option

Program processing is suspended for <time> seconds. The value of <time> need not be an integer. If <time> is a double-precision value, it is rounded to single precision. If <time> is less than approximately 0.0000023, the program resumes execution immediately. If <time> is larger than this value, then the number of seconds that the program is suspended is the smaller of <time> and  $(2^{**32}-1)*2.4$  microseconds (approximately 2.86 hours).

Depending on the amount of multiprocessing being performed and the priorities of other programs in execution, the actual time that a program is suspended can vary widely with respect to <time> but is at least <time> seconds.

### Examples of WHEN Statement

In the following example, the program is suspended for 10 seconds.

```
WHEN (10)
```

In the following example the program is suspended for  $2 * Y + Z$  seconds.

```
WHEN (2*Y+Z)
```

### WHILE Statement

The WHILE statement executes a statement as long as a specified condition is met.

<while statement>

```
— WHILE —<Boolean expression>— DO —<statement>—
```

### Execution of the WHILE Statement

The iterative WHILE statement is executed as follows: the Boolean expression is evaluated and, if the result is TRUE, the statement following DO is executed. This sequence of events continues until the value of the Boolean expression is FALSE or until the statement following DO transfers control outside the WHILE statement. Figure 4-7 illustrates the WHILE-DO loop.

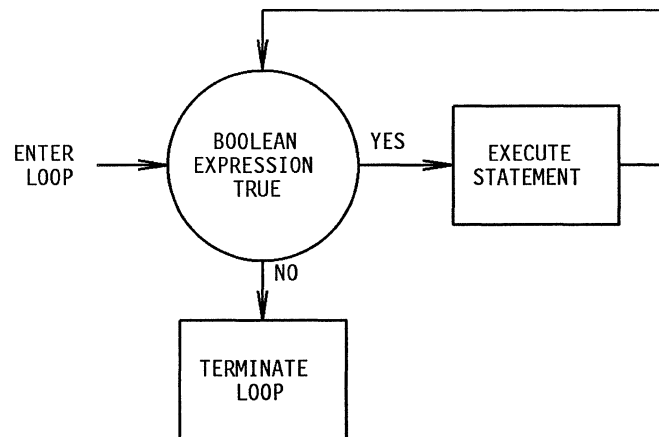


Figure 4-7. WHILE-DO Loop





WRITE statements that do not contain format designators or editing specifications provide a faster output operation than those that specify that data is to be edited.

## Write File Part

<write file part>

```

┌───────────> <file part> ───────────────────────────────────────────────────────────┐
└───┬───────────> <task designator> ─── . ───<file-valued task attribute name> ───┘

```

The write file part indicates where the data is to be written.

## <I/O option or carriage control>

If the <I/O option or carriage control> element is [*LINE* <arithmetic expression>] and the file is a printer file, then the printer spaces forward to the specified line before printing. The PAGESIZE file attribute of the file must be nonzero. Because the default action for ALGOL is to print before carriage action, a subsequent WRITE statement can overprint the line.

The [*SKIP* <arithmetic expression>] construct causes the printer to skip to the channel indicated by the value of the arithmetic expression after printing the current record. The LINENUM file attribute of the file is reinitialized to 1 when [SKIP 1] is used.

The [*SPACE* <arithmetic expression>] construct causes the printer to space the number of lines specified by the arithmetic expression after printing the current record, or before printing the current record if the WRITEAFTER compiler control option is set. For nonbinary writes, the default of single-spacing is equivalent to [SPACE 1]. Overprinting can be achieved with [SPACE 0]. For binary writes, a carriage control is done before the SPACE carriage control option is evaluated. The default of single-spacing is equivalent to [SPACE 0], and overprinting is not possible. On other types of devices, this construct causes the number of records specified by the value of the arithmetic expression to be spaced.

For disk files the [*SPACE* <arithmetic expression>] construct works in the following manner. A WRITE statement that is not a binary write spaces before writing. The disk file might be extended as a result. A binary write spaces after writing unless the WRITEAFTER compiler control option is used to indicate that spacing should take place before writing. The file cannot be extended. The effect of this construct is not necessarily the same as a WRITE statement following or preceding a SPACE operation.

If the specified file is a remote file, the [*STOP*] construct causes the normal line feed and carriage return action to be omitted.

The [*STACKER* <arithmetic expression>] construct allows pocket selection for card punch files. Valid values for the arithmetic expression are 0 and 1: 0 selects the normal pocket, and 1 selects the alternative pocket.

The [*SYNCHRONIZE*] construct enforces synchronization between the logical and physical file. Synchronization means that output must be written to physical file

## Statements

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before the program initiating the output can resume execution. The SYNCHRONIZE file attribute designates the synchronization for all output records, and the *[SYNCHRONIZE]* construct overrides the specified synchronization for the record being written. The *[SYNCHRONIZE]* construct is available for use by disk files with FILEORGANIZATION = NOTRESTRICTED or for tape files, and is not available for use with port files.

The *[TIMELIMIT < arithmetic expression >]* construct is meaningful only for remote files. The write operation is terminated with a timelimit error if the buffer is not available within the number of seconds specified by the value of the arithmetic expression.

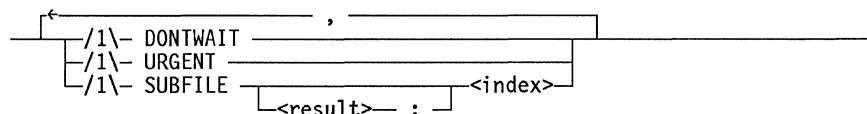
The *[STATION < arithmetic expression >]* construct is meaningful only for remote files. It assigns the value of the arithmetic expression to the LASTSUBFILE file attribute of the file.

For more information on the FILEORGANIZATION, LASTSUBFILE, LINENUM, PAGESIZE, or SYNCHRONIZE attribute, refer to the *A Series File Attributes Programming Reference Manual*.

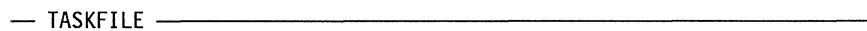
On output to the printer, the *[NO]* construct causes the line feed after a write to be suppressed.

## Write Subfile Specification

<write subfile specification>



<file-valued task attribute name>



If the file to be written is a port file (a file for which the KIND attribute is equal to PORT), an array row write containing a subfile specification must be used. Refer to “Array Row Write” later in this section.

The subfile specification is meaningful only for port files. It is used to specify the subfile to be used for the write operation and the type of write operation to be performed.

If a subfile index is used, the value of the subfile index is assigned to the LASTSUBFILE attribute of the file. It specifies the subfile to be used for the write operation. For a WRITE statement, if the subfile index is zero, a broadcast write is performed. If the subfile index is nonzero, then a write to the specified subfile is performed. The result variable, if specified, is assigned the resultant value of the LASTSUBFILE attribute.

For more information on the LASTSUBFILE file attribute, refer to the *A Series File Attributes Programming Reference Manual*.

If DONTWAIT is specified and no buffer is available, the program is not suspended.

The URGENT clause is meaningful only when the Transmission Control Protocol/Internet Protocol (TCP/IP) is being used. This clause sets the urgent indication associated with the data. For more information on TCP/IP, refer to the *A Series Distributed Systems Service (DSS) Operations Guide*.

If the URGENT clause is used for port subfiles that have the SERVICE attribute set to BNANATIVESERVICE, then the BADWRITEOPTION (43) write error is returned in field [26:10] of the write result and the STATE attribute. The error bit [0:1] is set also in the write result and the STATE attribute.

<core-to-core part>  
 <core-to-core file part>  
 <core-to-core blocking part>

Refer to “READ Statement” earlier in this section for a discussion of these constructs.

## Format and List Part

For the syntax of <format and list part>, see “READ Statement” earlier in this section. The format and list part element indicates which variables contain the data and how the data is to be interpreted.

If the format and list part element is omitted in a WRITE statement, a logically empty record is written. The actual output is device-dependent. Printers and card punches interpret this as a blank record; disks and tapes interpret this as a record with undefined contents.

## Formatted Write

A WRITE statement that contains a format designator, editing specifications, or a free-field part is called a formatted write.

A format designator without a list indicates that the referenced format contains one or more string literals that constitute the entire output of the WRITE statement.

A format designator with a list indicates that the variables in the list are to be written in the format described by the referenced format.

Editing specifications can appear in place of a format designator and have the same effect as if they had been declared in a FORMAT declaration and had been referenced through a format designator. For more information, refer to “FORMAT Declaration” in Section 3, “Declarations.”

## Binary Write

A WRITE statement of the following form is called a binary write:

```
WRITE(<write file part>,<list>)
```

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---

A binary **WRITE** statement can be used to write variables to a file in an internal form that can later be read with a binary **READ** statement.

An asterisk (\*) followed by a list specifies that the elements in the list are to be processed as full words and are to be written without being edited. The number of words written is determined by the number of elements in the list or the maximum record size, whichever is smaller. When unblocked records are used, the block size is the maximum record size.

In a binary write, when the record number or carriage control element is **LINE**, **SKIP**, **STACKER**, **STATION**, **TIMELIMIT**, or **STOP**, it is ignored and treated as a serial binary write. If the carriage control element is **SPACE**, the number of lines specified plus one is spaced after writing the current record. The extra space occurs because in a binary write normal carriage control is performed first and then any extra spacing is done.

When writing a character array, only full words are written. If there is a partial word left at the end of the array, it is ignored. For example, if **A** is an EBCDIC array that contains the characters 12345678, the following statement writes only the characters 123456:

```
WRITE(FILEID,*,A)
```

When a string variable occurs in the list of a binary **WRITE** statement, a word containing the string length is written to the file before the contents of the string are written. This feature allows the program to write string information that can later be read through a binary **READ** statement. For more information, see “Binary Read” under “**READ Statement**” earlier in this section.

### Array Row Write

A **WRITE** statement of any of the following forms is called an array row write:

```
WRITE(<write file part>,<arithmetic expression>,<array row>)
WRITE(<write file part>,<arithmetic expression>,<subscripted variable>)
WRITE(<write file part>,<arithmetic expression>,<pointer expression>)
WRITE(<write file part>,<arithmetic expression>,<string variable>)
```

The first three forms of the array row write specify that the elements of the designated array row, subscripted variable, or item referenced by the pointer expression are to be processed as full words and are to be written without being edited. The number of words written is determined by the smallest of the following:

- The number of elements in the array row, subscripted variable, or item referenced by the pointer expression
- The maximum record length
- The absolute value of the arithmetic expression

If the **FILETYPE** attribute of the file has a value of 6, then the maximum record length is ignored and records span block boundaries. When unblocked records are used, the block

size is the maximum record size. If the UNITS attribute equals CHARACTERS and the INTMODE attribute does not equal SINGLE, then all counts represent characters, not words.

A WRITE statement of the following form specifies that the characters in the string variable are to be written without being edited:

```
WRITE(<write file part>,<arithmetic expression>,<string variable>)
```

The number of characters written is determined by the maximum record size, the absolute value of the arithmetic expression, or the length of the string, whichever is smallest. If the UNITS attribute equals CHARACTERS and the INTMODE attribute does not equal SINGLE, then all counts represent characters, not words.

A WRITE statement of the following form is not an array row write:

```
WRITE (<write file part>,<arithmetic expression>,<string literal>)
```

This kind of statement can have unexpected results because the number of words or characters written is determined by the arithmetic expression and the UNITS attribute of the file part. If the arithmetic expression in the units of the file is greater than the length of the string literal, unexpected output can occur. Use a formatted write of the following form to write a string literal:

```
WRITE(<file part>,<" <string literal> "> )
```

## Free-Field Part

The free-field part allows output to be performed with editing but without using editing specifications. The appropriate format is selected automatically, but variations of the free-field part give the programmer some control over the form of the output.

On output, each value is edited into an appropriate format. An edited item is never split across a record boundary. If the record is too short to hold the representation of the item, a string of pound signs (#) is written in place of the item.

When a complex expression appears in the list of a free-field WRITE statement, two values are written. The first value corresponds to the real part, and the second value corresponds to the imaginary part.

Data items are normally separated by a comma and a space (, ). If the free-field part contains two slashes, data items are separated by two spaces.

If the optional asterisk (\*) is used, the name of the data item and an equal sign (=) are written to the left of the value of the data item. If the data item is not a variable, then the expression is written as the name of the data item.

If the free-field part includes the <number of columns> and <column width> elements, each list element is written in a separate column. This process is controlled by two column factors: the number of columns per record (*r*) and the width of each column (*w*), where *w* is measured in characters. Both *r* and *w* are integerized, if necessary.

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---

If  $r$  is 0 (zero), the number of columns per record is determined from the value of  $w$  and the record length. If  $w$  is 0, the width of each column is determined from the value of  $r$  and the record length. If both  $r$  and  $w$  are 0, the output has no column structure. If  $r$  and  $w$  are such that  $r$  columns of  $w$  characters cannot fit on one record, adjustments are made to both  $r$  and  $w$ . The width of a column does not include the two-character delimiter; therefore,  $r*(w+2)$  must be less than or equal to the length of the record.

### Example of Free-Field Part

```
BEGIN
  FILE DCOM(KIND=REMOTE,MAXRECSIZE=12,MYUSE=I0);
  INTEGER I;
  REAL R;
  DOUBLE D;
  STRING S;
  I := 25;
  R := 1002459;
  D := 25@05;
  S := "string";
  WRITE(DCOM,*/, I, R, D, S, I+R, R-D, S||" ABCDE", 7.2);
END.
```

The following output results when this program is executed:

```
I=25, R=1002459.0, D=2.5D+6, S=string, I+R=1002484.0, R-D=-1497541.0,
S||" ABCDE"=string ABCDE, <CNST>=7.2,
```

Additional information about I/O operations can be found under "I/O Statement" and "READ Statement" earlier in this section.

### Action Labels or Finished Event

This construct provides a means of transferring program control from a READ statement, WRITE statement, or SPACE statement when exception conditions occur (for normal I/O) or when the I/O is complete (for direct I/O). Exception conditions can also be handled by using the WRITE statement as a Boolean function. For more information, refer to "READ Statement" earlier in this section.

## Examples of WRITE Statement

```

WRITE(FILEID)
WRITE(SPOFILE,FMT,LISTID)
WRITE(FILEID[NO],FMT)
WRITE(SPOFILE,1Ø,ARRAY[3,*])
WRITE(SWFILEID[Ø],X+Y-Z,ARRAY[X,I,*])
WRITE(SPOFILE,/,LISTID)
WRITE(FILEID,FMT,LISTID)
WRITE(SWFILEID[3][PAGE])
WRITE(FILEID,/,A,B,C)
WRITE(FILEID,SWFMT[A*I])
WRITE(FILEID,*,LISTID)
WRITE(FILEID[5+I],/,SWLISTID[4])
WRITE(FILEID,/,LISTID)
WRITE(FILEID,*,A,B,C)
WRITE(FILEID,FMT,A,B,C,D+SIN(X)) [:PARL]
WRITE(FILEID,FMT,LISTID) [:PARSWL[M]]
WRITE(SWFILEID[1],SWFMT[2],SWLISTID[3]) [:PARSWL[4]]
WRITE(DIRFYLE,3Ø,DIRARAY) [EVNT]
WRITE(MYSELF.TASKFILE,<"ABOVE DUMP BEFORE TRANSACTION">)
WRITE(OUT,1Ø,S1 || S2)
WRITE(OUT,<2A1Ø>,TAKE(S1,2),S1 || "ABC")
WRITE(OUT[5,SYNCHRONIZE],3Ø,ARRAYNAME)

```

## ZIP Statement

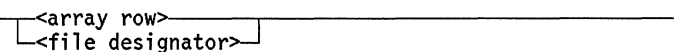
The ZIP statement causes the Work Flow Language (WFL) compiler to begin compiling the designated source code.



## Statements

---

### <zip statement>

— ZIP — WITH — 

The ZIP statement passes to the WFL compiler the source code in the array row or in the file referenced by the file designator. The source code in the array row or file must be valid WFL source input; otherwise, it is not executed. WFL syntax requirements are described in the *A Series Work Flow Language (WFL) Programming Reference Manual*.

The EXCEPTIONEVENT is caused for a user program when the program executes a ZIP statement.

### ZIP WITH <array row>

The array row can be a BCL or EBCDIC array row or a row of a word array. If the array row is a word array, the character type of the contents of the array row is the default character type. For more information, refer to “Default Character Type” in Appendix C, “Data Representation.” The array row is processed as one record, but it can include more than 72 characters. A semicolon (;) is used to separate statements within the array row. Only one question mark character can appear in the array row.

WFL examines the contents of the array row for correct syntax, and if errors occur it reports this fact to the Operator Display Terminal (ODT). If no errors are detected, the compiled job is run. In either case, program control passes to the next statement in the program.

### ZIP WITH <file designator>

When this form of the ZIP statement is executed, the file referenced by the file designator is passed to the WFL compiler. The file is compiled in the same manner as any other WFL source file. If the source compiles without syntax errors, it is executed, and control passes to the statement following the ZIP statement. If syntax errors occur when the source is compiled, the WFL job is not executed, and control passes to the statement following the ZIP statement.

On execution of a ZIP statement, control of the file referenced by the file designator is passed to the operating system.

## Examples of ZIP Statement

In the following example, the WFL source input in array ARAY is compiled and executed.

```
ZIP WITH ARAY
```

In the following example, the WFL source input in file FYLE is compiled and executed.

```
ZIP WITH FYLE
```

# Section 5

## Expressions and Functions

This section contains two main parts: one for expressions and one for intrinsic functions. In each part, the expressions or functions are presented in alphabetical order.

### Expressions

An expression describes how a value can be obtained by applying specified operations to designated operands or primaries.

<expression>

<arithmetic expression>
<bit manipulation expression>
<Boolean expression>
<case expression>
<complex expression>
<conditional expression>
<designational expression>
<function expression>
<pointer expression>
<string expression>

The evaluation of each expression returns a different value, as follows:

Expression	Value
Arithmetic	Numerical
Boolean	Boolean (TRUE or FALSE)
Complex	Complex: a real numerical part and an imaginary numerical part
Designational	Label
Pointer	A value that can be used to reference a character position in an array row
String	A value that is an EBCDIC, ASCII, or hexadecimal string

A bit manipulation expression operates on bits within words and makes it possible to build the contents of a word from groups of bits contained in other words.

Case expressions and conditional expressions allow one of several alternative expressions to be chosen for evaluation based on a selection value.

A function expression is a call on a typed procedure. The procedure can be declared in the program or it can be an intrinsic which is a typed procedure that is a predefined part of the ALGOL language. Intrinsic functions exist that are predefined arithmetic expressions, predefined Boolean expressions, predefined complex expressions, predefined pointer expressions, and predefined string expressions. For example,

## Expressions and Functions

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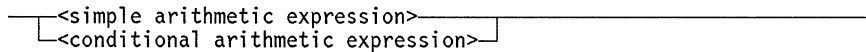
*SQRT*(*< arithmetic expression >*) is a function expression that returns the square root of the value of *< arithmetic expression >* construct. Because the *SQRT* returns a numeric value, it is an arithmetic function, a predefined arithmetic expression.

**Note:** *Expressions that are very large or deeply nested can cause the compiler to receive a stack overflow fault. The fault can be avoided by breaking very large or deeply nested expressions into several separate expressions or by increasing the maximum stack size by using the task attribute STACKLIMIT.*

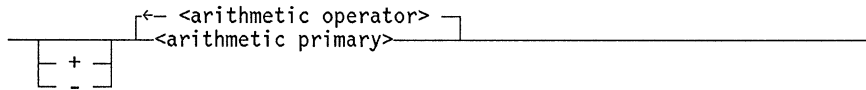
### Arithmetic Expression

Arithmetic expressions perform specified operations on designated arithmetic primaries to return numerical values.

*<arithmetic expression >*



*<simple arithmetic expression >*



The evaluation of a conditional arithmetic expression is described in “Conditional Expression” later in this section.

### Precision of Arithmetic Expressions

The value of an arithmetic expression can be expressed in single or double precision, depending on the precision of its constituents or, in the case of *MUX*, on the operator involved. The value of an arithmetic expression is double precision if any variable, function, or number of which it is composed is of type *DOUBLE*, or if two primaries are combined by the double-precision operator *MUX*. The *MUX* operator allows a double-precision result to be obtained from the multiplication of two single-precision arithmetic primaries.

The value of a case expression is double precision if any expression in its arithmetic expression list is of type *DOUBLE*. Likewise, the value of a conditional arithmetic expression is double precision if either arithmetic expression is double precision. In either case, single-precision arithmetic expressions are converted to double precision, when necessary.

## Arithmetic Operators

<arithmetic operator>

+
-
*
TIMES
MUX
/
DIV
MOD
**

The operators +, -, \*, and / have the conventional mathematical meaning of addition, subtraction, multiplication, and division, respectively. No two operators can be adjacent, and implied multiplication is not allowed.

The TIMES operator also denotes multiplication.

The DIV operator denotes integer division. It has the following mathematical meaning:

$$Y \text{ DIV } Z = \text{SIGN}(Y/Z) * \text{ENTIER}(\text{ABS}(Y/Z))$$

The MOD operator denotes remainder division. If Z is greater than or equal to 1, MOD has the following meaning:

$$Y \text{ MOD } Z = Y - (Z * (Y \text{ DIV } Z))$$

If Z is less than 1, the MOD operator produces undefined results.

The MUX operator multiplies either single-precision or double-precision arithmetic primaries, and yields a double-precision result.

The \*\* operator denotes exponentiation. The semantics of the exponentiation operator depend on the types and values of the primaries involved. Figure 5-1 explains the various meanings of Y\*\*Z.

	Integer			Real		
	$Z > 0$	$Z = 0$	$Z < 0$	$Z > 0$	$Z = 0$	$Z < 0$
$Y > 0$	Note 1	1	Note 2	Note 3	1	Note 3
$Y < 0$	Note 1	1	Note 2	Note 4	1	Note 4
$Y = 0$	$0$	Note 4	Note 4	$0$	Note 4	Note 4

### LEGEND

Note 1:  $Y^{**}Z = Y*Y*Y \dots *Y$  (Z times)

Note 2:  $Y^{**}Z = \text{Reciprocal of } Y*Y*Y \dots *Y$  (ABS(Z) times)

Note 3:  $Y^{**}Z = \text{EXP}(Z*\text{LN}(Y))$

Note 4: Value of the expression is undefined.

**Figure 5-1. Exponentiation: Meaning of  $Y^{**}Z$**

### Precedence of Arithmetic Operators

The sequence in which the operations of an arithmetic expression are performed is determined by the precedence of the operators involved. The order of precedence is as follows:

1. **\*\*** (highest precedence)
2. **\***, **/**, **MOD**, **DIV**, **MUX**, **TIMES**
3. **+**, **-**

Operators with the same precedence are applied in their order of appearance in an expression, from left to right.

The precedence of the assignment operator (**:=**) is as follows:

1. An expression to the right of an assignment operator is evaluated before the assignment.
2. The assignment is done before the evaluation of an expression involving the variable that is the target of the assignment.

Parentheses can be used in normal mathematical fashion to override the defined order of precedence. An expression in parentheses is evaluated by itself, and the resulting value is subsequently combined with the other elements of the expression. In the following expression, for example, the addition is performed before the division because of the parentheses:

$$(X+1)/Y$$

In the following expression, 1 is first divided by Y and then the result is added to X:

$$X + 1/Y$$

For information on the order of evaluation of subscripts, see "Arithmetic Update Assignment" in Section 4, "Statements."

Figure 5-2 illustrates how mathematical notation can be translated to an ALGOL arithmetic expression.

Mathematical Expression	Equivalent ALGOL Expression
$A \times B$	$A * B$
$A + \frac{B}{2}$	$A + B/2$
$\frac{X + 1}{Y}$	$(X + 1)/Y$
$\frac{D + E^2}{2A}$	$(D + E**2)/(2 * A)$
$4(X + Y)^3$	$4 * (X + Y) ** 3$
$\frac{M - N}{(M + N)^{P + 5 \times 10^{-6}}}$	$(M - N)/(M + N) ** (P + 50-6)$

Figure 5-2. Mathematical Notation

### Types of Resulting Values

The type of the value resulting from an arithmetic operation depends on the arithmetic operator and the types of the primaries being combined, except when the resulting value is undefined. Figure 5-3 describes the types of quantities that result from various combinations of arithmetic primaries.

## Expressions and Functions

Operand on Left	Operand on Right	+ - *	/	DIV	MOD	**	MUX
INTEGER	INTEGER	Note 3	REAL	INTEGER	INTEGER	Note 1	DOUBLE
INTEGER	REAL	REAL	REAL	INTEGER	REAL	Note 2	DOUBLE
INTEGER	DOUBLE	DOUBLE	DOUBLE	DOUBLE	DOUBLE	Note 2	DOUBLE
REAL	INTEGER	REAL	REAL	INTEGER	REAL	Note 2	DOUBLE
REAL	REAL	REAL	REAL	INTEGER	REAL	Note 2	DOUBLE
REAL	DOUBLE	DOUBLE	DOUBLE	DOUBLE	DOUBLE	DOUBLE	DOUBLE
DOUBLE	(any)	DOUBLE	DOUBLE	DOUBLE	DOUBLE	DOUBLE	DOUBLE

Note 1: If the operand on the right is negative or the absolute value of the result is greater than or equal to 2\*\*39, REAL; otherwise, INTEGER

Note 2: If the operand on the right is zero, INTEGER; otherwise, REAL

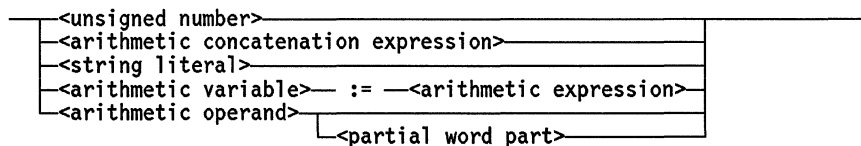
Note 3: If the absolute value of the result is less than 2\*\*39, INTEGER; otherwise, REAL

Figure 5-3. Types of Values Resulting from Arithmetic Operations

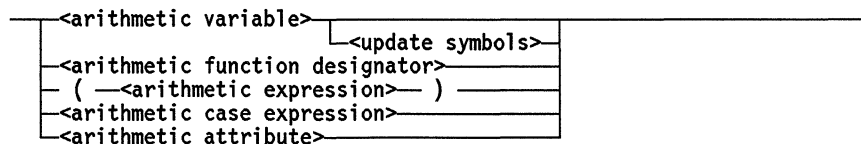
The type of an arithmetic case expression or a conditional arithmetic expression is DOUBLE if any of its constituent expressions are of type DOUBLE. For more information, refer to “Precision of Arithmetic Expressions” earlier in this section. If the conditional arithmetic expression or arithmetic case expression contains only expressions of type INTEGER and REAL, its type is REAL. A conditional arithmetic expression or arithmetic case expression is of type INTEGER only if all its constituent expressions are of type INTEGER.

## Arithmetic Primaries

<arithmetic primary>



<arithmetic operand>



### <arithmetic case expression>

—<case head>— ( — $\overbrace{\text{<arithmetic expression>}$ — ) —————|

### <conditional arithmetic expression>

—<if clause>—<arithmetic expression>— ELSE —————→  
 →<arithmetic expression>—————|

### <constant arithmetic expression>

An arithmetic expression that can be fully evaluated at compilation time.

The items on which arithmetic operators act are called arithmetic primaries.

A variable or function designator used as an arithmetic primary in an arithmetic expression must be of an arithmetic type: INTEGER, REAL, or DOUBLE.

An attribute used as an arithmetic primary must have a type that is INTEGER, REAL, or DOUBLE. For information on file attribute and direct array attribute types, see the *A Series File Attributes Programming Reference Manual*. The arithmetic-valued task attributes are described in “Arithmetic Assignment” in Section 4, “Statements.”

The length of a string literal used as an arithmetic primary must not exceed 48 bits. A string literal used as an arithmetic primary is interpreted as either type REAL or type INTEGER, depending on its value.

The arithmetic concatenation expression is described in “Concatenation Expression” later in this section.

The partial word part is described in “Partial Word Expression” later in this section.

The evaluation of an arithmetic case expression is described in “Case Expression” later in this section.

### Examples of Arithmetic Primaries

Valid	Invalid
5.678	X := * := Y
X := * + 3	+ DC8
(14 + 3.142)	B – A
MABEL	–(A + B)
R & 3 [1:2]	TRUE
Y.[30:4]	
"ABCD"	
SQRT(X)	
CASE I OF (5,15,17)	

*continued*



*continued*

**Valid**

FYLE.MAXRECSIZE

**Invalid**

### Bit Manipulation Expression

Bit manipulation expressions provide a means of isolating a field of one or more bits from a word, and these expressions allow words to be constructed from fields of one or more bits from other words.

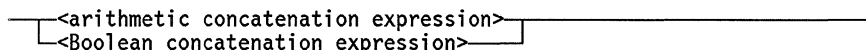
**<bit manipulation expression>**



### Concatenation Expression

The concatenation expression forms a primary from selected parts of two or more primaries.

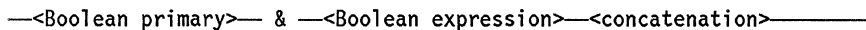
**<concatenation expression>**



**<arithmetic concatenation expression>**



**<Boolean concatenation expression>**



A concatenation expression is formed by taking a specified part of the bit pattern of an expression value and copying it into the specified portion of a primary. The rest of the destination primary is not changed by this operation.

Note that only arithmetic expressions can be concatenated with arithmetic primaries, and only Boolean expressions can be concatenated with Boolean primaries.

Because the concatenation expression is a primary and the syntax for a concatenation expression is of the form *<primary> & <expression> <concatenation>*, concatenation expressions of the following form are allowed:

```

<primary> & <expression> <concatenation>
      & <expression> <concatenation>
      .
      .
      .
      & <expression> <concatenation>
    
```



## Expressions and Functions

---

Because a concatenation expression is a primary, when it appears as an operand in a larger expression, the concatenation expression is evaluated before any other operation is executed. The following is an example of a concatenation expression evaluation:

Expression	Evaluated as
$2^{**}4 \& 1 [0:0:1]$	$2^{**}(4 \& 1 [0:0:1]) = 2^{**}5 = 32$

The expression is not evaluated as the following:

$$(2^{**}4) \& 1 [\emptyset:\emptyset:1] = 16 \& 1 [\emptyset:\emptyset:1] = 17$$

### Examples of Concatenation Expression

Assume that the real variables X, Y, and Z have the following values:

```
X = 32767 = 4"000000007FFF"  
Y = 1024 = 4"000000000400"  
Z = 1 = 4"000000000001"
```

Given these values, the following are examples of arithmetic concatenation expressions and their values:

Expression	Value
$X \& Y [47:11:4]$	4"400000007FFF"
$X \& Y [47:12]$	4"400000007FFF"
$Y \& X [39:20]$	4"0007FFF00400"
$Y \& Z [46:1]$	4"400000000400"
$0 \& Y [11:11]$	4"000000000800"
$0 \& X [23:48]$	4"007FFF000000"
$X \& Y [39:12] \& Z [47:1]$	4"804000007FFF"
$Y \& X [19:15:8]$	4"00000007F400"

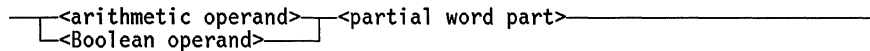
Assume that the elements of the real array INFO contain information about the data in a file. Each element of INFO contains a record number in the field [19:20], and the length of the data in that record is in field [39:20]. That is, each element of INFO stores the location and length of a record in the data file. Let N be a variable that contains a record number, and let L be a variable that contains the length of that record. The following declarations and assignment statement can be used to store a value into an element of INFO.

```
DEFINE  
  REC_NUMF = [19:20]#,  
  LENGTHF  = [39:20]#;  
  .  
  .  
  .  
INFO[I] := 0 & N REC_NUMF  
          & L LENGTHF;
```

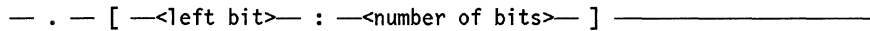
## Partial Word Expression

A partial word expression isolates the value of a field of one or more bits of a specified word.

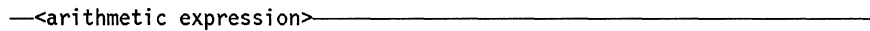
**<partial word expression>**



**<partial word part>**



**<left bit>**



The **<partial word part>** construct describes the location in the operand of the field to be isolated. The isolated field is copied to the low order (rightmost) field of a word of all zeros.

The **<left bit>** element defines the leftmost bit location of the field in the source word. The value of the left bit must lie within the range 0 through 47, where bit 0 is the rightmost, or least significant, bit in the word.

The **<number of bits>** element specifies the length of the field. The value of the number of bits must lie within the range 1 through 48. If the value of the number of bits exceeds the number of bits to the right of the left bit in the source word, the field wraps around and is continued at bit 47, the leftmost bit, of the same word.

If, through the use of variables, these ranges are exceeded, the program is discontinued with a fault. If 0 is used for the number of bits, no bits are copied.

### Examples of Partial Word Expression

Assume that real variables X, Y, and Z have the following values:

```
X = 32767 = 4"000000007FFF"
Y = 1024 = 4"00000000400"
Z = 2 = 4"000000000002"
```

Given these values, the following are examples of arithmetic partial word expressions and their values:

Expression	Value
X.[5:6]	4"00000000003F"
Y.[11:4]	4"000000000004"
Z.[19:48]	4"000040000000"
X.[23:24]	4"000000007FFF"
X.[23:20]	4"000000007FF"

## Expressions and Functions

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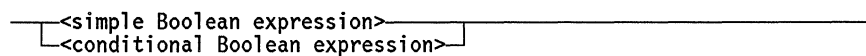
Using the INFO array example from “Concatenation Expression” earlier in this section, the following assignments could be used to extract information from INFO.

```
N := INFO[I].REC_NUMF;  
L := INFO[I].LENGTHF;
```

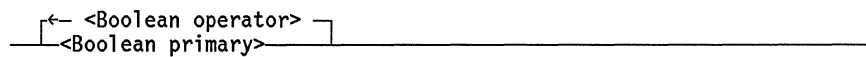
## Boolean Expression

Boolean expressions are expressions that return logical values by applying specified operations to designated Boolean primaries.

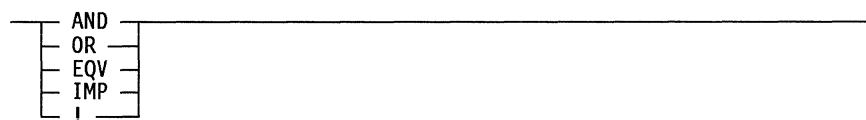
<Boolean expression>



<simple Boolean expression>



<Boolean operator>



The evaluation of a conditional Boolean expression is described in “Conditional Expression” later in this section.

## Operators in Boolean Expressions

The following table lists the operators that can be used in Boolean expressions, along with their meanings. When two operators are listed on the same line, they are equivalent to each other.

Operator	Meaning
NOT ^	Logical NOT
AND	Logical AND
OR !	Logical inclusive OR
IMP	Logical implication
EQV	Logical equivalence
IS	Identical to
ISNT	Not identical to
EQL =	Equal to
NEQ ^=	Not equal to

*continued*

*continued*

Operator	Meaning
GTR >	Greater than
GEQ >=	Greater than or equal to
LSS <	Less than
LEQ <=	Less than or equal to

### Logical Operators

The values returned by the logical operators are defined in Figure 5-4.

Operand A	Operand B	NOT A	A AND B	A OR B	A imp B	A EQV B
TRUE	TRUE	FALSE	TRUE	TRUE	TRUE	TRUE
TRUE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE
FALSE	TRUE	TRUE	FALSE	TRUE	TRUE	FALSE
FALSE	FALSE	TRUE	FALSE	FALSE	TRUE	FALSE

Figure 5-4. Results of Logical Operators

The Boolean operations defined in this table are performed on all 48 bits of the Boolean primaries on a bit-by-bit basis. For example, the constant TRUE (4"000000000001") does not have the same bit pattern as the Boolean expression NOT FALSE, because NOT complements all 48 bits of the constant FALSE (4"000000000000"), generating 4"FFFFFFFFFFFF". Even so, the constant TRUE and the Boolean expression NOT FALSE have the same Boolean value of TRUE because the Boolean value of a Boolean primary is based upon the value of the low-order bit (bit 0) of the Boolean primary (0 is FALSE; 1 is TRUE).

**Note:** *Exception: When NOT operates on an arithmetic relation, the low-order bit (bit zero) is complemented; however, the other 47 bits are not necessarily complemented. For example, if X = Y evaluates to TRUE, then NOT(X = Y) evaluates to FALSE, not necessarily to NOT TRUE as would be expected.*

### IS and ISNT Operators

The IS relational operator performs a bit-for-bit comparison on its two operands. The operator returns the value TRUE if the corresponding bits of each operand are the same. The ISNT operator is the negation of the IS operator.

If the IS operator is used to compare a double-precision arithmetic quantity to a single-precision (integer or real) arithmetic quantity, the result is always FALSE.

The IS operator differs from the EQL or = operator, which does an arithmetic comparison of its operands. Two operands can have the same arithmetic value with

## Expressions and Functions

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different bit patterns. Thus, the following pairs yield the value TRUE when compared with the EQL or = operator, but yield the value FALSE when compared with the IS operator:

- +0 and -0
- A normalized number and the same number not in normalized format
- A number with an exponent of +0 and the same number with an exponent of -0
- A number with bit 47 = 0 and the same number with bit 47 = 1

### Relational Operators

The action of the relational operators GTR, >, GEQ, >=, LSS, <, LEQ, <=, EQL, =, NEQ, and ^= depends on the kinds of items being compared. For more information, refer to “Arithmetic Relation,” “Complex Relation,” “String Relation,” “Pointer Relation,” and “String Expression Relation” later in this section.

### Precedence in Boolean Expressions

The components of Boolean expressions are evaluated in the following order:

1. All arithmetic, complex, pointer, and string expressions are evaluated.
2. All relations, table memberships, and assignments are evaluated.
3. Logical operators are then applied.

The order of precedence of the logical operators is as follows:

1. NOT (highest precedence)
2. AND
3. OR, !
4. IMP
5. EQV

Operators with the same precedence are applied in their order of appearance in an expression, from left to right.

The precedence of the assignment operator (: =) is as follows:

1. A primary to the right of an assignment operator is evaluated before the assignment.
2. The assignment is done before the evaluation of an expression involving the variable that is the target of the assignment.

Parentheses can be used in normal mathematical fashion to override the defined order of precedence. An expression in parentheses is evaluated by itself, and the resulting value is subsequently combined with the other elements of the expression. In the following

expression, for example, the OR is performed before the AND operator because of the parentheses:

X AND (Y OR Z)

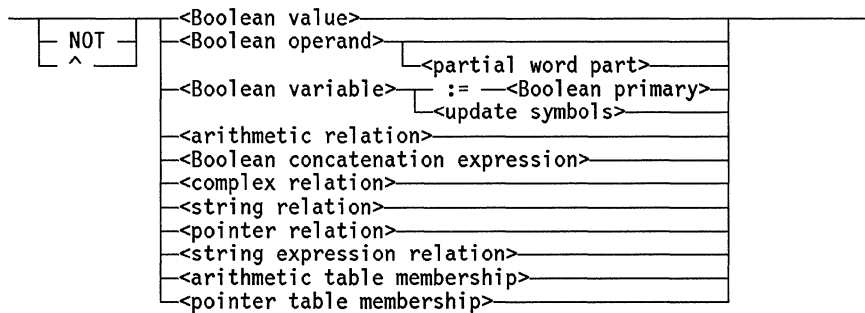
In the following expression the AND is performed before the OR:

X AND Y OR Z

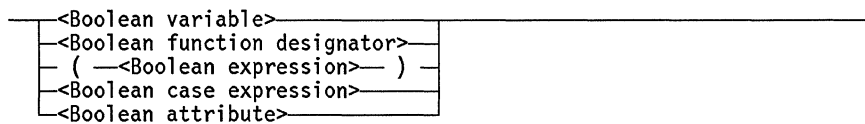
For information on the order of evaluation of subscripts, see “Arithmetic Update Assignment” in Section 4, “Statements.”

### Boolean Primaries

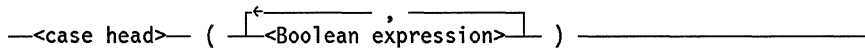
#### <Boolean primary>



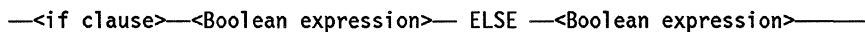
#### <Boolean operand>



#### <Boolean case expression>



#### <conditional Boolean expression>



The Boolean concatenation expression is described in “Concatenation Expression” earlier in this section.

The partial word part is described in “Partial Word Expression” earlier in this section.

The evaluation of a Boolean case expression is described in “Case Expression” later in this section.

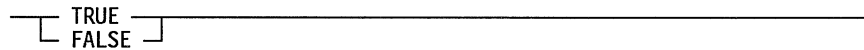


## Expressions and Functions

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### Boolean Value

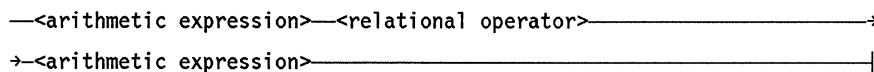
<Boolean value>



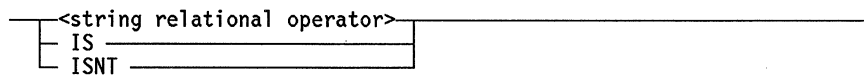
The Boolean value TRUE is represented internally as a 48-bit word containing 4"000000000001", and the Boolean value FALSE is represented internally as a 48-bit word containing 4"000000000000".

### Arithmetic Relation

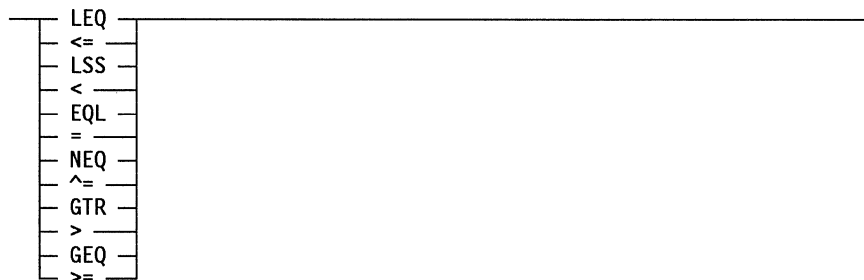
<arithmetic relation>



<relational operator>



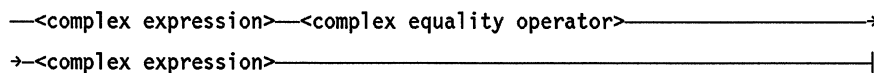
<string relational operator>



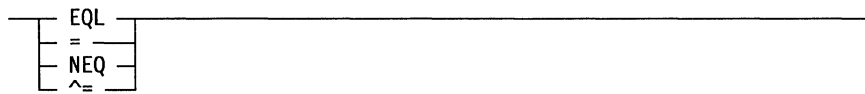
An arithmetic relation performs an arithmetic comparison of the values of two arithmetic expressions. The value of the relation is either TRUE or FALSE.

### Complex Relation

<complex relation>



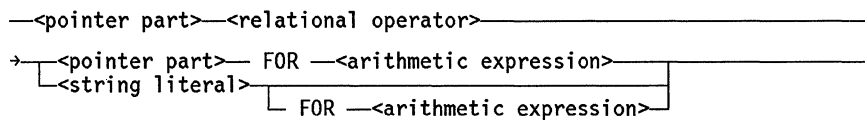
**<complex equality operator>**



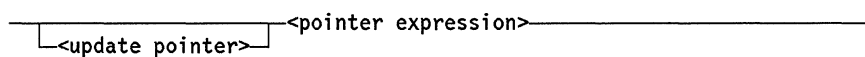
A complex relation performs a comparison between the values of two complex expressions. Because one of the forms of a complex expression is an arithmetic expression, the complex relation can also be used to compare a complex value and an arithmetic value. In a complex relation, the only allowed relational operators are =, EQL, ^=, and NEQ.

**String Relation**

**<string relation>**



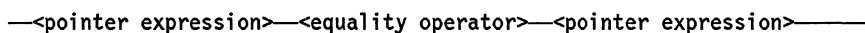
**<pointer part>**



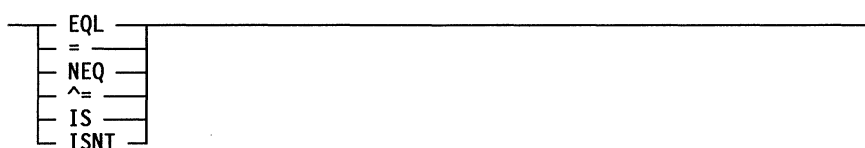
The string relation syntax causes a comparison to be performed between two character strings referenced by two pointer expressions, or between the character string referenced by a pointer expression and a string literal. The character strings are compared according to the EBCDIC collating sequence. The arithmetic expression specifies the number of characters to be compared (the repeat count). If a string literal follows the relational operator and a repeat count has been specified, then the string literal is concatenated with itself, if necessary, to form a 48-bit literal. The comparison is repeated until the repeat count is exhausted. If no repeat count is specified, the string characters are compared once.

**Pointer Relation**

**<pointer relation>**



**<equality operator>**



## Expressions and Functions

---

A pointer relation determines whether two pointer expressions refer to the same character position in the same array row. If the character sizes of the two pointer expressions are unequal, the comparison always yields the value FALSE.

A pointer relation should not be confused with a string relation. A string relation compares the character strings referenced by pointer expressions. A pointer relation compares the pointer expressions themselves. For example, assume that pointers P1 and P2 are initialized as follows:

```
POINTER P1,P2;
REAL ARRAY A,B[0:1];
P1 := POINTER(A,8);
P2 := POINTER(B,8);
REPLACE P1 BY "A";
REPLACE P2 BY "A";
```

Given these initializations, the following string relation has a value of TRUE:

```
P1 EQL P2 FOR 1
```

The following pointer relation has a value of FALSE because P1 refers to array A and P2 refers to array B:

```
P1 EQL P2
```

### String Expression Relation

<string expression relation>

```
—<string expression>—<string relational operator>—————→
→<string expression>—————|
```

The string expression relation compares two string expressions according to the collating sequence of the character type of the string expressions. Only string expressions of the same character type can be compared.

Two strings are equal only if the lengths of the two strings are equal and if every character in one string is equal to the corresponding character in the other string. Two null strings are equal.

One string is strictly greater than a second string only if at least one of the following conditions is true:

- The leftmost character in the first string that is not equal to the corresponding character in the second string compares as greater than the corresponding character in the second string.
- The length of the first string is greater than the length of the second string, and the two strings compare as equal for the length of the second string.

Whenever two string literals can be compared as two arithmetic primaries, they are so compared. For example, the following Boolean expression yields a value of FALSE, because the two quoted strings are treated as two arithmetic primaries:

```
"B" > "AA"
```

However, if the two string literals "B" and "AA" are assigned to two string variables T and S, respectively, then the following Boolean expression yields a value of TRUE, because the first character of T is greater than the first character of S:

```
T > S
```

For example, if a string S1 is assigned the value "AAB12+", then all of the following comparisons are TRUE:

```
S1 EQL TAKE(S1,6)
S1 NEQ HEAD(S1,ALPHA)
S1 GTR HEAD(S1,ALPHA)
S1 LSS DROP(S1,3)
S1 LSS DROP(S1,1)
```

### Table Membership

<arithmetic table membership>

```
—<arithmetic expression>— IN —<truth set table>—————|
```

<pointer table membership>

```
—<pointer expression>— IN —<truth set table>—————>
```

```
→
└─ FOR —<arithmetic expression>—┘—————|
```

The table membership constructs allow testing to determine whether a character is a member of a truth set. The character can be either a character in a string literal or a character in an array row referenced by a pointer expression. In a pointer table membership primary, the *FOR* <arithmetic expression> part applies the membership test to the first arithmetic expression characters to which the pointer expression points.

The subscripted variable form of the truth set table construct allows several truth set tables to be contained in one array row. The value of the subscript indicates the beginning of the desired table within the array row. For a description of truth sets, refer to "TRUTHSET Declaration" in Section 3, "Declarations."

### Examples of Boolean Expression

Valid	Invalid
TRUE	SQRT(X)
BOOL	5.67
B.[11:1]	-X

*continued*

## Expressions and Functions

---

*continued*

### Valid

B := TRUE  
B1 := \* AND B2  
CSIN(C1) = CSIN(C2)  
X > Y  
NOT B  
R = 3  
PTR = "ABCD"  
P1 < P2 FOR 20  
S1 S2 = S3  
HAPPENED(E)  
CASE I OF (B1, TRUE, X=Y)  
NOT FYLE.OPEN  
P1 = P2  
BOOL & TRUE [19:1]  
X IN ALPHA8  
P1 IN ALPHA8 FOR 6

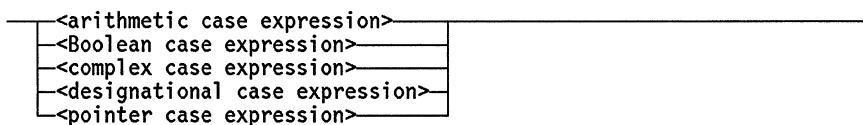
### Invalid

R + TRUE  
CSIN(C1) > CSIN(C2)  
P1 > P2  
S1 IS "ABCD"

## Case Expression

Case expressions provide a means of selecting one expression from a list of expressions for evaluation.

<case expression>



In a case expression, the list of expressions must be composed of expressions of the same kind: for example, all arithmetic expressions or all Boolean expressions. The expression to be evaluated is selected as follows:

1. The arithmetic expression in the case head is evaluated and rounded by an integer value, if necessary.
2. This value is used as an index into the expression list. The component expressions of the expression list are numbered sequentially from 0 through N-1, where N is the number of expressions in the list.
3. The expression selected by the index is evaluated, and its value is the value of the case expression.

If the value of the index lies outside the range 0 through N-1, the program is discontinued with a fault.

The type of an arithmetic case expression is DOUBLE if any of its constituent expressions is of type DOUBLE; in this case, any constituent expression that is not of type DOUBLE is extended to double precision. The type of an arithmetic case expression is INTEGER if and only if all of its constituent expressions are of type INTEGER. Otherwise, an arithmetic case expression is of type REAL.

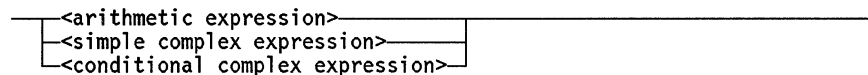
**Examples of Case Expression**

- CASE N OF (2, 20, 100, 37)
- CASE X.[27:2] OF (TRUE, FALSE, TRUE, TRUE)
- CASE I OF (C1, C2, COMPLEX(X,Y))
- CASE TSTS[INDEX] OF (LBL1, LBL2, AGAIN, NEXT, MORE)
- CASE CHAR.SZF OF (PTR, PTS, POINTER(A), PTEMP, POLO)

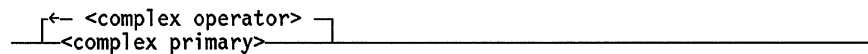
**Complex Expression**

Complex expressions are expressions that return complex values (arithmetic values that consist of a real part and an imaginary part) by applying specified operations to designated complex primaries.

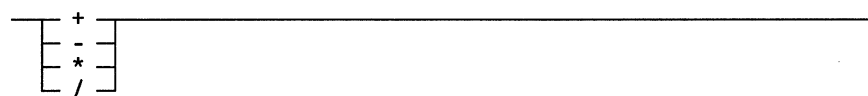
**<complex expression>**



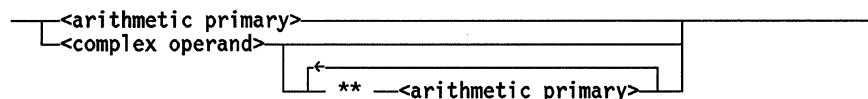
**<simple complex expression>**



**<complex operator>**



**<complex primary>**





$C2 + C1/C2$

The evaluation of a conditional complex expression is described in “Conditional Expression” later in this section.

The evaluation of a complex case expression is described in “Case Expression” earlier in this section.

### Examples of Complex Expression

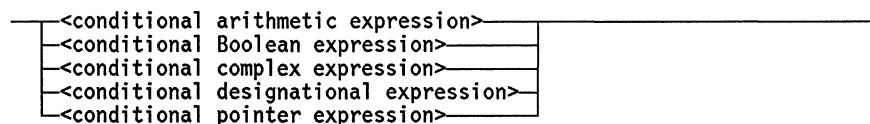
```

C1
C1+3
C1 ** X
C1 := COMPLEX(X,Y)
C1 := * - C2
CABS(C1)
(COMPLEX(R,S) * CCON)
CASE I OF (C1, C2, CLN(C2))
IF BOOL THEN C1 ELSE CONJUGATE(C1)
    
```

## Conditional Expression

Conditional expressions are expressions that return one of two possible values, depending upon a specified condition.

**<conditional expression>**



Conditional expressions are of the following form:

IF <Boolean expression> THEN <expression> ELSE <expression>

Either the first or the second expression is selected for evaluation, depending on the value of the Boolean expression. The two alternative expressions must be of the same kind: for example, two arithmetic expressions or two Boolean expressions.

The expression to be evaluated is selected as follows:



## Expressions and Functions

---

1. The Boolean expression following IF is evaluated.
2. If the resulting value is TRUE, the expression following THEN is evaluated, and the expression following ELSE is ignored.
3. If the resulting value is FALSE, the expression following THEN is ignored, and the expression following ELSE is evaluated.

If either of the two expressions is itself a conditional expression, the process is repeated until an unconditional expression is selected for evaluation.

The type of a conditional arithmetic expression is DOUBLE if either of its constituent expressions is of type DOUBLE; in this case, a constituent expression that is not of type DOUBLE is extended to double precision. The type of a conditional arithmetic expression is INTEGER if and only if both of its constituent expressions are of type INTEGER. Otherwise, a conditional arithmetic expression is of type REAL.

### Examples of Conditional Expression

```
IF BOOL THEN 47 ELSE 95

IF A = B THEN BOOL ELSE FALSE

IF NOT BOOL THEN C1 ELSE C2

IF ALLDONE THEN EOJLBL ELSE NEXTLBL

IF CHAR.SZF = 8 THEN PTRINEBCDIC ELSE PTRINHEX
```

## Designational Expression

Designational expressions are expressions that return a value that is a label.

**<designational expression>**

```
—<label designator>—————|
  |<designational case expression>|
  |<conditional designational expression>|
```

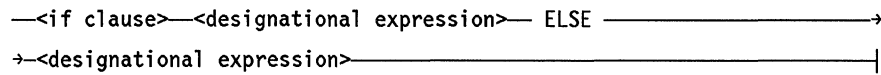
**<label designator>**

```
—<label identifier>—————|
  |<switch label identifier> [ —<subscript>— ] |
```

**<designational case expression>**

```
—<case head>— ( —<designational expression>— ) —————|
```

**<conditional designational expression>**



If a designational expression is a label identifier, then the value of the expression is that label.

If a designational expression is a subscripted switch label identifier, then the numerical value of the subscript designates one of the elements in the switch label list. The value of the subscript is rounded, if necessary, to an integer. This value is used as an index into the switch label list. The entries of the list are numbered sequentially from 1 through N, where N is the number of entries in the list. The entry corresponding to the value of the subscript is selected. If the value of the subscript is outside the range of the switch label list, program control continues to the next statement without any error indication. For more information about the switch label list, refer to “SWITCH LABEL Declaration” in Section 3, “Declarations.”

The evaluation of a designational case expression is described in “Case Expression” earlier in this section.

The evaluation of a conditional designational expression is described in “Conditional Expression” earlier in this section.

**Examples of Designational Expression**

```

ENDLABEL

CHOOSELABEL[I+2]

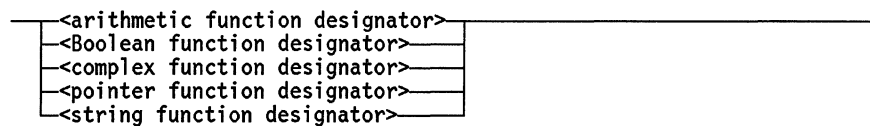
CASE X OF (GOTDATA, GOTERR, GOTREAL, GOTCHANGE, ESCAPE)

IF K = 1 THEN SELECT[2] ELSE START
    
```

**Function Expression**

A function expression is an expression that returns a single value that is the result of invoking a procedure. The procedure can be declared in the program, or it can be an intrinsic procedure.

**<function expression>**



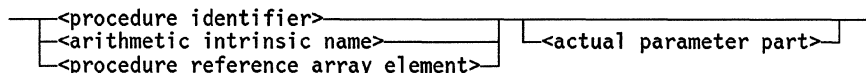
The two kinds of functions are predefined, or intrinsic, functions which are part of the ALGOL language, and programmer-defined functions, which are typed procedures that are declared in the program.

The intrinsic functions are described later in this section in “Intrinsic Functions.”

### Arithmetic Function Designator

An arithmetic function designator specifies a function that returns an arithmetic value: a value of type INTEGER, REAL, or DOUBLE.

**<arithmetic function designator>**



**<arithmetic intrinsic name>**

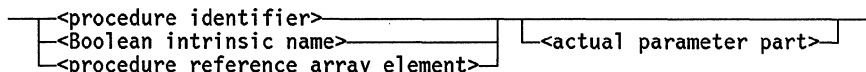
Any of the names listed under “Arithmetic Intrinsic Names” later in this section.

The procedure specified by the procedure identifier or the procedure reference array element must be of type INTEGER, REAL, or DOUBLE.

### Boolean Function Designator

A Boolean function designator specifies a function that returns a Boolean value (a value of TRUE or FALSE).

**<Boolean function designator>**



**<Boolean intrinsic name>**

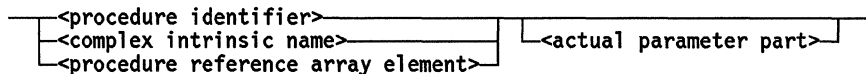
Any of the names listed under “Boolean Intrinsic Names” later in this section.

The procedure specified by the procedure identifier or the procedure reference array element must be of type BOOLEAN.

### Complex Function Designator

A complex function designator specifies a function that returns a complex value: a value with a real part and an imaginary part.

**<complex function designator>**



The procedure specified by the procedure identifier or the procedure reference array element must be of type COMPLEX.

## Pointer Function Designator

A pointer function designator specifies a function that returns a pointer value: a value that can be used to refer to a character position in an array row.

**<pointer function designator>**

—<pointer intrinsic name>—<actual parameter part>—————|

Unlike the other function designators, the syntax for pointer function designator does not allow a procedure identifier as part of the syntax. There is no PROCEDURE declaration that allows declaring a procedure of type POINTER.

## String Function Designator

A string function designator specifies a function that returns a string value: a hexadecimal string, an ASCII string, or an EBCDIC string.

**<string function designator>**

—<string procedure identifier>—————|  
 |<string intrinsic name>—————|<actual parameter part>|  
 |<procedure reference array element>|

**<string intrinsic name>**

Any of the names listed under “String Intrinsic Names” later in this section.

The procedure reference array element must designate a procedure declared with a type of HEX STRING, ASCII STRING, or EBCDIC STRING.

## Pointer Expression

A pointer expression is an expression that returns a value that is a pointer, which can be used to reference a character position in an array row.

**<pointer expression>**

—<simple pointer expression>—————|  
 |<conditional pointer expression>|

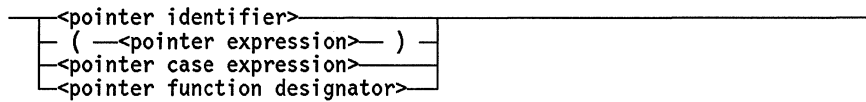
**<simple pointer expression>**

—<pointer primary>—————|  
 |<pointer assignment>|<skip>|  
 |<character array part>|

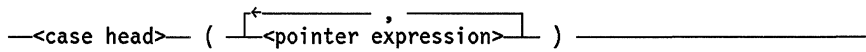
## Expressions and Functions

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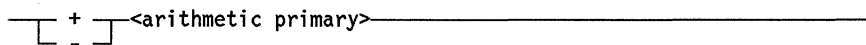
### <pointer primary>



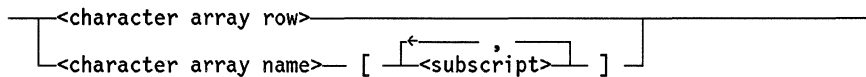
### <pointer case expression>



### <skip>



### <character array part>



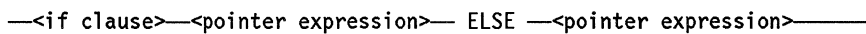
### <character array row>

An array row whose identifier is declared with a character type.

### <character array name>

An array name whose identifier is declared with a character type.

### <conditional pointer expression>



A pointer must be initialized before it can be used; otherwise, a run-time error occurs. A pointer can be initialized in the following ways:

- By the use of a pointer assignment
- By the appearance of an update pointer in any of the following:
  - A REPLACE statement
  - A SCAN statement
  - A string relation in a Boolean expression
  - The DINTEGER function
  - The DOUBLE function
  - The INTEGER function

When a one-dimensional array designator is used as a pointer expression, it references the beginning of the array, no matter what its lower bounds are.

The evaluation of a conditional pointer expression is described in “Conditional Expression” earlier in this section.

A one-dimensional array designator or a fully subscripted variable can be interpreted as a pointer primary whenever context determines that no conflict exists with other valid constructs (for example, when a pointer expression is required). This syntax can be used for such constructs as the following, where A and B are one-dimensional arrays:

```
REPLACE A BY B FOR 10 WORDS
```

The evaluation of a pointer case expression is described in “Case Expression” earlier in this section.

If the skip construct is used, the value of the arithmetic primary determines the adjustment to the value of the pointer primary. If N is the value of the arithmetic primary, the pointer is adjusted as follows:

- If N is less than or equal to 0, the pointer is not adjusted.
- If N is greater than 0, then the pointer is adjusted N characters to the right when the skip construct specifies "+", or N characters to the left if it specifies "-". Skipping to the right is defined as incrementing the value of the character index. Skipping to the left is defined as decrementing this value.

If the adjustment to the value of the pointer primary is given by the value of an arithmetic expression, note that the arithmetic expression must be enclosed in parentheses. For example, the following expression is invalid and generates a compile-time error:

```
PTR + X*Y
```

The expression is written correctly as follows:

```
PTR + (X*Y)
```

The use of a pointer expression to skip up and down an array for more than a few words is expensive. Each word of the array is accessed in order to ensure that no memory-protected words are encountered. For pointer moves of more than a few words, it is faster to reindex the array and use the `POINTER` function for word arrays, or to reindex the array for character arrays.

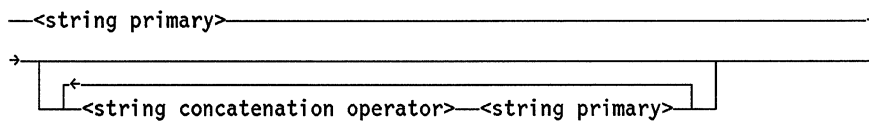
### Examples of Pointer Expression

PTR  
PTS+15  
PTR := POINTER(A)  
(PTEMP + (X\*Y))  
HEXARRAY  
HEXARRAY[N]  
CASE VAL OF (PTR,PTS,PTEMP,PSORCE)  
POINTER(INFO,8)  
READLOCK(PTR,POLD)  
IF BOOL THEN P1 ELSE POINTER(A)

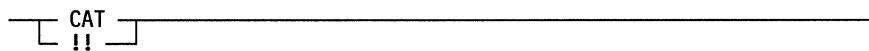
### String Expression

A string expression is an expression that returns a value that is a hexadecimal string, EBCDIC string, or ASCII string.

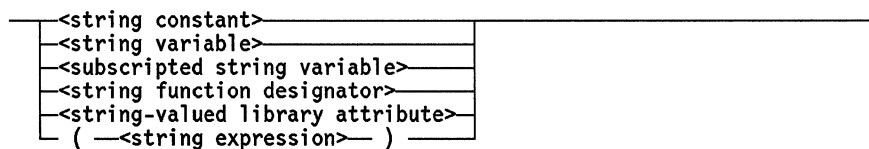
<string expression>



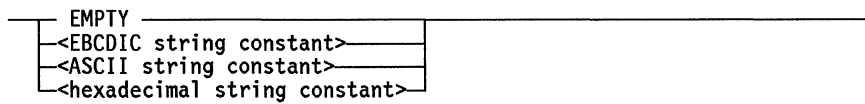
<string concatenation operator>



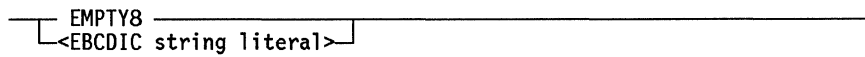
<string primary>



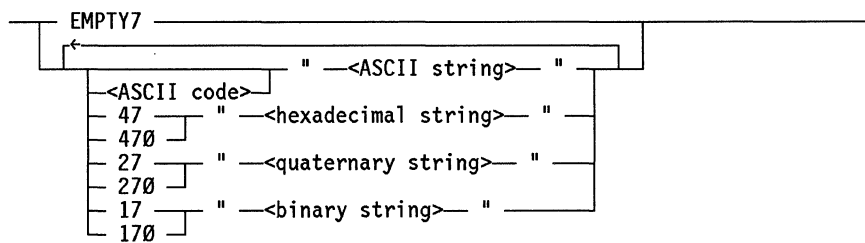
**<string constant>**



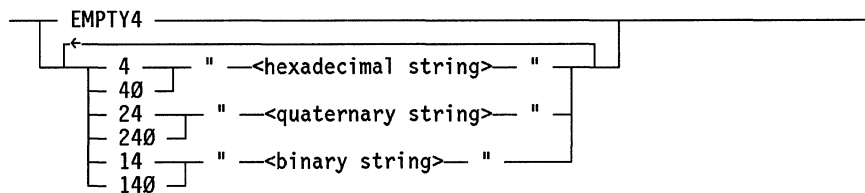
**<EBCDIC string constant>**



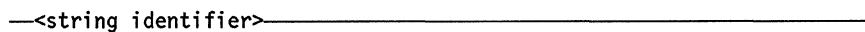
**<ASCII string constant>**



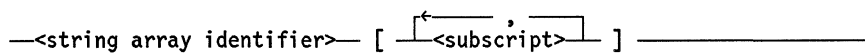
**<hexadecimal string constant>**



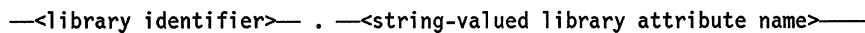
**<string variable>**



**<subscripted string variable>**



**<string-valued library attribute>**



**<constant string expression>**

A string expression that can be fully evaluated at compilation time.

In the syntax for EBCDIC string constant, ASCII string constant, and hexadecimal string constant, the string codes determine the interpretation of the characters between the quotation marks (") and have no effect on the justification of a string. A string is always left-justified; therefore, any 0 (zero) in a string code is ignored.



The `<EBCDIC code>` construct is optional in an EBCDIC string constant containing an EBCDIC string only if the default character type is EBCDIC. The `<ASCII code>` construct is optional in an ASCII string constant containing an ASCII string only if the default character type is ASCII. For more information, refer to “String Code” in Section 2, “Language Components,” and “Default Character Type” in Appendix C, “Data Representation.”

The reserved words `EMPTY8`, `EMPTY7`, and `EMPTY4` represent null strings of the character types EBCDIC, ASCII, and hexadecimal, respectively. The reserved word `EMPTY` represents a null string of the default character type.

For more information about string-valued library attributes, refer to “Library Attributes” in Section 8, “Library Facility.”

### String Concatenation

The operators `CAT` and `||` are used to concatenate two strings. The concatenation of two strings yields a new string whose length is the sum of the lengths of the two original strings, and whose value is formed by joining a copy of the second string immediately onto the end of a copy of the first string.

Only strings of the same character type can be concatenated.

If more than one string primary is used in a concatenation operation, the string primaries are evaluated from left to right.

No more than 256 characters can appear between one pair of quotation marks in a string constant; however, as many as 4095 characters can appear in an EBCDIC string constant, ASCII string constant, or hexadecimal string constant.

### Examples of String Expression

```

8"ABCD123"           % result = ABCD123

""WHY"48"6F""""     % result = "WHY?"

EMPTY8              % result =

S2 || S3

"AC" || S2 || "123"

S1 || TRANSLATE(S2,HEXTOEBCDIC)

HEAD(S,ALPHA)

TAIL(S,NOT "-")

REPEAT("ABC",3)

STRING(256,*)

TAKE(S,2)

DROP(TAKE(S,4),2)

TRANSLATE(S,HEXTOEBCDIC)

```

## Intrinsic Functions

Intrinsic functions are typed procedures that are predefined in the ALGOL language; that is, intrinsic functions can be used without being declared.

### Intrinsic Names by Type Returned

The intrinsic functions of ALGOL return values of type INTEGER, REAL, DOUBLE, BOOLEAN, COMPLEX, POINTER, and STRING.

### Arithmetic Intrinsic Names

The following intrinsic functions return arithmetic values that is, (values of type INTEGER, REAL, and DOUBLE).

#### Alphabetical Listing of Arithmetic Intrinsic Functions

The type of the value each function returns, INTEGER, REAL, or DOUBLE, is indicated by I, R, or D, respectively, following the name of the function.

ABS (R)	ARCCOS (R)	ARCSIN (R)
---------	------------	------------

*continued*

## Expressions and Functions

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*continued*

ARCTAN (R)	ARCTAN2 (R)	ARRAYSEARCH (I)
ATANH (R)	CABS (R)	CHECKSUM (R)
CLOSE (I)	COMPILETIME (R)	COS (R)
COSH (R)	COTAN (R)	DABS (D)
DALPHA (D)	DAND (D)	DARCCOS (D)
DARCSIN (D)	DARCTAN (D)	DARCTAN2 (D)
DCOS (D)	DCOSH (D)	DECIMAL (D)
DELTA (I)	DEQV (D)	DERF (D)
DERFC (D)	DEXP (D)	DGAMMA (D)
DIMP (D)	DINTEGER (D)	DLGAMMA (D)
DELINKLIBRARY (I)	DLN (D)	DLOG (D)
DMAX (D)	DMIN (D)	DNABS (D)
DNOT (D)	DOR (D)	DOUBLE (D)
DSCALELEFT (D)	DSCALERIGHT (D)	DSCALERIGHTT (D)
DSIN (D)	DSINH (D)	DSQRT (D)
DTAN (D)	DTANH (D)	ENTIER (I)
ERF (R)	ERFC (R)	EXP (R)
FIRST (R)	FIRSTONE (I)	FIRSTWORD (R)
GAMMA (R)	IMAG (R)	INTEGER (I)
INTEGERT (I)	LENGTH (I)	LINENUMBER (I)
LINKLIBRARY (I)	LISTLOOKUP (I)	LN (R)
LNGAMMA (R)	LOG (R)	MASKSEARCH (I)
MAX (R)	MESSAGESEARCHER (I)	MIN (R)
MLSTRANSLATE (I)	NABS (R)	NORMALIZE (R)
OFFSET (I)	ONES (I)	OPEN (I)
POTC (D)	POTH (D)	POTL (D)
PROCESSID (I)	RANDOM (R)	READLOCK (R)
REAL (R)	REMAININGCHARS (I)	SCALELEFT (I)
SCALERIGHT (I)	SCALERIGHTF (R)	SCALERIGHTT (I)
SECONDWORD (R)	SETACTUALNAME (I)	SIGN (I)
SIN (R)	SINGLE (R)	SINH (R)
SIZE (I)	SQRT (R)	TAN (R)
TANH (R)	TIME (R)	VALUE (I)
WAIT (I)	WAITANDRESET (I)	

**Arithmetic Intrinsic Functions by Type of Value Returned**

**Intrinsic Functions Returning Values of Type INTEGER**

ARRAYSEARCH	CLOSE	DELINKLIBRARY
DELTA	ENTIER	FIRSTONE
INTEGER	INTEGERT	LENGTH
LINENUMBER	LINKLIBRARY	LISTLOOKUP
MASKSEARCH	MESSAGESEARCHER	MLSTRANSLATE
OFFSET	ONES	OPEN
PROCESSID	REMAININGCHARS	SCALELEFT
SCALERIGHT	SCALERIGHTT	SETACTUALNAME
SIGN	SIZE	VALUE
WAIT	WAITANDRESET	

**Intrinsic Functions Returning Values of Type REAL**

ABS	ARCCOS	ARCSIN
ARCTAN	ARCTAN2	ATANH
CABS	CHECKSUM	COMPILETIME
COS	COSH	COTAN
ERF	ERFC	EXP
FIRST	FIRSTWORD	GAMMA
IMAG	LN	LNGAMMA
LOG	MAX	MIN
NABS	NORMALIZE	RANDOM
READLOCK	REAL	SCALERIGHTF
SECONDWORD	SIN	SINGLE
SINH	SQRT	TAN
TANH	TIME	

**Intrinsic Functions Returning Values of Type DOUBLE**

DABS	DALPHA	DAND
DARCCOS	DARCSIN	DARCTAN
DARCTAN2	DCOS	DCOSH
DECIMAL	DEQV	DERF
DERFC	DEXP	DGAMMA
DIMP	DINTEGER	DLGAMMA
DLN	DLOG	DMAX
DMIN	DNABS	DNOT

*continued*

## Expressions and Functions

---

*continued*

DOR	DOUBLE	DSCALELEFT
DSCALERIGHT	DSCALERIGHTT	DSIN
DSINH	DSQRT	DTAN
DTANH	POTC	POTH
POTL		

### Boolean Intrinsic Names

The following intrinsic functions return values of type **BOOLEAN**:

ACCEPT	AVAILABLE	BOOLEAN
CHANGEFILE	CHECKPOINT	FIX
FREE	HAPPENED	MLSACCEPT
READLOCK	READ	REMOVEFILE
SEEK	SPACE	WAIT
WRITE		

### Complex Intrinsic Names

The following intrinsic functions return values of type **COMPLEX**:

CCOS	CEXP
CLN	COMPLEX
CONJUGATE	CSIN
CSQRT	

### Pointer Intrinsic Names

The following intrinsic functions return values of type **POINTER**:

POINTER	READLOCK
---------	----------

### String Intrinsic Names

The following intrinsic functions return values of type **STRING**:

DROP	HEAD
REPEAT	STRING
STRING4	STRING7
STRING8	TAIL
TAKE	TRANSLATE

## Intrinsic Function Descriptions

For arithmetic intrinsic functions, all arithmetic parameters are assumed to be call-by-value. For a further description of some of the arithmetic intrinsic functions, refer to the *A Series System Software Utilities Operations Reference Manual*.

### ABS Function

— ABS — ( —<arithmetic expression>— ) \_\_\_\_\_|

The ABS function returns, as a real value, the absolute value of the specified arithmetic expression.

### ACCEPT Statement

The ACCEPT statement returns a Boolean value. For more information, refer to “ACCEPT Statement” in Section 4, “Statements.”

### ARCCOS Function

— ARCCOS — ( —<arithmetic expression>— ) \_\_\_\_\_|

The ARCCOS function returns, as a real value, the principal value of the arccosine (in radians) of the specified arithmetic expression. The arithmetic expression is greater than  $-1$  and less than  $1$ . If the value of the arithmetic expression is not in this range, a run-time error occurs.

### ARCSIN Function

— ARCSIN — ( —<arithmetic expression>— ) \_\_\_\_\_|

The ARCSIN function returns, as a real value, the principal value of the arcsine (in radians) of the specified arithmetic expression. The arithmetic expression is greater than  $-1$  and less than  $1$ . If the value of the arithmetic expression is not in this range, a run-time error occurs.

### ARCTAN Function

— ARCTAN — ( —<arithmetic expression>— ) \_\_\_\_\_|

The ARCTAN function returns, as a real value, the principal value of the arctangent (in radians) of the specified arithmetic expression.

### ARCTAN2 Function

— ARCTAN2 — ( —<arithmetic expression>— , \_\_\_\_\_  
 ↗<arithmetic expression>— ) \_\_\_\_\_|

The ARCTAN2 function returns, as a real value, the arctangent (in radians) of the following:

first <arithmetic expression> / second <arithmetic expression>

The returned value is adjusted according to the following formulas so that the value falls in the range (-pi to +pi).

In the following equations, let X be the value of the first arithmetic expression, and let Y be the value of the second arithmetic expression. If Y is greater than 0, then

$$\text{ARCTAN2}(X, Y) = \text{ARCTAN}(X/Y)$$

If Y equals 0, then

$$\text{ARCTAN2}(X, Y) = \text{SIGN}(X) * \text{pi} / 2$$

If Y is less than 0, then

$$\text{ARCTAN2}(X, Y) = \text{ARCTAN}(X/Y) + \text{SIGN}(X) * \text{pi}$$

### ARRAYSEARCH Function

— ARRAYSEARCH — ( —<arithmetic expression>— , —————→  
→<arithmetic expression>— , [ <array row>—————  
                                  <subscripted variable> ] ) —————|

The ARRAYSEARCH function searches for a specific value within an array. The first arithmetic expression is the value being searched for (the target value). The second arithmetic expression is the mask to be used in the search. The third parameter is a row or subscripted variable of an array of type INTEGER, REAL, BOOLEAN, or COMPLEX. For information on the subscripted variable, see “Arithmetic Assignment” in Section 4, “Statements.”

If the third parameter is an array row, the search begins with the last element of the specified array row; otherwise, the search begins with the element specified by the subscripted variable. Each element, in turn, is retrieved and the Boolean operation AND is performed using the value of the mask and the element as the operators. The Boolean operation AND is also performed on the target value. The results of these two operations are then compared with each other, using the IS operator. For more information on the IS operator, see “IS and ISNT Operators” earlier in this section.

If the comparison yields the value TRUE, the function returns an integer value equal to the difference between the subscript of the element where the value is found and the subscript of the first element in the array. If the comparison yields the value FALSE, the subscript of the element to be retrieved is decremented by 1, and the search continues until either a match is found or the first element of the array has been examined. If no match is found, -1 is returned. For information on <array row>, see “ARRAY Declaration” in Section 3, “Declarations.”

The ARRAYSEARCH function can be used on paged (segmented) arrays and unpaged (unsegmented) arrays.

### ATANH Function

— ATANH — ( —<arithmetic expression>— ) \_\_\_\_\_|

The ATANH function returns, as a real value, the hyperbolic arctangent of the specified arithmetic expression.

### AVAILABLE Function

— AVAILABLE — ( —<event designator>— ) \_\_\_\_\_|

The AVAILABLE function is a Boolean function that returns the value TRUE if the available state of the specified event is TRUE (available) and returns the value FALSE if the available state is FALSE (not available).

### BOOLEAN Function

— BOOLEAN — ( —<arithmetic expression>— ) \_\_\_\_\_|

The BOOLEAN function returns the value of the arithmetic expression as a Boolean value. If the arithmetic expression is double precision, its value is first truncated to single precision.

### CABS Function

— CABS — ( —<complex expression>— ) \_\_\_\_\_|

The CABS function returns, as a real value, the absolute value of the specified complex expression.

### CCOS Function

— CCOS — ( —<complex expression>— ) \_\_\_\_\_|

The CCOS function returns, as a complex value, the complex cosine of the specified complex expression.

### CEXP Function

— CEXP — ( —<complex expression>— ) \_\_\_\_\_|

The CEXP function returns the following as a complex value, where *e* is the base of the natural logarithms:

$e^{**} \text{ <complex expression>}$

### CHANGEFILE Statement

The CHANGEFILE statement returns a Boolean value. For more information, refer to “CHANGEFILE Statement” in Section 4, “Statements.”



### CHECKPOINT Statement

The CHECKPOINT statement returns a Boolean value. For more information, refer to “CHECKPOINT Statement” in Section 4, “Statements.”

### CHECKSUM Function

— CHECKSUM — ( —<array row>— , —<starting index>— , —————→  
→<ending index>— ) —————|

<starting index>

—<arithmetic expression>—————|

<ending index>

—<arithmetic expression>—————|

The CHECKSUM function returns, as a real value, a hash function of all bits in the words of the array row beginning with the word indexed by the <starting index> and up to, but not including, the word indexed by the <ending index>. Both the starting index and ending index are rounded to an integer value before they are used to index the array row. The value of this function can be used to verify the integrity of data being transferred or stored. The array row must be single precision and unpagged (unsegmented).

### CLN Function

— CLN — ( —<complex expression>— ) —————|

The CLN function returns, as a complex value, the natural logarithm of the specified complex expression.

### CLOSE Statement

The CLOSE statement returns an integer value. For more information, refer to “CLOSE Statement” in Section 4, “Statements.”

### COMPILETIME Function

— COMPILETIME — ( —<constant arithmetic expression>— ) —————|

The COMPILETIME function obtains various system time values at compilation time, for use by the object program. The form of the value returned by the COMPILETIME function is the same as that returned by the TIME function for the same argument. The compiler computes the returned value by using the TIME function at compilation time. For more information, refer to “TIME Function” later in this section.

COMPILETIME(20) returns, in integer form, the program version number as set by the most recent VERSION compiler control option.

COMPILETIME(21) returns, in integer form, the program cycle number as set by the most recent VERSION compiler control option.

COMPILETIME(22) returns, in integer form, the program patch number as set by the most recent VERSION compiler control option.

### COMPLEX Function

— COMPLEX — ( —<arithmetic expression>— , —————→  
 →<arithmetic expression>— ) —————|

The COMPLEX function returns the following as a complex value, where *i* is the square root of -1:

first <arithmetic expression> + *i* \* second <arithmetic expression>

The arithmetic expressions are first rounded to single precision, if necessary.

### CONJUGATE Function

— CONJUGATE — ( —<complex expression>— ) —————|

The CONJUGATE function returns, as a complex value, the complex conjugate of the specified complex expression.

### COS Function

— COS — ( —<arithmetic expression>— ) —————|

The COS function returns, as a real value, the cosine of an angle of <arithmetic expression> radians.

### COSH Function

— COSH — ( —<arithmetic expression>— ) —————|

The COSH function returns, as a real value, the hyperbolic cosine of the specified arithmetic expression.

### COTAN Function

— COTAN — ( —<arithmetic expression>— ) —————|

The COTAN function returns, as a real value, the cotangent of an angle of <arithmetic expression> radians.

### CSIN Function

— CSIN — ( —<complex expression>— ) —————|

## Expressions and Functions

---

The CSIN function returns, as a complex value, the complex sine of the specified complex expression.

### CSQRT Function

— CSQRT — ( —<complex expression>— ) —————|

The CSQRT function returns, as a complex value, the square root of the specified complex expression.

### DABS Function

— DABS — ( —<arithmetic expression>— ) —————|

The DABS function returns, as a double-precision value, the absolute value of the specified arithmetic expression.

### DALPHA Function

— DALPHA — ( —<pointer expression>— , —<arithmetic expression>—  
→ ) —————|

The DALPHA function returns, as a double-precision value, a bit image of the string of <arithmetic expression> characters starting with the character indicated by the specified pointer expression.

### DAND Function

— DAND — ( —<arithmetic expression>— , —<arithmetic expression>—  
→ ) —————|

The DAND function returns the following as a double-precision value:

first <arithmetic expression> AND second <arithmetic expression>

The arithmetic expressions are first extended to double precision, if necessary, and the AND operation is performed on all 96 bits.

### DARCCOS Function

— DARCCOS — ( —<arithmetic expression>— ) —————|

The DARCCOS function returns, as a double-precision value, the principal value of the arccosine (in radians) of the specified arithmetic expression, the arithmetic expression is greater than -1 and less than 1. If the value of the arithmetic expression is not in this range, a run-time error occurs.

### DARCSIN Function

— DARCSIN — ( —<arithmetic expression>— ) \_\_\_\_\_|

The DARCSIN function returns, as a double-precision value, the principal value of the arcsine (in radians) of the specified arithmetic expression, the arithmetic expression is greater than  $-1$  and less than  $1$ . If the value of the arithmetic expression is not in this range, a run-time error occurs.

### DARCTAN Function

— DARCTAN — ( —<arithmetic expression>— ) \_\_\_\_\_|

The DARCTAN function returns, as a double-precision value, the principal value of the arctangent (in radians) of the specified arithmetic expression.

### DARCTAN2 Function

— DARCTAN2 — ( —<arithmetic expression>— , \_\_\_\_\_→  
→<arithmetic expression>— ) \_\_\_\_\_|

The DARCTAN2 function returns, as a double-precision value, the principal value of the arctangent (in radians) of the following:

first <arithmetic expression> / second <arithmetic expression>

### DCOS Function

— DCOS — ( —<arithmetic expression>— ) \_\_\_\_\_|

The DCOS function returns, as a double-precision value, the cosine of an angle of <arithmetic expression> radians.

### DCOSH Function

— DCOSH — ( —<arithmetic expression>— ) \_\_\_\_\_|

The DCOSH function returns, as a double-precision value, the hyperbolic cosine of the specified arithmetic expression.

### DECIMAL Function

— DECIMAL — ( —<string expression>— ) \_\_\_\_\_|

The DECIMAL function returns the double-precision value represented by the string expression. The string expression must yield a valid number on evaluation. For more information on the <number> construct, see Section 2, “Language Components.” For example, the assignment  $D := DECIMAL(STR)$ ; is valid for the following strings:

## Expressions and Functions

---

```
STR = "+5497823"  
STR = "1.750--46"  
STR = "--4.31468"  
STR = "@2"  
STR = "+549"!!"7823"
```

However, the program is receives a run-time error for the following strings:

```
STR = "50 00."  
STR = "1,505,278,00"  
STR = "102.5"  
STR = ".573"!!"5.82"
```

### DELINKLIBRARY Function

— DELINKLIBRARY — ( —<library identifier>— ) —————|

The DELINKLIBRARY function unlinks the program from the library program specified by the library identifier. The DELINKLIBRARY function affects only the linkage between the program and the indicated library; other programs using the library program are not affected. This function returns an integer value that indicates success or failure and the reason for failure. The values returned by the function can be interpreted as follows:

Value	Meaning
1	The library has been unlinked from the program.
0	The library was not linked to the program.
-1	The library structure could not be accessed; a system fault has occurred.

### DELTA Function

— DELTA — ( —<pointer expression>— , —<pointer expression>— ) —|

The DELTA function returns, as an integer value, the number of characters between the character position referenced by the first pointer expression and the character position referenced by the second pointer expression. The value is calculated as follows: the character position referenced by the first pointer expression is subtracted from the character position referenced by the second pointer expression.

For a function that returns the number of characters between the character position referenced by a pointer expression and the beginning of the array row, see "OFFSET Function" later in this section. For a function that returns the number of characters between the character position referenced by a pointer expression and the end of the array row, see "REMAININGCHARS Function" later in this section.

### DEQV Function

— DEQV — ( —<arithmetic expression>— , —<arithmetic expression>— →  
→ ) —————|

The DEQV function returns the following as a double-precision value:

first <arithmetic expression> EQV second <arithmetic expression>

Both arithmetic expressions are first extended to double precision, if necessary, and the EQV operation is performed on all 96 bits.

### DERF Function

— DERF — ( —<arithmetic expression>— ) \_\_\_\_\_|

The DERF function returns, as a double-precision value, the value of the standard error function at the specified arithmetic expression. For any valid N, DERF(-N) = -DERF(N).

### DERFC Function

— DERFC — ( —<arithmetic expression>— ) \_\_\_\_\_|

The DERFC function returns, as a double-precision value, the complement of the value of the standard error function at the specified arithmetic expression. For any valid N, DERFC(N) = 1 - DERF(N).

### DEXP Function

— DEXP — ( —<arithmetic expression>— ) \_\_\_\_\_|

The DEXP function returns the following as a double-precision value, where *e* is the base of the natural logarithms:

e \*\* <arithmetic expression>

### DGAMMA Function

— DGAMMA — ( —<arithmetic expression>— ) \_\_\_\_\_|

The DGAMMA function returns, as a double-precision value, the value of the gamma function at the specified arithmetic expression.

### DIMP Function

— DIMP — ( —<arithmetic expression>— , —<arithmetic expression>—  
→ ) \_\_\_\_\_|

The DIMP function returns the following as a double-precision value:

first <arithmetic expression> IMP second <arithmetic expression>

Both arithmetic expressions are first extended to double precision, if necessary, and the IMP operation is performed on all 96 bits.

### DINTEGER Function

The DINTEGER function has two forms, each of which returns a double-precision value.

The following form of DINTEGER function returns the value of the arithmetic expression as a double-precision integer value. Specifically, the function returns the following:

— DINTEGER — ( —<arithmetic expression>— )

The following form of the DINTEGER function returns the decimal value represented by the string of characters indicated by the pointer expression, as a double-precision integer value. The absolute value of the integer value to be returned must be less than or equal to 3.0223145903657293676543@@23.

The arithmetic expression specifies the length of the string of characters and must have a value, when rounded to an integer, less than 24. If the rounded value of the arithmetic expression is 24 or greater, the program is terminated with a fault. If the length is 0 (zero), a result of 0 is returned.

A zone field configuration of 1"1101" in the least significant character position causes the result of the function to be negative. With 4-bit characters, a 1"1101" in the most significant character position results in a negative value.

The state of the pointer expression when the count is exhausted can be preserved by using the update pointer construct.

DOUBLE(ENTIER(<arithmetic expression> + 0.5))  
 — DINTEGER — ( [ <update pointer> ] <pointer expression> , —>  
 →<arithmetic expression> )

### DINTEGERT Function

— DINTEGERT — ( —<arithmetic expression>— )

The DINTEGERT function returns the value of the arithmetic expression integerized with truncation to a double-precision integer value.

### DLGAMMA Function

— DLGAMMA — ( —<arithmetic expression>— )

The DLGAMMA function returns, as a double-precision value, the natural logarithm of the gamma function at the specified arithmetic expression.

### DLN Function

— DLN — ( —<arithmetic expression>— )

The DLN function returns, as a double-precision value, the natural logarithm of the specified arithmetic expression.

### DLOG Function

— DLOG — ( —<arithmetic expression>— ) —————|

The DLOG function returns, as a double-precision value, the base-10 logarithm of the specified arithmetic expression.

### DMAX Function

— DMAX — ( ( —<arithmetic expression>— ) —————|

The DMAX function returns, as a double-precision value, the maximum of the values of all the specified arithmetic expressions.

### DMIN Function

— DMIN — ( ( —<arithmetic expression>— ) —————|

The DMIN function returns, as a double-precision value, the minimum of the values of all the specified arithmetic expressions.

### DNABS Function

— DNABS — ( —<arithmetic expression>— ) —————|

The DNABS function returns, as a double-precision value, the negative of the absolute value of the specified arithmetic expression.

### DNORMALIZE Function

— DNORMALIZE — ( —<arithmetic expression>— ) —————|

The DNORMALIZE function returns, as a double-precision value, the normalized form of the specified arithmetic expression. For more information on normalized format, refer to “Double-Precision Operand” in Appendix C, “Data Representation.”

### DNOT Function

— DNOT — ( —<arithmetic expression>— ) —————|

The DNOT function returns, as a double-precision value, the logical complement of the value of the specified arithmetic expression. The arithmetic expression is first extended to double precision, if necessary, and the NOT operation is performed on all 96 bits.



### DOR Function

— DOR — ( —<arithmetic expression>— , —<arithmetic expression>— )  
→ ) \_\_\_\_\_ |

The DOR function returns the following as a double-precision value:

first <arithmetic expression> OR second <arithmetic expression>

Both arithmetic expressions are first extended to double precision, if necessary, and the OR operation is performed on all 96 bits.

### DOUBLE Function

The DOUBLE function has three forms, each of which returns a double-precision value.

The following form of the DOUBLE function returns the value of the arithmetic expression extended to a double-precision value.

— DOUBLE — ( —<arithmetic expression>— ) \_\_\_\_\_ |

The following form of the DOUBLE function returns a double-precision value in which the first word is equal to the value of the first arithmetic expression and the second word is equal to the value of the second arithmetic expression. The arithmetic expressions are first truncated to single precision, if necessary.

— DOUBLE — ( —<arithmetic expression>— , —<arithmetic expression>— )  
→ ) \_\_\_\_\_ |

The following form of the DOUBLE function returns, as a double-precision value, the decimal value represented by the string of characters starting with the character pointed to by the pointer expression.

A zone field configuration of 1"1101" in the least significant character position causes the result of the function to be negative. With 4-bit characters, a 1"1101" in the most significant character position results in a negative value.

The state of the pointer expression when the count is exhausted can be preserved by the use of the <update pointer> construct.

— DOUBLE — ( \_\_\_\_\_<update pointer>\_\_\_\_\_<pointer expression>— , \_\_\_\_\_ )  
→<arithmetic expression>— ) \_\_\_\_\_ |

### DROP Function

— DROP — ( —<string expression>— , —<arithmetic expression>— ) \_\_\_\_\_ |

The DROP function returns a string with a value equal to the value of the string expression with the first arithmetic expression characters deleted. The value of the arithmetic expression is rounded to an integer, if necessary. An error occurs if the rounded value of the arithmetic expression is greater than the number of

characters in the string expression or less than 0 (zero). If the rounded value of the arithmetic expression is 0, the result is the same as the value of the string expression. If the rounded value of the arithmetic expression is equal to the length of the string expression, the result is the null string.

The DROP function and the TAKE function are complementary functions. This means that for any string expression S and any arithmetic expression A in the range  $0 \leq A \leq \text{LENGTH}(S)$ , the following relation is always TRUE:

$$S = \text{TAKE}(S,A) \text{ CAT } \text{DROP}(S,A)$$

For more information, see "TAKE Function" later in this section.

### Examples of DROP Function

In the following examples, string S has a length of 6 and contains "ABCDEF".

$$\text{DROP}(S,2) = \text{"CDEF"}$$

$$\text{DROP}(\text{TAKE}(S,4),2) = \text{"CD"}$$

$$\text{DROP}(S,6) = \text{the null string}$$

### DSCALELEFT Function

— DSCALELEFT — ( —<arithmetic expression>— , —————>  
 →<arithmetic expression>— ) —————|

The DSCALELEFT function returns the following as a double-precision value The second arithmetic expression, rounded to an integer, has a value in the range 0 to 12.

$$\text{first } \langle \text{arithmetic expression} \rangle * (10^{**} \text{second } \langle \text{arithmetic expression} \rangle)$$

The DSCALELEFT function is undefined when the integerized value of the second arithmetic expression is less than 0 or greater than 12.

### DSCALERIGHT Function

— DSCALERIGHT — ( —<arithmetic expression>— , —————>  
 →<arithmetic expression>— ) —————|

The DSCALERIGHT function returns, as a double-precision value, the rounded result of the following, where the second arithmetic expression, rounded to an integer, has a value in the range 0 to 12:

$$\text{first } \langle \text{arithmetic expression} \rangle / (10^{**} \text{second } \langle \text{arithmetic expression} \rangle)$$

A run-time error occurs if the integerized value of the second arithmetic expression is less than 0 or greater than 12.

### DSCALERIGHTT Function

— DSCALERIGHTT — ( —<arithmetic expression>— , —————→  
→<arithmetic expression>— ) —————|

The DSCALERIGHTT function returns, as a double-precision value, the truncated result of the following, where the second arithmetic expression, rounded to an integer, has a value in the range 0 to 12:

first <arithmetic expression>/ (10 \*\* second <arithmetic expression>)

A run-time error occurs if the integerized value of the second arithmetic expression is less than 0 or greater than 12.

### DSIN Function

— DSIN — ( —<arithmetic expression>— ) —————|

The DSIN function returns, as a double-precision value, the sine of an angle of <arithmetic expression> radians.

### DSINH Function

— DSINH — ( —<arithmetic expression>— ) —————|

The DSINH function returns, as a double-precision value, the hyperbolic sine of the specified arithmetic expression.

### DSQRT Function

— DSQRT — ( —<arithmetic expression>— ) —————|

The DSQRT function returns, as a double-precision value, the square root of the specified arithmetic expression. The value of the arithmetic expression must be greater than or equal to 0.

### DTAN Function

— DTAN — ( —<arithmetic expression>— ) —————|

The DTAN function returns, as a double-precision value, the tangent of an angle of <arithmetic expression> radians.

### DTANH Function

— DTANH — ( —<arithmetic expression>— ) —————|

The DTANH function returns, as a double-precision value, the hyperbolic tangent of the specified arithmetic expression.

## ENTIER Function

— ENTIER — ( —<arithmetic expression>— ) —————|

The ENTIER function returns the largest integer that is not greater than the value of the arithmetic expression.

Because of the limitations of finite representation arithmetic, the ENTIER function erroneously returns 0, rather than -1, for negative numbers of small magnitude. For a single-precision expression, the threshold is  $-0.5 * 8^{*-13}$  (approximately  $-9.09E-13$ ). This number correctly yields -1, whereas the next smaller (in magnitude) single-precision number incorrectly yields 0. For a double-precision expression, the threshold can differ on various systems because of different algorithms for double-precision rounding, but it is in the vicinity of  $-8^{*-26}$  (approximately  $-3.31E-24$ ).

The ENTIER function returns an incorrect result for single-precision, negative integers less than or equal to  $-(8^{*32})$ . The result of the function for an integer expression should be equal to the value of the expression. However, ENTIER(-68719476736) returns a value of -68719476737.

The ENTIER function is not a simple truncation function, as illustrated by the examples. For a simple truncation function, see “INTEGERT Function” later in this section.

### Examples of ENTIER Function

ENTIER(2.6) = 2  
 ENTIER(3.1) = 3  
 ENTIER(-0.01) = -1  
 ENTIER(-3.4) = -4  
 ENTIER(-1.8) = -2

## ERF Function

— ERF — ( —<arithmetic expression>— ) —————|

The ERF function returns, as a real value, the value of the standard error function at the specified arithmetic expression. For any valid N,  $ERF(-N) = -ERF(N)$ .

## ERFC Function

— ERFC — ( —<arithmetic expression>— ) —————|

The ERFC function returns, as a real value, the complement of the value of the standard error function at the specified arithmetic expression. For any valid N,  $ERFC(N) = 1 - ERF(N)$ .



### FIX Statement

The FIX statement returns a Boolean value. For more information, refer to “FIX Statement” in Section 4, “Statements.”

### FREE Statement

The FREE statement returns a Boolean value. For more information, refer to “FREE Statement” in Section 4, “Statements.”

### GAMMA Function

— GAMMA — ( —<arithmetic expression>— ) —————|

The GAMMA function returns, as a real value, the value of the gamma function at the specified arithmetic expression.

### HAPPENED Function

— HAPPENED — ( —<event designator>— ) —————|

The HAPPENED function is a Boolean function that returns the value TRUE if the happened state of the specified event is TRUE (happened) and returns the value FALSE if the happened state is FALSE (not happened)

### HEAD Function

— HEAD — ( —<string expression>— , —<string character set>— ) —|

<string character set>

┌ NOT ┐ ┌<string constant>┐ —————|  
└<truth set table>┘

The HEAD function returns a string whose value consists of the leftmost characters of the string expression up to, but not including, the first character that is not a member of the string character set. If the first character of the string expression is not a member of the string character set, the null string is returned. If all characters of the string expression are members of the string character set, the entire string expression is returned.

The string character set must be of the same character type as the string expression. If a truth set table is used, it must not be composed of characters of different character types. The option NOT indicates a string character set made up of all characters that are not specified in the string constant or truth set table, but that are of the same character type as the string expression.

The HEAD function and the TAIL function are complementary functions. This means that for any string expression S and any string character set C, the following relation is always TRUE:

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---

S = HEAD(S,C) CAT TAIL(S,C)

For more information, see "TAIL Function" later in this section.

### Examples of HEAD Function

In the following examples, S is a string of length 9 that contains 8"ABC/1-2+3".

HEAD(S,NOT "/" ) = 8"ABC"

HEAD(S,ALPHA) = 8"ABC"

HEAD(S,"123") = the null string

### IMAG Function

— IMAG — ( —<complex expression>— ) —————|

The IMAG function returns, as a real value, the imaginary part of the specified complex expression.

For a function that returns the real part of a complex expression, see "REAL Function" later in this section.

### INTEGER Function

The INTEGER function has two forms, each of which returns an integer value.

— INTEGER — ( —<arithmetic expression>— ) —————|

This form of the INTEGER function returns the value of the arithmetic expression integerized with rounding. Specifically, it returns the following:

ENTIER(<arithmetic expression> + 0.5)

— INTEGER — (     <update pointer>     <pointer expression>— , —————>  
→<arithmetic expression>— ) —————|

This form of the INTEGER function returns, as an integer value, the decimal value represented by the string of characters starting with the character pointed to by the pointer expression. The absolute value of the integer value to be returned must be less than or equal to 549755813887.

The arithmetic expression specifies the length of the string of characters and must, when rounded to an integer, have a value less than 24. If the rounded value of the arithmetic expression is 24 or greater, the program is terminated with a fault. If the length is 0 (zero), a result of 0 is returned.

A zone field configuration of 1"1101" in the least significant character position causes the result of the function to be negative. With 4-bit characters, a 1"1101" in the most significant character position results in a negative value.

When the pointer expression is a hexadecimal pointer, or a hexadecimal array, if the character in the most significant character position is not in the range 0 through 9, the character is assumed to be a sign. Accordingly, the number of characters processed is one greater than that specified by the arithmetic expression. Note that this extra character affects the value of the update pointer.

If the string of characters is all 1"11111111" (48"F") for 8 characters or 1"1111" (4"F") for 4-bit characters, the string is treated as though it were a sequence of nines. Note that in the 4-bit character case, the first character is treated as a sign (positive) and the rules previously described are followed.

Other than the preceding special cases, if the numeric field of each character in the string of characters contains anything other than a digit, the results are undefined and can vary.

The state of the pointer expression when the count is exhausted can be preserved by the use of the <update pointer> construct.

### INTEGERT Function

— INTEGERT — ( —<arithmetic expression>— ) \_\_\_\_\_|

The INTEGERT function returns the value of the arithmetic expression integerized with truncation.

The INTEGERT function does not necessarily return the same value as the ENTIER function. For example, the function INTEGERT(-1.2) returns the value -1, but the function ENTIER(-1.2) returns the value -2.

### LENGTH Function

— LENGTH — ( —<string expression>— ) \_\_\_\_\_|

The LENGTH function returns, as an integer value, the number of characters in the string that results from evaluation of the string expression. The null string has a length of 0.

### LINENUMBER Function

— LINENUMBER \_\_\_\_\_|

The LINENUMBER function returns, as an integer value, the sequence number of the source file record on which it appears.

### LINKLIBRARY Function

— LINKLIBRARY — ( —<library identifier>— ) \_\_\_\_\_|

The LINKLIBRARY function determines whether or not the program is currently linked to or is capable of being linked to the library program specified by the library identifier. Results indicating a successful linkage are returned by the LINKLIBRARY function if



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the program is presently linked to the library or if the program is capable of being linked, in which case the LINKLIBRARY function performs the linkage. If the program cannot be linked to the library, the function returns a result indicating the reason for the failure. In any case, the program continues to execute; that is, the use of the LINKLIBRARY function prevents the termination or suspension of a program upon an unsuccessful attempt to link to a library.

During the linkage process, an attempt is made to link to every entry point exported from the library whose name matches an entry point declared in the program. Only those names that match are checked for correct function type, number of parameters, and parameter types. Therefore, the LINKLIBRARY function does not check that every entry point declared in the program is also exported from the library.

The values returned by the LINKLIBRARY function can be interpreted as follows:

Value	Meaning
2	Successful linkage was made to the library, but not all entry points were provided.
1	Successful linkage was made to the library, and all entry points were provided.
0	The program was already linked to the specified library at the time of the LINKLIBRARY call.
-1	The library code file is missing.
-2	The family size of a process running in Swapper was exceeded during the attempt to link to the library.
-3	A by-calling procedure specified more than one library task.
-4	The library is not a system library.
-5	No library objects were available for linkage. This can be due to any of the following: library does not provide the object, object is not visible from the user, an entrypoint is missing, no entrypoints in the program are provided by the library, or parameters are mismatched.
-6	The library was terminated, canceled, or thawed before being frozen; therefore, the library was not successfully initiated.
-7	An invalid circular chain of library linkages was detected.
-8	A by-calling procedure never specified a library task.
-9	A bad task was passed by a by-calling library procedure.
-10	A library feature that was used is not implemented.
-11	The library template contained an illegal provision type.
-12	The library template level is obsolete. This program must be recompiled.
-13	The library directory level is incompatible with the library template level. The older program must be recompiled.
-14	The program cannot link to a system library.

*continued*

*continued*

Value	Meaning
-15	The library was not initiated for one of the following reasons: <ul style="list-style-type: none"> <li>• A task array for a by-calling library was not declared in the library stack.</li> <li>• There was an attempt to link to a file that is not a code file.</li> <li>• The code file is not a library code file.</li> <li>• The file structure is incompatible with the current release.</li> </ul>
-16	This program is not authorized to use this library procedure.
-17	The library is not visible to the program attempting to link to the library.

### LISTLOOKUP Function

— LISTLOOKUP — ( —<arithmetic expression>— , —<array row>— , —>  
 →<arithmetic expression>— ) —————|

The LISTLOOKUP function causes a linked list of words to be searched and returns, as an integer value, an index into the list as follows:

1. The array row is indexed by the value of the second arithmetic expression and the word is extracted. Each word contains a value (in field [47:28]) and a link (in field [19:20]) to the next word of the linked list.
2. If the value in the extracted word is greater than or equal to the value of the first arithmetic expression, the operation stops, and the index of the word whose link points to the extracted word is returned by the function.
3. If the value in the extracted word is less than the value of the first arithmetic expression, the link of the extracted word is used as an index into the array row, a new word is extracted, and the process is repeated.

A word with a link of 0 terminates the search. The value of a word is tested only if the link field is nonzero. If the linked list is exhausted, that is, (if a word with a link of 0 is encountered), a value of -1 is returned by the LISTLOOKUP function.

### LN Function

— LN — ( —<arithmetic expression>— ) —————|

The LN function returns, as a real value, the natural logarithm of the specified arithmetic expression.

### LNGAMMA Function

— LNGAMMA — ( —<arithmetic expression>— ) —————|

The LNGAMMA function returns, as a real value, the natural logarithm of the gamma function at the specified arithmetic expression.

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### LOG Function

— LOG — ( —<arithmetic expression>— ) —————|

The LOG function returns, as a real value, the base-10 logarithm of the specified arithmetic expression.

### MASKSEARCH Function

— MASKSEARCH — ( —<arithmetic expression>— , —————→  
→<arithmetic expression>— , —<array row>—————|  
                          |<subscripted variable>| ) —————|

The MASKSEARCH function performs the same operations as the ARRAYSEARCH function, except that it is intended for use only with unpagged (unsegmented) arrays.

If the third parameter to the MASKSEARCH function is an array row or a subscripted variable of a paged (segmented) array, then a warning message is given at run time. This warning message is given only the first time the statement containing the MASKSEARCH function is executed.

If the third parameter is an array row of a paged array, execution of the MASKSEARCH function causes a fault.

If the third parameter is a subscripted variable of a paged array, then no fault is generated at run time, but the results can be unexpected. The MASKSEARCH function searches only the 256-word segment containing the specified array element. If the target value is found in that array segment, the index relative to the beginning of the segment is returned. If the target is not found in that segment, -1 is returned.

### MAX Function

— MAX — ( —<arithmetic expression>— ) —————|

The MAX function returns, as a real value, the maximum of the values of all the specified arithmetic expressions.

### MESSAGESEARCHER Statement

The MESSAGESEARCHER statement returns an integer value. For more information, refer to “MESSAGESEARCHER Statement” in Section 4, “Statements.”

### MIN Function

— MIN — ( —<arithmetic expression>— ) —————|

The MIN function returns, as a real value, the minimum of the values of all the specified arithmetic expressions.

### MLSACCEPT Statement

The `MLSACCEPT` statement returns a Boolean value. For more information, refer to “`MLSACCEPT` Statement” in Section 4, “Statements.”

### MLSTRANSULATE Statement

The `MLSTRANSULATE` statement returns an integer value. For more information, refer to “`MLSTRANSULATE` Statement” in Section 4, “Statements.”

### NABS Function

— `NABS` — ( —<arithmetic expression>— ) \_\_\_\_\_|

The `NABS` function returns, as a real value, the negative of the absolute value of the specified arithmetic expression.

### NORMALIZE Function

— `NORMALIZE` — ( —<arithmetic expression>— ) \_\_\_\_\_|

The `NORMALIZE` function returns, as a real value, the value of the arithmetic expression, normalized and rounded to a single-precision operand. For more information on the normalized format, refer to “Real Operand” in Appendix C, “Data Representation.”

### OFFSET Function

— `OFFSET` — ( —<pointer expression>— ) \_\_\_\_\_|

The `OFFSET` function returns, as an integer value, the number of characters between the character position referenced by the pointer expression and the beginning of the array row, not including the character designated by the pointer expression. The function value is in terms of the character size of the pointer expression. If it is a word pointer, the value returned is given in terms of 8-bit characters. If the pointer expression points to a paged (segmented) array, the `OFFSET` function returns the total offset from the beginning of the first segment of the row.

For a function that returns the number of characters between the character position referenced by a pointer expression and the end of the array row, see “`REMAININGCHARS` Function” later in this section.

### ONES Function

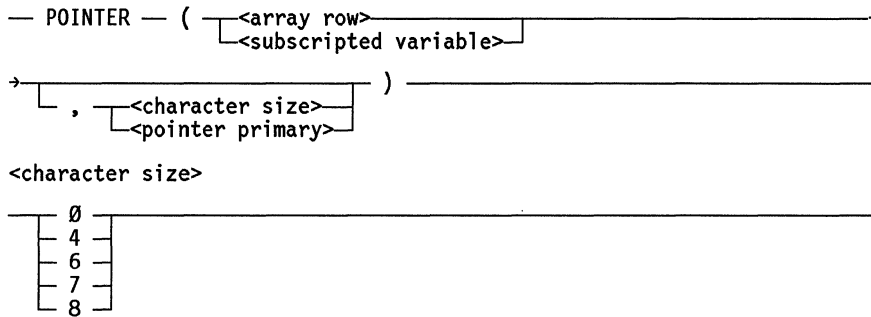
— `ONES` — ( —<arithmetic expression>— ) \_\_\_\_\_|

The `ONES` function returns, as an integer value, the number of nonzero bits in the value of the arithmetic expression. If the arithmetic expression is double precision, all 96 bits of its value are examined.

### OPEN Statement

The OPEN statement returns an integer value. For more information, refer to “OPEN Statement” in Section 4, “Statements.”

### POINTER Function



The POINTER function generates a pointer to the specified location.

If the first parameter is an array row, the pointer references the first character of the first word of the specified array row. If the first parameter is a subscripted variable, the pointer references the first character of the array element specified by the subscripted variable.

If the second parameter is not given, the character size of the pointer is 6 or 8 bits, depending on the default character type. For more information on the default character type, refer to “Default Character Type” in Appendix C, “Data Representation.”

If the second parameter is a character size of 4, 6, or 8, the character size of the pointer being generated is 4 bits, 6 bits, or 8 bits, respectively. If the second parameter is a character size of 7, the character size of the pointer is 8 bits. If the second parameter is a character size of 0, the pointer is word-oriented, rather than character-oriented. In addition, the pointer is single precision if the array it points to is single precision (INTEGER, REAL, or BOOLEAN), and the pointer is double precision if the array is double precision (DOUBLE or COMPLEX).

If a pointer primary is given as the second parameter, the character size of that pointer primary is used for the character size of the pointer being generated.

**Note:** *The BCL data type is not supported on A Series systems. The appearance of a BCL construct that can cause the creation of a BCL descriptor, such as a 6-bit pointer, generates compile-time warning messages for the program.*



### Examples of POT Function

```
RESULT := POTL[X]; % WHERE X < 64
```

```
DEFINE POT(T) = (POTL[T.[5:6]] * POTC[T.[11:6]] * POTH[T.[14:3]])#;  
ONEDIVTENTO I := 1 / POT(I);
```

### PROCESSID Function

```
— PROCESSID —————|
```

The positive integer value uniquely identifies the process executing the function.

The PROCESSID function returns a value that remains unique to that process for the duration of its execution. However, the value is not guaranteed to be the same on every invocation of the PROCESSID function. For example, upon restarting from a checkpoint, the value of the PROCESSID function can have changed. Also, after a process terminates, its PROCESSID value can be assigned to a new process.

### RANDOM Function

```
— RANDOM — ( —<arithmetic variable>— ) —————|
```

The RANDOM function returns, as a real value, a random number that is greater than or equal to 0 and less than 1. The arithmetic variable is a call-by-name parameter, and its value is changed each time the function is referenced. A compile-time or run-time error occurs if the parameter is not a single-precision arithmetic variable. An integer overflow error occurs if the integerized value of the arithmetic variable is not in the range  $[(-2^{**39}) + 1]$  through  $[(2^{**39}) - 1]$ .

### READ Statement

The READ statement returns a Boolean value. For more information, refer to “READ Statement” in Section 4, “Statements.”

### READLOCK Function

Taking only one memory cycle, the READLOCK function stores the value of the specified expression in the designated variable and returns the previous contents of the variable.

The READLOCK function has three forms. One form returns a real value, one form returns a Boolean value, and one form returns a pointer. The following form of the READLOCK function stores the value of the arithmetic expression in the arithmetic variable and returns the previous contents of the variable as a real value. Both the variable and the expression must be single precision.

```
— READLOCK — ( —<arithmetic expression>— , —<arithmetic variable>—  
→ ) —————|
```

The following form of the READLOCK function stores the value of the Boolean expression in the Boolean variable and returns the previous contents of the variable as a Boolean value.

— READLOCK — ( —<Boolean expression>— , —<Boolean variable>— ) —|

The following form of the READLOCK function stores the value of the pointer expression in the pointer variable and returns the previous contents of the variable as a pointer value.

— READLOCK — ( —<pointer expression>— , —<pointer variable>— ) —|

## REAL Function

The REAL function has four forms, each of which returns a real value. The following form of the REAL function returns the value of the arithmetic expression rounded to a single-precision, real value.

— REAL — ( —<arithmetic expression>— ) —————|

The following form of the REAL function returns the value of the Boolean expression as a real value. All bits of the Boolean expression are used.

— REAL — ( —<Boolean expression>— ) —————|

The following form of the REAL function returns, as a real value, the real part of the specified complex expression.

— REAL — ( —<complex expression>— ) —————|

For a function that returns the imaginary part of a complex expression, see “IMAG Function” earlier in this section. The following form of the REAL function returns, as a real value, the string of < arithmetic expression > characters starting with the character indicated by the pointer expression.

— REAL — ( —<pointer expression>— , —<arithmetic expression>— ) —|

If the arithmetic expression indicates a string of characters that is less than or equal to 48 bits long, this string is right-justified in one word with leading zeros, if necessary, and this word is returned as the function result. If the arithmetic expression indicates a string of characters more than 48 bits long but less than or equal to 96 bits long, this string is right-justified with leading zeros, if necessary, in a two-word operand. Then only the first word is returned as the function result. If the arithmetic expression indicates a string of characters more than 96 bits long, a run-time error occurs.

## REMAININGCHARS Function

— REMAININGCHARS — ( —<pointer expression>— ) —————|

The REMAININGCHARS function returns, as an integer value, the number of characters between the character position referenced by the pointer expression and the end of the array row, including the character designated by the pointer expression. The returned value is in terms of the character size of the pointer expression. If the pointer expression is a word pointer, the value returned is in terms of 8-bit characters. If



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the pointer expression points to a paged (segmented) the array, REMAININGCHARS function returns gives the number of characters left in the entire array row.

For a function that returns the number of characters between the character position referenced by a pointer expression and the beginning of the array row, see “OFFSET Function” earlier in this section.

### REMOVEFILE Statement

The REMOVEFILE statement returns a Boolean value. For more information, refer to “REMOVEFILE Statement” in Section 4, “Statements.”

### REPEAT Function

— REPEAT — ( —<string expression>— , —<arithmetic expression>— )

The REPEAT function returns a string according to the following rules:

- If the arithmetic expression equals 0, the result of the REPEAT function is the null string.
- If the arithmetic expression is greater than 0, the result of the REPEAT function is the same as if <arithmetic expression> occurrences of the value of the string expression were all concatenated together.
- If the arithmetic expression is less than 0, the result of the REPEAT function is either a compile-time or a run-time error.

The value of the arithmetic expression is rounded to an integer, if necessary, before it is used as the repeat count.

#### Examples of REPEAT Function

```
REPEAT("ABC",3) = "ABCABCABC"
```

```
REPEAT("WON'T WORK",0) = the null string
```

### SCALELEFT Function

— SCALELEFT — ( —<arithmetic expression>— , — )

The SCALELEFT function returns the following as an integer value, where the second arithmetic expression, rounded to an integer, has a value in the range 0 to 12:

```
first <arithmetic expression>*(10 ** second <arithmetic expression>)
```

The SCALELEFT function is undefined when the integerized value of the second arithmetic expression is less than 0 or greater than 12.

### SCALERIGHT Function

— SCALERIGHT — ( —<arithmetic expression>— , —————→  
 →<arithmetic expression>— ) —————|

The SCALERIGHT function returns, as an integer value, the rounded result of the following, where the second arithmetic expression, rounded to an integer, has a value in the range 0 to 12:

$$\text{first } \langle \text{arithmetic expression} \rangle / (10^{**} \text{ second } \langle \text{arithmetic expression} \rangle)$$

A run-time error occurs if the integerized value of the second arithmetic expression is less than 0 or greater than 12.

### SCALERIGHTF Function

— SCALERIGHTF — ( —<arithmetic expression>— , —————→  
 →<arithmetic expression>— ) —————|

The SCALERIGHTF function returns, as a real value, a left-justified, packed decimal (4-bit decimal) number representing the following, where the second arithmetic expression, rounded to an integer, has a value in the range 0 to 12:

$$\text{first } \langle \text{arithmetic expression} \rangle \text{ MOD } (10^{**} \text{ second } \langle \text{arithmetic expression} \rangle)$$

A run-time error occurs if the integerized value of the second arithmetic expression is less than 0 or greater than 12.

The number of significant digits returned by the function is equal to the integerized value of the second arithmetic expression. The external sign flip-flop (EXTF) is set to reflect the sign of the first arithmetic expression for use with the editing phrases specified in a PICTURE declaration.

#### Examples of SCALERIGHTF Function

$$\text{SCALERIGHTF}(1234,4) = 4"123400000000"$$

$$\text{SCALERIGHTF}(12345678,12) = 4"000012345678"$$

### SCALERIGHTT Function

— SCALERIGHTT — ( —<arithmetic expression>— , —————→  
 →<arithmetic expression>— ) —————|

The SCALERIGHTT function returns, as an integer value, the truncated result of the following, where the second arithmetic expression, rounded to an integer, has a value in the range 0 to 12:

$$\text{first } \langle \text{arithmetic expression} \rangle / (10^{**} \text{ second } \langle \text{arithmetic expression} \rangle)$$

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A run-time error occurs if the integerized value of the second arithmetic expression is less than 0 or greater than 12.

### SECONDWORD Function

— SECONDWORD — ( —<arithmetic expression>— ) \_\_\_\_\_|

The SECONDWORD function returns, as a real value, the second word of the double-precision arithmetic expression. The arithmetic expression is first extended to double precision, if necessary.

For a function that returns the first word of a double-precision arithmetic expression, see “FIRSTWORD Function” earlier in this section.

### SEEK Statement

The SEEK statement returns a Boolean value. For more information, refer to “SEEK Statement” in Section 4, “Statements.”

### SETACTUALNAME Function

— SETACTUALNAME — ( —<library entry point identifier>— , \_\_\_\_\_→  
→<pointer expression>— ) \_\_\_\_\_|

<library entry point identifier>

A procedure identifier declared with a library entry point specification.

The SETACTUALNAME function determines whether or not the ACTUALNAME of the library entry point specified by the library entry point identifier can be changed to the name specified the pointer expression. The function then makes the change, if it is possible. The Results of a successful change are returned upon completing the ACTUALNAME change; otherwise, results indicating the reason for failure are returned.

The ACTUALNAME of an entry point of a linked library cannot be modified. Therefore, a linked library must be delinked before the SETACTUALNAME function can be called to change the ACTUALNAME of any of its entry points. The function can be called to modify an entry point of a library that has not yet been linked.

Starting with the first character pointed to by the pointer expression, characters are included as the new entry point name until a period is encountered, the maximum allowable number of characters is included, or the end of the array row is encountered. The last case results in an error condition.

The SETACTUALNAME function returns the following integer values:

Value	Meaning
1	A successful change was made to the ACTUALNAME of the entry point.
0	The new ACTUALNAME is the same as the current ACTUALNAME of the entry point.
-1	The library is linked. The library must be delinked before the SETACTUALNAME function is called.
-2	The library entry point identifier is not currently in an accessible library template.
-3	A parameter error occurred in the SETACTUALNAME function.

### Example of SETACTUALNAME Function

The following example changes the ACTUALNAME of the library entry point EP2 to "ENTRYPOINT2", if possible:

```
REPLACE NEWEPNAME BY "ENTRYPOINT2.";
SETACTUALNAME (EP2,NEWEPNAME);
```

### SIGN Function

— SIGN — ( —<arithmetic expression>— ) \_\_\_\_\_|

The SIGN function returns the integer 1 if the value of the arithmetic expression is greater than 0, returns the integer 0 if the value of the arithmetic expression is equal to 0, and returns the integer -1 if the value of the arithmetic expression is less than 0.

### SIN Function

— SIN — ( —<arithmetic expression>— ) \_\_\_\_\_|

The SIN function returns, as a real value, the sine of an angle of < arithmetic expression > radians.

### SINGLE Function

— SINGLE — ( —<arithmetic expression>— ) \_\_\_\_\_|

The SINGLE function returns, as a real value, the value of the arithmetic expression normalized and truncated to single precision.

### SINH Function

— SINH — ( —<arithmetic expression>— ) \_\_\_\_\_|

The SINH function returns, as a real value, the hyperbolic sine of the specified arithmetic expression.



If the first parameter to the `STRING` function is a pointer expression, the `STRING` function converts the string of characters designated by the pointer expression into a string. The number of characters converted is indicated by the value of the arithmetic expression rounded to an integer, if necessary. If this rounded value is less than 0, a compile-time or run-time error occurs. If the rounded value is 0, the null string is returned.

If the first parameter to the `STRING` function is an arithmetic expression, the `STRING` function returns a string consisting of a decimal representation of the value of that arithmetic expression. If the second parameter is also an arithmetic expression, then the value of this expression, rounded to an integer, specifies the length of the resulting string. If the value of the second arithmetic expression is less than 0, a compile-time or run-time error occurs. If this value is equal to 0, the null string is returned. If the second parameter is an asterisk (\*), the resulting string is exactly long enough to represent the value of the arithmetic expression with no blanks. If the value of the first arithmetic expression is 0 and the second parameter is an asterisk, the resulting string is one character long.

When the `STRING` function is to return an ASCII or EBCDIC string and the first parameter is an arithmetic expression, its value is converted into the most efficient form, depending on the length specified by the second parameter. If both parameters are arithmetic expressions and the rounded value of the second parameter is greater than the minimum number of characters needed to represent the first parameter, leading blanks are inserted in the resulting string. If both parameters are arithmetic expressions and the rounded value of the second parameter is less than the number of characters needed to represent the first parameter, then a string of all asterisks is returned.

For the function `STRING4`, when the first parameter is an arithmetic expression, only the integer portion of the value of this expression is converted. If both parameters to `STRING4` are arithmetic expressions and the rounded value `N` of the second parameter is less than the number of characters needed to represent the first parameter, then the rightmost `N` digits of the converted value of the first parameter are returned. If both parameters to `STRING4` are arithmetic expressions and the rounded value of the second parameter is greater than the number of characters needed to represent the converted value of the first parameter, then leading zeros are inserted into the resulting string.

### Examples of STRING Function

```
STRING(P,20)

STRING(POINTER(A),N-3)

STRING(256,*) = 8"256"

STRING(-335.25,8) = 8" -335.25"

STRING(4.780-2,5) = 8".0478"

STRING(555000,1) = 8"*"

STRING(456.789,7) = 8"456.789"

STRING4(123.456,8) = 4"00000123"

STRING4(12345678,4) = 4"5678"
```

### TAIL Function

— TAIL — ( —<string expression>— , —<string character set>— ) —|

The TAIL function returns a string whose value consists of the rightmost characters of the string expression beginning with the first character that is not a member of the string character set. If all characters in the string expression are members of the string character set, the null string is returned. If the first character of the string expression is not a member of the string character set, the entire string expression is returned.

The string character set must be of the same character type as the string expression. For an explanation of the string character set, see "HEAD Function" earlier in this section.

The TAIL function and the HEAD function are complementary functions. This means that for any string expression S and any string character set C, the following relation is always TRUE:

$$S = \text{HEAD}(S,C) \text{ CAT } \text{TAIL}(S,C)$$

For additional information, see "HEAD Function" earlier in this section.

### Examples of TAIL Function

In the following examples, S is a string of length 9 that contains 8"ABC/1-2+3".

```
TAIL(S,NOT "--") = 8"--2+3"

TAIL(DROP(S,7),"+--") = 8"3"
```

### TAKE Function

— TAKE — ( —<string expression>— , —<arithmetic expression>— ) —|

The TAKE function returns a string whose value is equal to the first <arithmetic expression> characters taken from the value of the string expression. The value of the arithmetic expression is rounded to an integer, if necessary. An error occurs if the rounded value of the arithmetic expression is greater than the number of characters in the string expression or less than 0(zero). If the rounded value of the arithmetic expression is 0, the result is the null string. If the rounded value of the arithmetic expression is equal to the length of the string expression, the result is the same as the value of the string expression.

The TAKE function and the DROP function are complementary functions. This means that for any string expression S and any arithmetic expression A in the range  $0 \leq A \leq \text{LENGTH}(S)$ , the following relation is always true:

$$S = \text{TAKE}(S,A) \text{ CAT } \text{DROP}(S,A)$$

For additional information, see “DROP Function” earlier in this section.

#### Examples of TAKE Function

In the following examples, string S has a length of 6 and contains 8"ABCDEF".

$$\text{TAKE}(S,2) = 8"AB"$$

$$\text{TAKE}(S,4) = 8"ABCD"$$

$$\text{TAKE}(\text{DROP}(S,2),2) = 8"CD"$$

### TAN Function

— TAN — ( —<arithmetic expression>— ) —————|

The TAN function returns, as a real value, the tangent of an angle of <arithmetic expression> radians.

### TANH Function

— TANH — ( —<arithmetic expression>— ) —————|

The TANH function returns, as a real value, the hyperbolic tangent of the specified arithmetic expression.

### TIME Function

— TIME — ( —<arithmetic expression>— ) —————|

The TIME function makes various system time values available. The value of the arithmetic expression is rounded to an integer, if necessary, before being used. The



## Expressions and Functions

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results returned for different values of the integerized arithmetic expression are given in the following table. If the integerized value of the arithmetic expression is not one of the values listed in the table, the TIME function returns the value 0 (zero).

Parameter	Result Returned
0	The current date in BCL characters in the format 6"YYDDD", where YY is the year and DDD is the day of the year.
1	The time of day, in 60ths of a second, as an integer value.
2	The elapsed processor time of the program, in 60ths of a second, as an integer value.
3	The elapsed I/O time of the program, in 60ths of a second, as an integer value.
4	The value of a 6-bit clock that increments 60 times per second.
5	The month, day, and year as six BCL characters, right-justified, in the format 6"00MMDDYY".
6	The time and date (a timestamp) in the following form:  $\emptyset$ & (JULIANDATE-700000) [47:16] & (TIME(11) DIV 16) [31:32]

**Note:** *The timestamp encoding is not a simple real numeric value, therefore arithmetic relational operators cannot be used to compare timestamps accurately. For simple tests of equality or inequality, the IS or ISNT operators are appropriate. For testing relations, the timestamp values must be treated as unsigned 48-bit integers.*

*The following Boolean expression correctly computes the truth of the proposition that T1 is less (earlier) than T2, assuming that T1 and T2 are real variables containing timestamp values:*

DOUBLE(1,T1) < DOUBLE(1,T2)

Parameter	Result Returned
7	The current date and time in the following form: [47:12] Year (1900–1999) [35:06] Month (1-12) [29:06] Day (1-31) [23:06] Hour (0-23) [17:06] Minute (0-59) [11:06] Second (0-59) [05:06] Day of the week (0 = Sunday, 1 = Monday, and so on)
9	The current time in EBCDIC characters in the format 8"HHMMSS", where HH is the hour, MM is the minute, and SS is the second.
10	The same value as TIME(0), except that the time is expressed in EBCDIC characters in the format 8"YYDDD".
11	The same value as TIME(1), except that the time is expressed in multiples of 2.4 microseconds.

*continued*

*continued*

Parameter	Result Returned
12	The same value as TIME(2), except that the time is expressed in multiples of 2.4 microseconds.
13	The same value as TIME(3), except that the time is expressed in multiples of 2.4 microseconds.
14	The time elapsed since the last halt/load expressed in multiples of 2.4 microseconds.
15	The current date in EBCDIC characters in the format 8"MMDDYY".
16	The same value as TIME(6).
23	The system identification information in the following format: [31:08] ASD system flag 0 - Non-ASD system 1 - Non-ASD system 2 - ASD system [23:16] System serial number [07:08] Type of machine DIV 100 If the system type is not of the form B XX00, this field contains the number zero.
24	The system type as a real value containing six EBCDIC characters. The name is left-justified with blank fill.
25	The compiler target, for example TARGET = LEVEL 0.
26	The microcode version.
27	The number of initial presence bits taken on a stack.
28	The amount of time taken to process the initial presence bits.
29	The number of other bits taken on a stack.
30	The amount of time taken to process the other bits.
31	The following MCP information is returned: [47:16] mark level of software release [31:16] cycle number [15:16] patch number
32	Offset from Universal Time (UT), in the form of direction, hours, minutes, and the one-character military-style mnemonic, if the offset matches one, encoded in partial word fields. The format is as follows: TZ_VALIDF = [47:01] (1 if time zone valid) TZ_DIRECTIONF = [46:01] (which direction?) TZ_SUBV = 0 (UT - offset = LT)

*continued*

## Expressions and Functions

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*continued*

Parameter	Result Returned
	TZ_ADDV = 1 (UT + offset = LT)
	(not used) = [45:02] (not used)
	TZ_CUSTOMF = [43:01] (1 if custom time zone)
	(not used) = [42:03] (not used)
	TZ_HOURSF = [39:08] (hours offset 0–24)
	TZ_MINUTESF = [31:08] (minutes offset 0–59)
	TZ_MNEMONICF = [23:08] (military mnemonic)
	(not used) = [15:04] (not used)
	TZ_NUMBERF = [11:12] (if predefined, number)

If a predefined time zone is configured, its number is also returned. This allows programs to use the exported (unprotected) intrinsic MESSAGESEARCHER to obtain the time zone abbreviation or name. The message number of the who field (WHOF) is 80. The which field (WHICHF) is 1 for the time zone name, 2 for the time zone abbreviation. The message requires one parameter, the time zone number.

The military mnemonic is a single letter that identifies 25 time zones with integral hours offset values from –12 to +12 hours, including zero hours. The letters used are A through M for –1 through –12. The letter J is not used. The letters N through Y are used for +1 through +12. The letter Z is used for zero.

33	Offset from UT as a four-digit signed integer for use by programs written in languages in which it is difficult to manipulate bits. The format is +/- <i>HHMM</i> . Note that if no time zone is configured, the value 9999 is returned.
34	Time zone abbreviation in left-justified blank-filled EBCDIC characters. If no time zone is configured, six nulls are returned. If a standard time zone is configured its abbreviation is returned in the task or system language.
36	Halt/load time in TIME(6) format.

TIME (50) through TIME (59) provide the same values as those in TIME (0) through TIME (9), but in Universal Time. TIME (53), TIME (54), AND TIME (58) are not currently in use.

**Note:** *If no time zone is configured, the following values are returned:*

TIME Specified	Value Returned
TIME (50)	TIME (10)
TIME (51)	TIME (1)
TIME (52)	TIME (11)
TIME (55)	TIME (15)
TIME (56)	TIME (16)
TIME (57)	TIME (7)

*continued*

*continued*

TIME Specified	Value Returned
TIME (59)	TIME (9)

## TRANSLATE Function

— TRANSLATE — ( —<string expression>— , —<translate table>— ) —|

The TRANSLATE function returns a string of the same length as the string expression; each character of the string expression is translated according to the designated translate table.

The translate table can be a translate table identifier declared in the program or one of the intrinsic translate tables. The use of a subscripted variable as a translate table is not allowed in the TRANSLATE function.

### Examples of TRANSLATE Function

```
TRANSLATE(S,HEXTOEBCDIC)
```

```
TRANSLATE(TAKE(S,10),MYTT)
```

## VALUE Function

— VALUE — ( —<mnemonic file attribute value>—  
 —<arithmetic-valued file attribute name>—  
 —<Boolean-valued file attribute name>—  
 —<pointer-valued file attribute name>—  
 —<translate-table-valued file attribute name>—  
 —<mnemonic task attribute value>—  
 —<arithmetic-valued task attribute name>—  
 —<Boolean-valued task attribute name>—  
 —<event-valued task attribute name>—  
 —<file-valued task attribute name>—  
 —<pointer-valued task attribute name>—  
 —<task-valued task attribute name>—  
 —<mnemonic library attribute value>— ) —|

<mnemonic task attribute value>

A valid mnemonic name for a value of a task attribute.

If a mnemonic file attribute value, mnemonic library attribute value, or mnemonic task attribute value is specified, the VALUE function returns the integer value that corresponds to that mnemonic attribute value. If an attribute name is specified, the VALUE function returns the attribute number that corresponds to that attribute name.

For more information on file attribute names and mnemonic file attribute values, refer to the *A Series File Attributes Programming Reference Manual*. For more information on task attributes and their values, refer to the *A Series Task Attributes Programming Reference Manual*.

### Examples of VALUE Function

F.KIND := VALUE(DISK)

F.INTMODE := VALUE(EBCDIC)

T.STATUS := VALUE(TERMINATED)

### WAIT Statement

Depending on the form used, the WAIT statement returns no value, a Boolean value, or an integer value. For more information, refer to “WAIT Statement” in Section 4, “Statements.”

### WAITANDRESET Statement

The WAITANDRESET statement returns an integer value. For more information, refer to “WAITANDRESET Statement” in Section 4, “Statements.”

### WRITE Statement

The WRITE statement returns a Boolean value. For more information, refer to “WRITE Statement” in Section 4, “Statements.”

# Section 6

## Compiling Programs

This section presents information outside of the ALGOL language. This information is necessary to compile and run an ALGOL program. The section describes the files used by the ALGOL compiler when it compiles a program, the format of a source record, and compiler control options.

### Files Used by the Compiler

When the ALGOL compiler compiles a program, it requires, at minimum, one input file that contains the source code to be compiled. If the compile is successful, the compiler produces, at minimum, one output file that contains executable object code.

Through the use of compiler control options, the compiler can be directed to use additional input files and to produce additional output files. Among the optional input files that can be used are files containing source code that is to be merged or inserted into the required source code file, and files containing information needed to perform separate compilation and binding. Among the optional output files that can be produced are a printer listing of the program, a cross-reference file, an updated source file, an error message file, and a file containing information needed for future separate compilation.

Figure 6-1 lists the logical input and output files used by the ALGOL compiler. Each file is listed with values for the INTNAME, KIND, INTMODE, MAXRECSIZE, BLOCKSIZE, and FILETYPE attributes. Some or all of the attributes for these files can be changed, using compiler file equation, when the compiler is initiated. For information on file attributes refer to the *A Series File Attributes Programming Reference Manual*. For information about compiler file equation, see the *A Series Work Flow Language (WFL) Programming Reference Manual*.

## Compiling Programs

COMPILER INPUT FILES							
Description	INITNAME	Initiation	KIND	INITMODE	MAXRECSIZE	BLOCKSIZE	DEPENDENT SPECS
PRIMARY INPUT FILE	CARD	WFL	READER	EBCDIC	Taken from physical file	Taken from physical file	TRUE
		CANDE	DISK				
OPTIONAL SECONDARY INPUT FILE	SOURCE*	WFL AND CANDE	DISK	EBCDIC	Taken from physical file	Taken from physical file	TRUE
OPTIONAL SOURCE FILES INPUT BY \$ INCLUDE COMPILER CONTROL OPTIONS	(INCLUDED files)	WFL AND CANDE	DISK	EBCDIC	Taken from physical file	Taken from physical file	TRUE
OPTIONAL OBJECT FILE INPUT	HOST	WFL AND CANDE	DISK	SINGLE	30 words	270 words	TRUE
OPTIONAL INFO FILE	INFO	WFL AND CANDE	DISK	SINGLE	Taken from physical file	Taken from physical file	TRUE

COMPILER OUTPUT FILES							
Description	INITNAME	Initiation	KIND	INITMODE	MAXRECSIZE	BLOCKSIZE	FILETYPE
OBJECT CODE FILE	CODE	WFL AND CANDE	DISK	SINGLE	30 words	270 words	—
OPTIONAL UPDATED SYMBOLIC FILE	NEWSOURCE*	WFL AND CANDE	DISK	EBCDIC	15 words	420 words	—
OPTIONAL LINE PRINTER LISTING	LINE	WFL AND CANDE	PRINTER	EBCDIC	22 words	22 words	—
OPTIONAL ERROR MESSAGE FILE	ERRORS*	WFL AND CANDE	PRINTER	EBCDIC	12 words	12 words	
			REMOTE				
OPTIONAL CROSS-REFERENCE FILE	XREFFILE	WFL AND CANDE	DISK	EBCDIC	510 words	510 words	Ø
OPTIONAL INFO FILE	INFO	WFL AND CANDE	DISK	SINGLE	256 words	2560 words	Ø

Figure 6-1. Compiler Files

\* The following synonyms can be used:

File Name	Synonym
SOURCE	TAPE
NEWSOURCE	NEWTAPE
ERRORS	ERRORFILE

### Input Files

The input files used by the compiler consist of the following:

- **CARD**, the required source code file
- **SOURCE** or **TAPE**, a source code file that can be merged with **CARD**
- **INCLUDE** files, source code files that can be inserted into **CARD** or **TAPE**
- **HOST**, information used for separate compilation and binding
- **INFO**, information used for separate compilation

The **EXTMODE** attribute (the character type of the physical file) of these input files can be **EBCDIC**, **ASCII**, or **BCL**. The **MAXRECSIZE** attribute of these input files must be large enough to accommodate at least 72 characters. Because the values of the **MAXRECSIZE** and **BLOCKSIZE** attributes for these files are taken from the physical file (since **DEPENDENTSPECS = TRUE**), these two attributes do not require explicit assignment.

### CARD File

The **CARD** file supplies the primary source input to the compiler and must be present for each compilation. If the compiler is initiated from the Work Flow Language (WFL) and compiler file equation is not applied to the **CARD** file, the file is assumed to be a card reader file. If the compiler is initiated through **CANDE** and compiler file equation is not applied to the **CARD** file, the file is assumed to be a disk file.

### SOURCE File

The synonym **TAPE** can be used in place of **SOURCE**.

The **SOURCE** file supplies secondary source input to the compiler. Its presence is optional. If you do not file-equate either **SOURCE** or **TAPE**, the compiler attempts to open a file with the name **TAPE**, and if it does not find one, it attempts to open a file named **SOURCE**. The file is assumed to be a disk file regardless of whether the compiler is initiated from **WFL** or **CANDE**.

When this file is present and the **MERGE** option is **TRUE**, records from the **TAPE** file are merged with those of the **CARD** file on the basis of sequence numbers. If a record from the **CARD** file and a record from the **TAPE** file have the same sequence number, the record from the **CARD** file is compiled and the **TAPE** record is ignored. For more information on the **MERGE** option, see “**MERGE Option**” later in this section.



## Compiling Programs

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### INCLUDE Files

INCLUDE files provide source input to the compiler in addition to that supplied by the CARD and SOURCE (or TAPE) files. An INCLUDE file is used only if an INCLUDE compiler control option appears in the source input being compiled. For more information on the INCLUDE option, see “INCLUDE Option” later in this section.

### HOST File

The HOST file provides the compiler with information that allows it to separately compile and bind to a host program only procedures that are being changed. This process is called a SEPCOMP and the HOST file is used if the SEPCOMP compiler control option is TRUE. The HOST file is a special object code file, created by a previous compile when the MAKEHOST compiler control option was TRUE. The HOST file contains information about the outer block environment of the program and the environments of selected procedures. For more information on the SEPCOMP and MAKEHOST options, see “SEPCOMP Option” and “MAKEHOST Option” later in this section.

### INFO File

The INFO file contains the contents of variables and tables used in the compiler, saved from a previous compile. This file is used for separate compilation of procedures. It is created by the DUMPINFO compiler control option and is used as an input file by the LOADINFO compiler control option. For more information on the DUMPINFO and LOADINFO options, see “DUMPINFO Option” and “LOADINFO Option” later in this section.

### Output Files

The output files produced by the compiler consist of the following:

- **CODE:** the object code file
- **NEWSOURCE** or **NEWTAPE:** the updated source code file
- **LINE:** the printer listing of the program
- **ERRORS** or **ERRORFILE:** the error message file
- **XREFFILE:** cross-reference information
- **INFO:** information used for separate compilation

### CODE File

The CODE file is produced unconditionally and contains the executable object code produced by the compiler. This file is either stored permanently, executed and then discarded, or discarded, depending on the specifications in the WFL or CANDE COMPILE statement that initiated the compiler, and on whether or not syntax errors occurred during the compilation. For more information on the WFL and CANDE

COMPILE statements, refer to the *A Series Work Flow Language (WFL) Programming Reference Manual* and the *A Series CANDE Operations Reference Manual*.

### NEWSOURCE File

The synonym NEWSOURCE can be used in place of NEWTAPE.

The NEWSOURCE file is produced only if the NEW compiler control option is TRUE. The NEWSOURCE file is an updated source file that consists of the source input from the CARD file, the SOURCE (or TAPE) file, and (if the INCLNEW compiler control option is TRUE) the included files that were actually compiled. If either NEWSOURCE or NEWTAPE are not file equated, a disk file is created with the name *NEWSOURCE*. For more information on the NEW and INCLNEW options, see “New Option” and “INCLNEW Option” later in this section.

### LINE File

The LINE file is produced if either of the compiler control options LIST or TIME is TRUE. If compiler file equation is not applied to the LINE file, it is a printer file.

The contents and format of the LINE file depend on the values of the following compiler control options:

CODE	FORMAT
LISTDELETED	LISTINCL
LISTOMITTED	LISTP
MAP	PAGE
SEGS	SINGLE
STACK	TIME

The LINE file always contains at least the following information:

- The title of the source file CARD used as input to the compiler
- Code segmentation information
- Error messages and error count, if syntax errors occur
- Summary information about the compile, such as the number of lines read and the size of the object code file

For more information about the compiler control options that affect the LINE file, see “Option Descriptions” later in this section.

### ERRORS File

The synonym ERRORFILE can be used in place of ERRORS.

The ERRORS file is produced only if the ERRLIST compiler control option is TRUE. If either ERRORS or ERRORFILE are not equated, the file is created with the title

**ERRORS.** It is a printer file if the compile is initiated through WFL, and a remote file if the compile is initiated through CANDE. If no syntax errors occur during compilation, no ERRORS file is produced, regardless of the value of the ERRLIST option. For more information on the ERRLIST option, see “ERRLIST Option” later in this section.

For every syntax error that occurs during compilation, two records are written to the ERRORFILE file. The first record is a copy of the source record that contains the error. The second record contains the sequence number of that source record (if the source record was sequenced) and the error message.

### XREFFILE File

When either of the compiler control options XREF or XREFFILES is TRUE, the compiler saves raw cross-reference information in the XREFFILE file. The contents of the file are affected by the compiler control options XDECS and XREFS. Before this information can be printed or read by SYSTEM/INTERACTIVEXREF or the Editor, it must be analyzed by SYSTEM/XREFANALYZER. The XREFFILE file is given the file name *XREF/<code file name>*, where *<code file name>* is the file name of the object code file being produced. For more information about the cross-reference options, see “Option Descriptions” later in this section.

### INFO File

The INFO file contains the contents of variables and tables used in the compiler. It is intended for use in separate compilations of procedures. This file is created by the DUMPINFO compiler control option, and it is used as an input file by the LOADINFO compiler control option.

## Source Record Format

The records of a source code file read by the ALGOL compiler can be any size greater than or equal to 72 characters.

Assume that the character positions (called columns) of a source record are numbered from 1 to  $n$ , where  $n$  is the size of the record in characters. The compiler divides each source record as follows:

- The data in columns 1 through 72 is assumed to be ALGOL source language as defined in this manual. Any characters that appear beyond column 72 are not compiled as source language constructs.
- Characters in columns 73 through 80 of a record are treated as a sequence number, which is optional.
- Any information beyond column 80 is ignored.

The column in which an ALGOL construct begins is not significant, unless the source record is a compiler control record or the construct continues beyond column 72. For more information on compiler control records, refer to “Compiler Control Records” later in this section. The data in columns 1 through 72 is treated as a continuous stream from

record to record. In other words, no delimiters are implied at the end of a record, and string literals, identifiers, and all other valid ALGOL constructs can be continued from column 72 of one record to column 1 of the succeeding record.

## Compiler Control Options

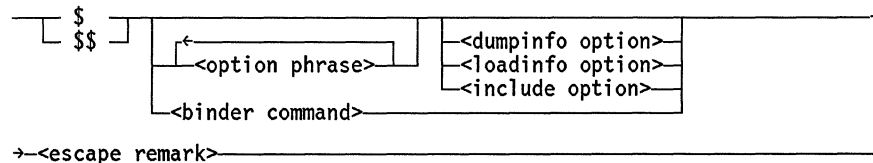
Compiler control options provide the programmer with the means to control many aspects of the compilation of an ALGOL program. These options can instruct the compiler to use optional input files or to produce optional output files. In addition to other things, the options can do all of the following:

- Affect the contents of the printer listing
- Designate the target computer for which code is to be produced
- Set the default character type
- Cause the compiler to perform separate compilation
- Invoke the Binder
- Invoke debugging features
- Exclude source records
- Set a limit on the number of syntax errors the program can get
- Resequence source records
- Check that sequence numbers are in order
- Control code file segmentation
- Flag BCL constructs

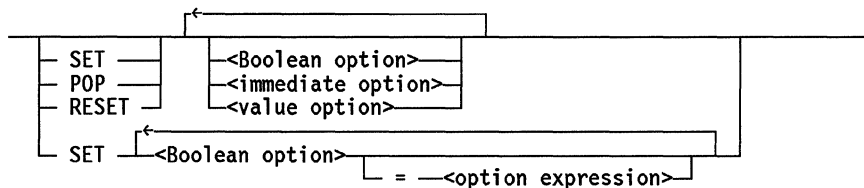
## Compiler Control Records

Compiler control options are included in an ALGOL program by using special source records called compiler control records.

**<compiler control record>**



## <option phrase>



## <Boolean option>

A < Boolean option > can be any of the following:

- |                      |                        |
|----------------------|------------------------|
| <ASCII option>       | <autobind option>      |
| <BCL option>         | <check option>         |
| <code option>        | <delete option>        |
| <errlist option>     | <errorlist option>     |
| <format option>      | <inclnew option>       |
| <inclseq option>     | <installation option>  |
| <intrinsic option>   | <library option>       |
| <lineinfo option>    | <list option>          |
| <listdeleted option> | <listdollar option>    |
| <listincl option>    | <listomitted option>   |
| <listp option>       | <makehost option>      |
| <map option>         | <MCP option>           |
| <merge option>       | <new option>           |
| <newseqerr option>   | <noBCL option>         |
| <nobindinfo option>  | <nostackarrays option> |
| <noxreflist option>  | <oldresize option>     |
| <omit option>        | <optimize option>      |
| <rangecheck option>  | <segs option>          |
| <sepcomp option>     | <seq option>           |
| <sequence option>    | <seqerr option>        |
| <single option>      | <stack option>         |
| <statistics option>  | <strings option>       |
| <TADS option>        | <time option>          |
| <user option>        | <void option>          |
| <voidt option>       | <warnsupr option>      |
| <writeafter option>  | <xdecs option>         |

*continued*



Compiler control records with the \$\$ in columns 1 and 2, or a blank in column 1 and a \$ in column 2, are considered permanent compiler control records and are saved in the NEWSOURCE file, if there is one.

A compiler control record can contain the following:

- Boolean options
- Value options
- Immediate options
- Special options
- Binder commands

A Boolean option is one that is either enabled (TRUE) or disabled (FALSE). When enabled, it causes the compiler to apply an associated function to all subsequent processing until the option is disabled.

A value option causes the compiler to store a value associated with a given function.

An immediate option causes the compiler to perform immediately a function that is not applied to subsequent processing.

The special options (the DUMPINFO option, the LOADINFO option, and the INCLUDE option), like the immediate options, cause the compiler to perform immediately a function that is not applied to subsequent processing. However, they are not grouped with the immediate options because of special syntactic requirements.

Binder commands are passed directly to the Binder program. For more information on Binder statements and control options, refer to the *A Series Binder Programming Reference Manual*.

The keywords SET, RESET, and POP affect the value of Boolean options. Each Boolean option has an associated stack in which the current value and up to 46 previous values of the option are saved. The management of this stack of values is as follows:

1. If the first keyword to the left of a Boolean option in a compiler control record is SET or RESET, the current value of the option is pushed onto the stack and the option is assigned a value of TRUE or FALSE, respectively. In other words, the option is assigned a new value, and the previous value is saved in the stack.
2. If the first keyword to the left of a Boolean option in a compiler control record is POP, the current value of the option is discarded and the previous value is removed from the top of the stack and assigned to the option.
3. If a Boolean option is not preceded in a compiler control record by any keyword, then the following actions occur:
  - a. All resettable standard Boolean options are assigned a value of FALSE and all previous values in their stacks are discarded.
  - b. The Boolean options appearing in the compiler control record with no preceding keyword are assigned a value of TRUE.

The following is a list of the resettable standard Boolean options that are affected when a Boolean option appears in a compiler control record without a preceding keyword:

ASCII	AUTOBIND (if SEPCOMP is FALSE)
BCL	CHECK
CODE	DELETE
FORMAT	INCLNEW
INCLSEQ	INSTALLATION
INTRINSICS	LIST
LISTDELETED	LISTDOLLAR
LISTINCL	LISTP
MAKEHOST (if the first syntactic item has not been seen)	MAP
NEW	NEWSEQERR
NOXREFLIST	OMIT
OPTIMIZE	SEGS
SEQ	SEQUENCE
SEQERR	STACK
STATISTICS	STRINGS
TIME	VOID
VOIDT	WARNSUPR
WRITEAFTER	XREF
XREFFILES	XREFS
\$	

A compiler control record that consists of only an initial \$ (a \$ followed by all blanks) has no effect unless it is in the CARD file, the MERGE option is TRUE, and a record is present in the secondary input file TAPE that has the same sequence number as this compiler control record. When these three conditions are met, then that TAPE record is ignored.

In an <option expression>, the Boolean operators have the same precedence as they do in Boolean expressions; that is, *NOT* and  $\wedge$  are equivalent and have the highest precedence, followed by *AND*, *OR*, *IMP*, and *EQV*, in that order. The <option primary> "\*" represents the current value of the Boolean option whose value is being assigned. For example, the following compiler control record causes records from both the CARD and TAPE files to be ignored if either the OMIT option is TRUE or the user option DEBUGCODE is TRUE.

```
$ SET OMIT = * OR DEBUGCODE
```



### Examples

The following compiler control record assigns a value of `TRUE` to the `LIST` option, `MERGE` option, and `NEW` option, and assigns a value of `FALSE` to the `SINGLE` option. The previous value of each of these options is saved in the corresponding stack.

```
$ SET LIST MERGE NEW RESET SINGLE
```

The following compiler control record invokes the immediate option `PAGE`, causing the compiler to skip the printer listing to the top of the next page (if the `LIST` option is `TRUE`). Because the `PAGE` option is not a Boolean option, the action described above for Boolean options not preceded by a keyword does not occur.

```
$ PAGE
```

The following compiler control record assigns a value of `TRUE` to the `LISTP` option, assigns the value `135000` to the sequence base option, and returns the `LIST` option to its most recent previous value.

```
$ SET LISTP 135000 POP LIST
```

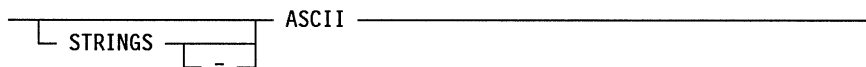
The following compiler control record assigns `FALSE` to all resettable standard Boolean options and discards all previous values in their stacks, assigns the value `TRUE` to the `LISTP` option, and returns the `USER` option `MYOPTION` to its most recent previous value. The stack for `MYOPTION` is unaffected by the purge of the stacks for the standard resettable Boolean options, because it is not a standard option.

```
$ LISTP POP MYOPTION
```

## Option Descriptions

The remainder of this section describes the individual compiler control options.

### ASCII Option



(Type: Boolean, Default value: `FALSE`)

`STRINGS = ASCII` is a synonym that can be used for the `ASCII` option. When `TRUE`, the `ASCII` option sets the default character type to `ASCII`. For more information, refer to “Default Character Type” in Appendix C, “Data Representation.”

If the `BCL` option is `TRUE` and the `ASCII` option is assigned the value `TRUE`, a syntax error is given.

## AUTOBIND Option

— AUTOBIND —————|

(Type: Boolean, Default value: FALSE)

If **TRUE**, the **AUTOBIND** option causes the processes of compilation and program binding to be combined into one job. During compilation, the compiler produces a set of instructions to be passed to the Binder program. In most cases, these Binder instructions are sufficient. If additional Binder instructions are required, the ALGOL `<binder command>` syntax can be used.

The **AUTOBIND** option can be assigned a value at any time during compilation. However, for the following reasons, it should be assigned a value only once, at the beginning of compilation:

- The value of the **AUTOBIND** option is significant only at the end of compilation. For example, if four procedures are being compiled, the first three with the **AUTOBIND** option **FALSE** and the last with the **AUTOBIND** option **TRUE**, the Binder attempts to bind all four procedures to the specified host.
- When the **AUTOBIND** option is **FALSE**, compile-and-go on a separate procedure is not executed. If the **AUTOBIND** option is **TRUE** throughout compilation, execution of the resulting program takes place after binding.

In ALGOL, an outer block or a separate procedure compiled at lexical (lex) level two can serve as a host for binding. Separate ALGOL procedures compiled at lex level three (the default level) or higher can be bound into a host. Any number of separate procedures, but only one host, can be compiled in one job. The host must be the last program unit compiled. If an appropriate host file is compiled with the **AUTOBIND** option equal to **TRUE**, it is assumed to be the host for binding. This assumption cannot be overridden by file equation or by use of the **HOST** option. If no eligible host is being compiled, a host must be specified, either by file equation of the compiler file **HOST** or by use of the **HOST** option.

The object code file of any procedure compiled at lex level three or higher with the **AUTOBIND** option equal to **TRUE** is marked as nonexecutable. To be executed, the procedure must be bound into a host file by the Binder program or invoked by a **PROCESS** or **CALL** statement.

Object code files of any procedures compiled at lex level three or higher are purged after being bound into a host by the **AUTOBIND** option. To be retained, such a code file must be referenced specifically in either a **BIND** option or an **EXTERNAL** option.

If the **TADS** option is **TRUE** when the **AUTOBIND** option is assigned the value **TRUE**, then the **AUTOBIND** option is left equal to **FALSE** and a warning message is given.

The process of binding might be permitted by the compiler, even if there are syntax errors in the compilation. This can occur, for example, when the host file is compiled successfully, even though none of the separate procedures succeeded. In another example, there is no host file in the compilation, but at least one of the separate procedures compiles.

### BCL Option

— BCL \_\_\_\_\_|

(Type: Boolean, Default value: FALSE)

When TRUE, the BCL option sets the default character type to BCL. For more information, refer to “Default Character Type” in Appendix C, “Data Representation.”

If the ASCII option is TRUE when the BCL option is assigned the value TRUE, a syntax error is given.

*Note: The BCL data type is not supported on all A Series systems. The appearance of a BCL construct that can cause the creation of a BCL descriptor, such as the BCL option, causes the program to get a compile-time warning message.*

### BEGINSEGMENT Option

— BEGINSEGMENT \_\_\_\_\_|

(Type: immediate)

The BEGINSEGMENT option and the ENDSEGMENT option allow the programmer to control code file segmentation. Procedures encountered between a BEGINSEGMENT option and an ENDSEGMENT option are placed in the same code segment, which is called a user segment because it is user-controlled instead of compiler-controlled.

The BEGINSEGMENT option must appear before the declaration of the first procedure to be included in the user segment. The ENDSEGMENT option must appear after the last source record of the last procedure to be included in the user segment.

A procedure cannot be split across user segments. The first procedure in the user segment must be one for which the compiler would normally generate a segment; that is, it must have local declarations. External procedures cannot be declared in a user segment.

Declarations of global items other than procedures within a user segment can result in those items not being initialized. This could cause the program to get a fault at run time. Declarations of global items other than procedures should be placed outside user segments.

User segments can be nested; that is, a BEGINSEGMENT option can appear in a user segment. In this case, an ENDSEGMENT option applies to the user segment currently being compiled.

If a BEGINSEGMENT option appears before the beginning of a separately compiled procedure, an ENDSEGMENT option is assumed at the end of the procedure, even if none appears. The driver procedure created for procedures compiled at lexical level three is always in a different code segment.

The segment information in the printer listing is modified for user segments. User segments are numbered consecutively in a program, beginning with 1; that is, the first user segment is `USERSEGMENT1`, the second user segment is `USERSEGMENT2`, and so forth. The code segment number of each user segment is printed at its beginning; the length of each user segment is printed at its end. Procedures or blocks whose segmentation is overridden by user segmentation are printed out as being in that user segment.

Forward procedure declarations are not affected by user segmentation.

If more than one `BEGINSEGMENT` option appears before a procedure, the warning message *EXTRA BEGINSEGMENT IGNORED* is printed. If an `ENDSEGMENT` option appears and there has been no `BEGINSEGMENT` option, the warning message *EXTRA ENDSEGMENT IGNORED* is printed.

The `BEGINSEGMENT` option and `ENDSEGMENT` option allow the programmer to reduce presence-bit overhead by grouping frequently called procedures and infrequently called procedures in separate segments.

### BIND Option

— BIND —<text>—————|

(Type: Binder command)

During autobinding, the `BIND` option is passed directly to the Binder program for analysis. The format and function of this option are the same as those of the Binder `BIND` statement and are described in the *A Series Binder Programming Reference Manual*.

### BINDER Option

— BINDER —<text>—————|

(Type: Binder command)

During autobinding, the text in the `BINDER` option is passed directly to the Binder program for analysis. The format and function of `<text>` are the same as those of the Binder control options and are described in the *A Series Binder Programming Reference Manual*.

### CHECK Option

— CHECK —————|

(Type: Boolean, Default value: FALSE)

When `TRUE`, the `CHECK` option causes an error to be given if the sequence number on a record of the `SOURCE` or `NEWSOURCE` file is not strictly greater than the sequence number of the preceding record. If a sequence error occurs in the `SOURCE` file, the word *SEQERR*, followed by the sequence number of the previous source record, is

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printed at the right side of the source record on the printer listing. If a sequence error occurs in the NEWTAPE file, the message *NEWTAPE SEQ ERROR*, followed by the sequence number of the previous source record, is printed on the listing and the message *NEWTAPE SEQ ERR* is displayed on the Operator Display Terminal (ODT). In the ERRORS file, the sequence number of the record that caused the sequence error and the sequence number of the previous source record appear on the line following the source record.

If the NEW option is FALSE and resequencing is occurring, the old sequence number is the sequence number that is checked.

### CODE Option

— CODE \_\_\_\_\_|

(Type: Boolean, Default value: FALSE)

If both the LIST option and the CODE option are TRUE, the printer listing includes the compiler-generated object code. If the LIST option is TRUE but the CODE option is FALSE, the printer listing does not include the object code. The value of the CODE option is ignored if the LIST option is FALSE.

### DONTBIND Option

— DONTBIND <text> \_\_\_\_\_|

During autobinding, the DONTBIND option is passed directly to the Binder program for analysis. The DONTBIND option directs the Binder not to bind a specified subprogram (procedure). In addition, the DONTBIND option can be used to suppress the binding of all external references declared by a program. The format and function of the DONTBIND option are the same as those of the Binder DONTBIND statement. For information about the DONTBIND statement, refer to the *A Series Binder Programming Reference Manual*.

### DUMPINFO Option

— DUMPINFO \_\_\_\_\_|  
          └─<file specification>┘

<file specification>

└─<title> \_\_\_\_\_|  
  └─<internal file name> ┘  
  └─<name and title> ┘

<title>

A quoted string containing a file title.

<internal file name>

—<identifier>—————|

<name and title>

—<internal file name> = —<title>—————|

(Type: special)

The DUMPINFO option is described with the LOADINFO option in this section.

### ENDSEGMENT Option

— ENDSEGMENT —————|

(Type: immediate)

The ENDSEGMENT option is described with the BEGINSEGMENT option in this section.

### ERRLIST Option

┌ ERRLIST ───────────────────|  
└ ERRORLIST ─────────────────┘

(Type: Boolean, Default value: TRUE for CANDE-originated compiles, FALSE otherwise)

ERRORLIST is a synonym that can be used for the ERRLIST option. The ERRORLIST synonym should not be used if code is to be run through SYSTEM/PATCH.

When TRUE, the ERRLIST option causes syntax error information to be written to the ERRORS file. When a syntax error is detected in the source input, the source record that contains the error, an error message, and the syntactical item where the error occurred are written on two lines in the ERRORS file. This option is provided primarily for use when the compiler is invoked at a terminal by CANDE, but it can be used regardless of the manner in which the compiler is invoked. When the compiler is invoked from CANDE, the default value of the ERRLIST option is TRUE, and the ERRORS file is automatically equated to the remote device from which the compiler was invoked.

### EXTERNAL Option

— EXTERNAL —<text>—————|

(Type: Binder command)

During autobinding, the EXTERNAL option is passed directly to the Binder program for analysis. The format and function of this option are the same as those of the Binder EXTERNAL statement and are described in the *A Series Binder Programming Reference Manual*.

### FORMAT Option

— FORMAT \_\_\_\_\_|

(Type: Boolean, Default value: FALSE)

If both the LIST option and the FORMAT option are TRUE, then to aid readability of the printer listing, several blank lines are inserted after each procedure. If the LIST option is TRUE but the FORMAT option is FALSE, no blank lines are inserted after procedures. If the LIST option is FALSE, the value of the FORMAT option is ignored.

### GO TO Option

— GO TO <sequence number> \_\_\_\_\_|

<sequence number>

/8\<digit> \_\_\_\_\_|

(Type: immediate)

The GO TO option is used to reposition the secondary source input file TAPE. This option is intended for use with disk files and does not work on tape files.

The <sequence number> construct specifies a sequence number appearing on a record in the TAPE file. The GO TO option causes the TAPE file to be repositioned so that the next record from this file used by the compiler is the first record with a sequence number greater than or equal to the specified sequence number. The TAPE file must be properly sequenced in ascending order; that is, the sequence number on each record in the file must be strictly greater than the sequence number on the preceding record. The specified sequence number can be greater than or less than the sequence number of the record on which the option appears.

This option cannot appear within a DEFINE declaration or in included source input.

### HOST Option

— HOST <text> \_\_\_\_\_|

(Type: Binder command)

During autobinding, the HOST option is passed directly to the Binder program for analysis. The format and function of this option are the same as those of the Binder HOST statement and are described in the *A Series Binder Programming Reference Manual*.

### INCLNEW Option

— INCLNEW \_\_\_\_\_|

(Type: Boolean, Default value: FALSE)

If both the NEW option and the INCLNEW option are TRUE, included source input is written to the NEWTAPE file. If the NEW option is TRUE but the INCLNEW option is FALSE, included source input is not written to the NEWTAPE file. If the NEW option is FALSE, the value of the INCLNEW option is ignored.

### INCLSEQ Option

— INCLSEQ \_\_\_\_\_|

(Type: Boolean, Default value: FALSE)

If both the SEQ option and the INCLSEQ option are TRUE, included source input is resequenced. If the SEQ option is TRUE but the INCLSEQ option is FALSE, included source input is not resequenced. If the SEQ option is FALSE, the value of the INCLSEQ option is ignored.

### INCLUDE Option

— INCLUDE \_\_\_\_\_|  
           └─<file specification>┘ └─<start specification>┘  
 → └─<stop specification>┘ \_\_\_\_\_|

<start specification>

└─ \* \_\_\_\_\_|  
   └─<sequence number>┘

<stop specification>

└─ - \_\_\_\_\_|  
   └─ TO ┘ └─<sequence number>┘

(Type: special)

The INCLUDE option causes the compiler to accept source language input from files other than the CARD and TAPE files. The included records are compiled in place of the record on which the INCLUDE option appears. The included records can themselves contain INCLUDE options; in this way, included source input can be nested up to five levels deep.

The <file specification> construct specifies the file from which source input is to be included. If the <title> form is used, the quoted string specifies the TITLE attribute of the file. The <internal file name> form provides an internal file name that can be associated with an actual file through file equation. The <name and title> form provides both an internal file name available for file equation and a title to be used if the internal file name is not file-equated.



If the <file specification> construct is not used, the same file as that specified in the previous INCLUDE option at the same level of nesting is used. Therefore, the first INCLUDE option at any of the five possible levels of nesting must contain the <file specification> construct.

The <start specification> construct specifies the record of the included file at which inclusion is to start. If the <sequence number> form is specified, inclusion begins with the first record with a sequence number greater than or equal to the specified sequence number. If the asterisk (\*) form of <start specification> is used, inclusion begins at the point where it left off the last time inclusion took place from this file at the same level of nesting. If the <start specification> construct is not used, inclusion begins with the first record of the file.

The <stop specification> construct specifies the record after which inclusion is to stop. If the <stop specification> construct is not used, inclusion ends after the last record of the file.

Source files suitable for use by the INCLUDE option can be produced by the compiler by using the NEW option.

Files declared globally in Work Flow Language (WFL) jobs should not be used as INCLUDE files.

The INCLUDE option must be the last option appearing on a compiler control record.

### Examples

The following example instructs the compiler to accept as input all records from the file indicated by the internal name FILE8, with a sequence number greater than or equal to 00001000 and less than or equal to 09000000.

```
$ INCLUDE FILE8 00001000 - 09000000
```

The following example instructs the compiler to accept as input a portion of the file accessed by the last INCLUDE option at this level of nesting. The records to be included are all records that follow the last record included by that preceding INCLUDE option. If, for example, the preceding INCLUDE option was the one in the first example above, the file that is accessed is FILE8, and the records that are included are all the records with a sequence number greater than 09000000.

```
$ INCLUDE *
```

The following example instructs the compiler to accept as input a portion of the file with the title *SOURCE/XYZ*. The included records are all records of the file with a sequence number less than or equal to 00000900.

```
$ INCLUDE "SOURCE/XYZ." - 900
```

The following example instructs the compiler to accept as input all records of either the file to which the internal name INCL was file-equated or, if the INCL file was not file-equated, the file *SYMBOL/ALGOL/INCLUDE1*.

```
$ INCLUDE INCL = "SYMBOL/ALGOL/INCLUDE1."
```

### INITIALIZE Option

```
— INITIALIZE —<text>—————|
```

(Type: Binder command)

During autobinding, the INITIALIZE option is passed directly to the Binder program for analysis. The format and function of this option are the same as those of the Binder INITIALIZE statement and are described in the *A Series Binder Programming Reference Manual*.

### INSTALLATION Option

```
— INSTALLATION —————|
  |<installation number list>|
```

<installation number list>

```
←—————|
|<installation number>| — , —|
|—————| — —<installation number>|
```

<installation number>

```
—<unsigned integer>—————|
```

(Type: Boolean, Default value: FALSE)

When TRUE, the INSTALLATION option causes the compiler to recognize one or more groups of installation intrinsics so that they can be referenced in an ALGOL program. This option must be assigned a value before the first syntactic item in a program. Assigning a value to this option at any other time has no effect.

An installation number must be an unsigned integer between 1 and 2047, inclusive. Each installation number in an installation number list must be strictly greater than the preceding installation number in that list. Installation numbers larger than 2047 are treated as if they were equal to 2047.

An INSTALLATION option with no installation number list is equivalent to one with an installation number list of 100 through 2047.

### INTRINSICS Option

```
— INTRINSICS —————|
```

(Type: Boolean, Default value: FALSE)

When TRUE, the INTRINSICS option causes separately compiled procedures to be compiled at lexical (lex) level two and allows a <global part> construct to appear before

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the procedures. These procedures can then be used as installation intrinsics. A <global part> is not normally allowed when compiling separate procedures at lex level two.

The title of the object code file generated for a procedure when the INTRINSICS option is TRUE is the same as if the procedure were compiled at lex level three. Thus, the separate procedures being compiled can be bound into the intrinsics. When the Binder program is used to bind procedures into the intrinsics, the INTRINSICS option must be assigned the value TRUE before the first source statement.

### LEVEL Option

```
— LEVEL —<outer level>—————|  
<outer level>  
—<unsigned integer>—————|
```

(Type: value, Default value: 2 for programs, 3 for separately compiled procedures)

The LEVEL option allows the programmer to override the lexical (lex) levels assigned by the compiler. This feature is needed when compiling separate procedures for binding to a host program. The <outer level> construct specifies the lex level at which compilation is to begin.

The LEVEL option must appear before the first syntactic item in a program.

### LIBRARY Option

```
— LIBRARY —————|
```

(Type: Boolean, Default value: TRUE for CANDE-originated compiles and when the SEPCOMP option is TRUE, FALSE otherwise)

When compiling multiple separate procedures (such as intrinsics), assigning TRUE to the LIBRARY option improves the efficiency of the binding. When TRUE, this option causes all object code from this compilation to be put in one file, which is marked as a multiprocedure code file. If the LIBRARY option is FALSE, each separate procedure produces its own object code file.

The LIBRARY option must appear before the first syntactic item in a program.

The LIBRARY option is unrelated to the library facility described in Section 8, “Library Facility.”

### LIMIT Option or ERRORLIMIT Option

```
— [ LIMIT ] [ ERRORLIMIT ] [ = ] <error limit> —————|
```

**<error limit>**

—<unsigned integer>—————|

(Type: value, Default value: 10 for CANDE-originated compiles, 150 otherwise)

The LIMIT option allows the programmer to specify the number of compile-time errors that can occur before the compilation is terminated because of excessive errors.

A limit of 0 indicates that the program is not to be terminated for excessive errors. If, when the LIMIT option is assigned a value, the number of syntax errors already equals or exceeds that value, then the program is immediately terminated.

### LINEINFO Option

— LINEINFO —————|

(Type: Boolean, Default value: TRUE for CANDE-originated compiles, FALSE otherwise)

When TRUE, the LINEINFO option causes the compiler to associate sequence number information with the object code. This information is then displayed in the event of a run-time error. A larger code file is generated if the LINEINFO option is TRUE than if it is FALSE.

### LIST Option

— LIST —————|

(Type: Boolean, Default value: FALSE for CANDE-originated compiles, TRUE otherwise)

When TRUE, the LIST option causes source input from the CARD and TAPE files and other information to be printed on the compiler LINE file.

When a value is assigned to the LIST option, the same value is assigned to the SEGS option.

### LISTDELETED Option

— LISTDELETED —————|

(Type: Boolean, Default value: FALSE)

When both the LIST option and the LISTDELETED option are TRUE, the printer listing includes records from the secondary input file TAPE that are replaced, voided, or deleted during the compilation. The word *REPLACED* appears to the right of the source records replaced by a record from the primary input file, CARD; the word *VOIDT* appears if the record is voided from the TAPE file by the VOIDT option; and the word *DELETED* appears if the record is deleted by a compiler control record that consists of a dollar sign (\$) followed by all blanks.

If the `LIST` option is `TRUE` but the `LISTDELETED` option is `FALSE`, records from the `TAPE` file that are replaced, voided, or deleted are not written to the printer listing. If the `LIST` option is `FALSE`, the value of the `LISTDELETED` option is ignored.

### LISTINCL Option

— LISTINCL \_\_\_\_\_|

(Type: Boolean, Default value: `FALSE`)

When both the `LIST` option and the `LISTINCL` option are `TRUE`, source records included by using the `INCLUDE` option are written to the printer listing. If the `LIST` option is `TRUE` but the `LISTINCL` option is `FALSE`, the included records are not written to the printer listing. If the `LIST` option is `FALSE`, the value of the `LISTINCL` option is ignored.

### LISTOMITTED Option

— LISTOMITTED \_\_\_\_\_|

(Type: Boolean, Default value: `TRUE`)

When both the `LIST` option and the `LISTOMITTED` option are `TRUE`, source records omitted by the `OMIT` option are written to the printer listing. In the listing, the word *OMIT* appears next to the sequence number of each omitted record. If the `LIST` option is `TRUE` but the `LISTOMITTED` option is `FALSE`, omitted records are not written to the printer listing. If the `LIST` option is `FALSE`, the value of the `LISTOMITTED` option is ignored.

### LISTP Option

— LISTP \_\_\_\_\_|

(Type: Boolean, Default value: `FALSE`)

When `TRUE`, the `LISTP` option causes records from the primary source input file, `CARD`, to be written to the printer listing. Because these records are also written when the `LIST` option is `TRUE`, the `LISTP` option is effective only when the `LIST` option is `FALSE`.

### LOADINFO Option

— LOADINFO \_\_\_\_\_|  
    |<file specification>|

(Type: special)

The `DUMPINFO` option and the `LOADINFO` option make it possible for the contents of certain simple variables and arrays of the compiler to be saved in a disk file and subsequently reloaded for separate compilation.

The <file specification> construct specifies the file to be created by the DUMPINFO option or loaded by the LOADINFO option. If the <title> form is used, the quoted string specifies the TITLE attribute of the file. The <internal file name> form provides an internal file name that can be associated with an actual file by file equation. The <name and title> form provides both an internal file name available for file equation and a title to be used if the internal file name is not file-equated. If the <file specification> construct is not used, the default INFO file or the file that is file-equated to the INFO file is used.

These options are used in conjunction with separate compilation of procedures. Typically, all global declarations are compiled, and then the DUMPINFO option is used to dump information about the global declarations from the compiler to the file INFO. When the separate procedures are to be compiled, the file INFO, containing information about all of the global declarations, is read in by the LOADINFO option before the procedures are compiled. When the XREF option or XREFFILES option is set, the cross-reference information available at the time of a DUMPINFO is saved. If the option is set when a LOADINFO is done, that cross-reference information will be loaded and available for use with any new cross-reference information created in the separate compilation of procedures. For example, consider the following programs:

### Program 1

```
BEGIN
  <global declarations>
  $ DUMPINFO
END.
```

### Program 2

```
%%% LOAD THE GLOBALS
[
  $ LOADINFO
  <additional global declarations>
]
<separate PROCEDURE declarations>
```

Each time a loadinfo operation is done, the old information in the affected variables and tables of the compiler is discarded. Thus, compiling different portions of the same program, even if they are in different environments, can be done in the same compilation.

The loadinfo operation changes all items in the INFO file to globals and all procedures already compiled to forward PROCEDURE declarations. Thus, an INFO file created by a DUMPINFO operation that is done immediately before a PROCEDURE declaration in a normal compilation is suitable for loading global declarations when that procedure is to be compiled separately.

When two or more items with the same identifier are declared at different lexical (lex) levels, a separate compilation can access only the last declaration seen before the loadinfo operation occurred.

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If the release level of the compiler that performs the dumpinfo operation to create an INFO file and the release level of the compiler that performs the loadinfo operation on that file are not the same, a syntax error is given, and the compilation is discontinued. If a loadinfo operation is attempted and the file specified as the INFO file is not in fact an INFO file, or the INFO file was created by a compiler for a different language, a syntax error is given and the compilation is discontinued.

The DUMPINFO option and LOADINFO option must be the last options appearing on a compiler control record.

### MAKEHOST Option

— MAKEHOST — (  $\overbrace{\text{<environment>}}^{\leftarrow}$  ) \_\_\_\_\_|

<environment>

$\overbrace{\text{<procedure identifier>}}^{\leftarrow}$  OF \_\_\_\_\_|

(Type: Boolean, Default value: FALSE)

Given only the source code and object code of a host program to be changed and the patches to change it, the SEPCOMP facility of the compiler can separately compile and bind to the host program only the procedures that are being changed. This method, which is particularly useful for large programs, requires that information not normally collected and saved during the compilation of the host program be saved. When TRUE, the MAKEHOST option causes this information to be saved when compiling a program or a procedure at lexical (lex) level two.

If the MAKEHOST option is TRUE, information is saved in the object code file of the program about the symbolic file used or created by the compilation, the sequence ranges of all procedures declared in the outer block of the program, and the global declarations. The saving of the outer block environment enables lex-level-three procedures to be compiled separately within this environment.

The information saved about the items declared in an environment describes all of the items in that environment. There is no information about the relative order of the declarations and therefore which items are visible from which procedures. Thus, a SEPCOMP of a patch is not necessarily equivalent to a full compile of that patch. For example, consider the following host program:

```
BEGIN
  REAL X;
  PROCEDURE P;
    BEGIN
      REAL R;
      R := X + 5;
    END P;
  REAL ARRAY A[0:4];
  P;
END.
```

If a patch replaces the statement  $R := X + 5$ ; by the statement  $R := X + A[2]$ ; a full compile with the patch fails with a syntax error on the assignment to  $R$ , because array  $A$  has not yet been declared. A SEPCOMP of the patch, however, is successful, because the environment information saved for the outer block describes  $A$  as well as  $X$  and  $P$ .

Additional environments can be saved, if desired, so that procedures at lex levels greater than three can be replaced. The list of environments can extend across several source records. Environments must be fully qualified through the outermost level of a PROCEDURE declaration, except that for a program that is a procedure, the name of that procedure must not appear. A procedure that is specified as an environment must contain a local declaration. If a specified environment does not contain a local declaration or if it is never found during the course of compilation, the compiler gives a syntax error containing the name of the environment. Environments can appear in any order, without regard to the actual block structure of the host program.

Source records that are inserted into a program using the INCLUDE option are not included in the environment information saved by the MAKEHOST option. This information is not saved because sequence numbers on included records can duplicate sequence numbers occurring in the rest of the program.

The information necessary to make a program into a host program includes the information saved for the Binder program when the NOBINDINFO option is FALSE; therefore, an error is given if both the NOBINDINFO option and the MAKEHOST option are TRUE.

When a host program is being created, the NEW option should be set to TRUE if any changes are made to the host program. The default title of the source file is saved in the host file for use during a SEPCOMP. If the host is being created as the result of a SEPCOMP, the title of the SOURCE file is saved. If the compilation is not a SEPCOMP but the NEW option is TRUE, the title of the NEWSOURCE file is saved. If NEW is FALSE but MERGE is TRUE, the title of the SOURCE file is saved. Otherwise, the title of the CARD file is saved.

The MAKEHOST option must appear before the first syntactic item in a program.

### Examples

When the following program is compiled, information about the global environment is saved in the object code file for the program. If a patch is made to the body of procedure INNER, then during the SEPCOMP process, all of procedure P1 is recompiled and bound to the host program. If, however, the MAKEHOST option was *\$ SET MAKEHOST (P1)* then the local environment of P1 is also saved in the object code file of the program. A SEPCOMP of a patch to the body of procedure INNER would cause only INNER to be recompiled and bound to the host program.



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```
BEGIN
  ARRAY A[0:9];
  PROCEDURE P1;
  BEGIN
    BOOLEAN B;
    PROCEDURE INNER;
    BEGIN
      REAL R;
      IF B THEN
        R := * + A[2];
      ...
    END INNER;
    ...
  END P1;
  PROCEDURE P2;
  BEGIN
    ...
  END P2;
  ...
END.
```

In the following example, the second compiler control option overrides the first, saving the environment of procedures PASSONE, PASSTWO, and WRAPUP OF PASSTWO in addition to the global environment.

```
$SET MAKEHOST
$SET MAKEHOST (PASSONE, PASSTWO, WRAPUP OF PASSTWO)
```

### MCP Option

— MCP —————|

(Type: Boolean, Default value: FALSE)

When TRUE, the MCP option causes all value arrays, translate tables, truth sets, and constant pools to be allocated at lexical (lex) level two.

The MCP option cannot be assigned a value after the appearance of the first syntactical item in a program.

### MERGE Option

— MERGE —————|

(Type: Boolean, Default value: FALSE)

When TRUE, the MERGE option causes the primary source input file, CARD, to be merged with a secondary source input file, TAPE, to form the input to the compiler. If matching sequence numbers occur, the record from CARD overrides the record from TAPE. If the MERGE option is FALSE, only primary source input is used, and the TAPE file is ignored.

The total input to the compiler when the `MERGE` option is `TRUE` consists of all records from the `CARD` file, all records from the `TAPE` file that do not have sequence numbers identical to those on records in the `CARD` file, and all records inserted by `INCLUDE` options. Records in the `CARD` file also override `INCLUDE` options in the `TAPE` file if matching sequence numbers are encountered.

## NEW Option

— NEW \_\_\_\_\_|

(Type: Boolean, Default value: FALSE)

When the `NEW` option is `TRUE`, the source input to the compiler from the `CARD` file is written to the updated source output file `NEWTAPE`. If the `MERGE` option is also `TRUE`, then the merged source input from the `CARD` and `TAPE` files is written to `NEWTAPE`. The format of the file written to `NEWTAPE` is such that it can later be used as input to the compiler.

Records included in the source input by the `INCLUDE` option are written to the `NEWTAPE` file only if the `INCLNEW` option is also `TRUE`. Compiler control records are written to the `NEWTAPE` file only if the initial dollar sign (\$) does not appear in column 1.

The `NEWTAPE` file is created whether or not syntax errors occur in the source input.

If the `MAKEHOST` option is `TRUE` and the first syntactic item has been compiled, any attempt to assign a value to the `NEW` option results in a syntax error.

## NEWSEQERR Option

— NEWSEQERR \_\_\_\_\_|

(Type: Boolean, Default value: FALSE)

When `TRUE`, the `NEWSEQERR` option causes an error to be given if the sequence number on a record of the `NEWTAPE` file is not strictly greater than the sequence number of the preceding record. If sequence errors occur and the `NEWSEQERR` option is `TRUE`, the `NEWTAPE` file is not locked, the message *NEWTAPE NOT LOCKED* is displayed on the Operator Display Terminal (ODT), and the message *NEWTAPE NOT LOCKED <number of errors> NEWTAPE SEQUENCE ERRORS* is printed on the printer listing. The `NEWSEQERR` option is effective even if the `CHECK` option is `FALSE`.

## NOBCL Option

— NOBCL \_\_\_\_\_|

(Type: Boolean, Default value: FALSE)

When `TRUE`, the `NOBCL` option causes a syntax error to be given whenever a `BCL` construct that may lead to the creation of a `BCL` descriptor is encountered. This option

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is intended to aid in the elimination of BCL constructs from a program so that the program can run on non-BCL systems.

### NOBINDINFO Option

— NOBINDINFO —————|

(Type: Boolean, Default value: FALSE)

When TRUE, the NOBINDINFO option prevents information needed by the Binder program from being written to the object code file. The resulting object code file can be executed, but it cannot be used as an input file to the Binder program. Object code files that do not contain binding information (bindinfo) are smaller than object code files that contain bindinfo.

The Binder program cannot bind object code files that contain the timing code necessary for statistics; therefore, if the NOBINDINFO option is FALSE when the STATISTICS option is assigned the value TRUE, the NOBINDINFO option is assigned the value TRUE and a warning message is given. If the STATISTICS option is TRUE when the NOBINDINFO option is assigned the value FALSE, a syntax error is given.

If the MAKEHOST option is TRUE when the NOBINDINFO option is assigned the value TRUE, a syntax error is given.

### NOSTACKARRAYS Option

— NOSTACKARRAYS —————|

(Type: Boolean, Default value: FALSE)

When TRUE, the NOSTACKARRAYS option prevents arrays from being allocated within the stack.

When the NOSTACKARRAYS option is FALSE, the data from certain arrays is allocated within the stack. Such arrays are referred to as in-stack arrays, and can be accessed slightly faster than an array whose data area is allocated in memory.

### NOXREFLIST Option

— NOXREFLIST —————|

(Type: Boolean, Default value: FALSE)

When TRUE, the NOXREFLIST option prevents the SYSTEM/XREFANALYZER program from being initiated by the compiler when cross-reference information is being saved (that is, when either the XREF option or the XREFFILES option is TRUE). Instead, the file XREF/<code file name>, where <code file name> is the name of the object code file generated by the compiler, remains on disk. SYSTEM/XREFANALYZER can be run later using the file XREF/<code file name> as input. The NOXREFLIST option has no effect if both the XREF option and the XREFFILES option are FALSE.

For more information on cross-referencing, refer to the description of the XREF option later in this section.

### OLDRESIZE Option

— OLDRESIZE \_\_\_\_\_|

(Type: Boolean, Default value: FALSE)

The OLDRESIZE option, which affected the semantics of the RESIZE statement, no longer has any effect. Any compiler control record that assigns the value TRUE to the OLDRESIZE option causes a syntax error to be given. Any other appearance of the OLDRESIZE option in a compiler control record causes a warning message to be given.

### OMIT Option

— OMIT \_\_\_\_\_|

(Type: Boolean, Default value: FALSE)

When TRUE, the OMIT option causes records from the CARD file (and, if the MERGE option is TRUE, from the TAPE file) to be ignored (not compiled). If both the LIST option and the LISTOMITTED option are TRUE, then in the printer listing, the word OMIT appears next to the sequence number of each omitted record. When the OMIT option is TRUE, compiler control records with the initial dollar sign (\$) in either column 1 or column 2 are recognized, but compiler control records with the \$ in columns 3 through 72, inclusive, are ignored.

### OPTIMIZE Option

— OPTIMIZE \_\_\_\_\_|

(Type: Boolean, Default value: FALSE)

When TRUE, the OPTIMIZE option causes additional analysis of Boolean expressions to be performed, and object code is generated to permit early termination of the expression evaluation. Any portion of the Boolean expression that could cause side effects is always evaluated.

### PAGE Option

— PAGE \_\_\_\_\_|

(Type: immediate)

When the LIST option is TRUE and the PAGE option appears, the printer listing is spaced to the top of the next page.

### PARAMCHECK Option

— PARAMCHECK —————|

When TRUE, the PARAMCHECK option causes the compiler to report, as a syntax error, the redeclaration of a formal parameter of a procedure, within the outer block of the procedure. This permits the user to see where a formal parameter has been rendered inaccessible to the procedure.

### PURGE Option

— PURGE <text>—————|

(Type: Binder command)

During autobinding, the PURGE option is passed directly to the Binder program for analysis. The format and function of this option are the same as those of the Binder PURGE statement and are described in the *A Series Binder Programming Reference Manual*.

### SEGDESCABOVE Option

— SEGDESCABOVE [ <unsigned integer> ]—————|

(Type: value, Default value: none)

The SEGDESCABOVE option is used when compiling large programs that may have difficulty in addressing the segment dictionary.

When a host program is compiled, this option causes all code segment descriptors to be allocated starting at the word in the D1 stack specified by the unsigned integer. The unsigned integer must be in the range 4 to 4095, inclusive. If the option is used after the first syntactic item has been compiled, the given value is added to the current size of the D1 stack. The Binder program preserves the segdescabove specification. Care should be taken when using this option, because unused D1 stack locations below the code segment descriptors occupy save memory when the program is running.

This option is intended to be used when compiling host files and is ignored when separate procedures are compiled.

### SEGS Option

— SEGS —————|

(Type: Boolean, Default value: FALSE for CANDE-originated compiles, TRUE otherwise)

If both the LIST option and the SEGS option are TRUE, the printer listing will contain beginning and ending segment messages. Assigning a value to the LIST option assigns the same value to the SEGS option. However, to suppress the segment messages, the

SEGS option can be assigned the value FALSE even though the LIST option is TRUE. When the value of the LIST option is FALSE, the value of the SEGS option is ignored.

## SEPCOMP Option

— SEPCOMP <title>

(Type: Boolean, Default value: FALSE)

When TRUE, the SEPCOMP option invokes the automatic separate compilation and binding facility, called the SEPCOMP facility.

The title of the host program can be specified either by using the <title> syntax of the SEPCOMP option or by file-equating the HOST file of the compiler. The <title> specification takes precedence over file equation. The title of the default source file is stored in the host program, but this title can be overridden by file equation of the compiler file TAPE.

Compiler control records with blank sequence numbers are accepted following the compiler control record that assigns TRUE to the SEPCOMP option and before the first patch record. A patch record is a source record with a nonblank sequence number; at least one patch record is required in a SEPCOMP. Sequence number errors among patch records are not allowed. The SEPCOMP option examines the patch records, decides which procedures of the host program must be recompiled, and generates Binder input for binding these procedures to the host program. The SEPCOMP option always tries to compile procedures at the highest possible lexical (lex) level. Therefore, the number of extra environments specified when making a host program affects the choices available to the SEPCOMP option.

When TRUE, the SEPCOMP option assigns TRUE to both the AUTOBIND option and the LIBRARY option, causing all procedures to be compiled into one multiprocedure code file (a temporary file used by the Binder program). Explicitly assigning FALSE to the AUTOBIND option prevents the Binder from being called and causes the object code file to be locked on disk if the LIBRARY option is TRUE. Explicitly assigning FALSE to the LIBRARY option causes each procedure compiled to be put in a separate, permanent object code file. Binding still occurs, but at a somewhat slower rate.

If procedures are put in separate code files, the titles of the code files are determined in the standard way, with the procedure name replacing the last identifier from the title on the compile statement that invoked the compiler. Procedures compiled at lex level four and higher have the name of their environment in the code file name also. In the following example, when two lex-level-four procedures are compiled having the same name but different environments, two code files are produced (titled *A/PASSONE/Q* and *A/PASSTWO/Q*) in addition to the new host file titled *A/HOST*, assuming that PASSONE and PASSTWO were specified as extra environments when A/HOST was made.

```
% PATCH CARD TO Q OF PASSONE      <sequence number>
% PATCH CARD TO Q OF PASSTWO      <sequence number>
```

The special information associated with a host program is always copied by the Binder to the object code file of the new program so it can be used as a host. This information is not updated by either the Binder or the compiler during the SEPCOMP process. Following a SEPCOMP, this information can inaccurately reflect the actual structure and content of the host program with which it is associated.

Because the arrangement of data in a bound code file differs from that of an unbound code file, binding to a bound host is faster than binding to an unbound host. For this reason, assigning TRUE to the AUTOBIND option when compiling a host program can be advantageous, because it causes the Binder to be invoked.

If the release level of the compiler that creates the host code file and the release level of the compiler that is attempting a SEPCOMP to that file are not the same, a syntax error is given and the compilation is discontinued. If the code file specified as the host program was not compiled with the MAKEHOST option equal to TRUE, or if the host program was compiled by a compiler for a different language, a syntax error is given and the compilation is discontinued.

The SEPCOMP option automatically assigns values to several other compiler control options in order to simplify operation. The MERGE option is unavailable for use while the SEPCOMP option is TRUE. Assigning TRUE to the MERGE option before assigning TRUE to the SEPCOMP option is not allowed because it destroys the default file equation of the source file to be used for the patches.

If the TADS option is TRUE when the SEPCOMP option is assigned the value TRUE, the value of the SEPCOMP option is left equal to FALSE and a warning message is given. The SEPCOMP option cannot be assigned a value after the first syntactic item of a program has been compiled. Multiple SEPCOMP option settings are not allowed because, when first assigned TRUE, the SEPCOMP option initiates preprocessing of the source input from the CARD file.

For more information on the SEPCOMP facility, refer to "MAKEHOST Option" earlier in this section.

### SEQ Option

— SEQ —  
— SEQUENCE —

(Type: Boolean, Default value: FALSE)

SEQUENCE is a synonym that can be used for the SEQ option. The SEQUENCE synonym should not be used if the code is to be run through SYSTEM/PATCH.

When TRUE, the SEQ option causes the printer listing and the updated source file, NEWTAPE, to contain new sequence numbers. These new sequence numbers are determined by the current values of the sequence base option and the sequence increment option.

This option is effective only when the LIST option or NEW option is TRUE. The sequence numbers that appear on the records in these files when the SEQ option is

FALSE are identical to the sequence numbers on the corresponding records in the input files.

The sequence base option and the sequence increment option are described in this section.

### SEQERR Option

— SEQERR \_\_\_\_\_|

(Type: Boolean, Default value: FALSE)

When TRUE, the SEQERR option causes an error to be given if the sequence number on a record of the TAPE file is not strictly greater than the sequence number of the preceding record. If sequence errors occur and the SEQERR option is TRUE, the object code file is not locked, the message *CODE FILE NOT LOCKED* is displayed on the Operator Display Terminal (ODT), and the message *CODE FILE NOT LOCKED <number of errors> TAPE SEQUENCE ERRORS* is printed on the printer listing. The SEQERR option is effective even when the CHECK option is FALSE.

### SEQUENCE BASE Option

— /8\-<digit> \_\_\_\_\_|

(Type: value, Default value: 1000)

The SEQUENCE BASE option specifies the sequence number that is to be assigned to the next record when the SEQ option is TRUE. After each record is resequenced, the value of the SEQUENCE BASE option is increased by the value of the sequence increment option.

### SEQUENCE INCREMENT Option

— + /8\-<digit> \_\_\_\_\_|

(Type: value, Default value: 1000)

The value of the SEQUENCE INCREMENT Option is used to increment the value of the sequence base option when records are resequenced because the SEQ option is TRUE.

### SHARING Option

— SHARING = \_\_\_\_\_|  
                   | DONTCARE \_\_\_\_\_|  
                   | PRIVATE \_\_\_\_\_|  
                   | SHARED BY ALL \_\_\_\_\_|  
                   | SHARED BY RUN UNIT \_\_\_\_\_|

(Type: value, Default value: DONTCARE)



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The **SHARING** option is used in a library program to specify how other programs are to share the library.

### **DONTCARE**

If the **SHARING** option has the value **DONTCARE**, the operating system determines the sharing, and it is unknown to all users invoking the library. **DONTCARE** is the default value of the **SHARING** option.

### **PRIVATE**

If the **SHARING** option has the value **PRIVATE**, a separate instance of the library is started for each invocation of the library. Any changes made to global items in the library by a block that invoked the library apply only to that user of the library.

### **SHAREDYALL**

If the **SHARING** option has the value **SHAREDYALL**, all invocations of the library share the same instance of the library. Any changes made to global items in the library by a block that has invoked the library apply to all users of that library.

### **SHAREDYRUNUNIT**

A run unit consists of a program and all libraries that are initiated either directly or indirectly by that program. A program, in this context, does not include either a library that is not frozen or any tasks that are initiated by the program (that is, a process family is not a run unit). If the **SHARING** option has the value **SHAREDYRUNUNIT**, all invocations of a library within a run unit share the same instance of the library.

Note that a library is its own run unit until it freezes. For example, program P initiates library A and, before library A freezes, it in turn initiates library B. Now library B is in library A's run unit, not in program P's run unit. Had library A initiated library B after freezing, both library A and library B would be in program P's run unit.

The **SHARING** option must appear before the first syntactic item in the program.

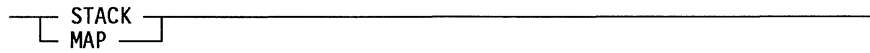
## **SINGLE** Option

— **SINGLE** —————|

(Type: Boolean, Default value: **TRUE** if the compiler was compiled with the **DOUBLESPACE** compiler-generation option equal to **FALSE**, **FALSE** otherwise)

When **TRUE**, the **SINGLE** option causes the printer listing to be single-spaced. When **FALSE**, the **SINGLE** option causes the printer listing to be double-spaced.

### STACK Option

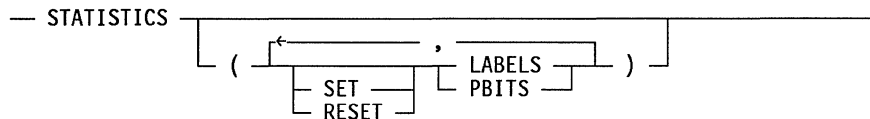


(Type: Boolean, Default value: FALSE)

MAP is a synonym that can be used for the STACK option.

If both the LIST option and the STACK option are TRUE, the printer listing includes the relative stack addresses, in the form of address couples, for all program variables. If the LIST option is TRUE but the STACK option is FALSE, the printer listing does not contain these address couples. The value of the STACK option is ignored if the LIST option is FALSE.

### STATISTICS Option



(Type: Boolean, Default value: FALSE)

When TRUE, the STATISTICS option causes timing statistics to be gathered. The option is examined at the beginning of each procedure or block and, if it is TRUE at that time, timing statistics are gathered for that procedure or block. Although the value of the option can be altered at any time, only its value at the beginning of procedures and blocks is significant in determining whether timings are made.

The Binder program cannot bind object code files that contain the timing code necessary for statistics; therefore, if the NOBINDINFO option is FALSE when the STATISTICS option is assigned the value TRUE, the NOBINDINFO option is assigned the value TRUE and a warning message is given. If the STATISTICS option is TRUE when the NOBINDINFO option is assigned the value FALSE, a syntax error is given.

If statistics are taken for a procedure or block, the frequency of execution of that procedure or block is measured, along with the length of time spent in that procedure or block. When the program is completed for any reason, including both normal and abnormal termination, the statistics of the executing task are printed out to the TASKFILE.

On the statistics output listing, an asterisk (\*) indicates that doubt exists about the timing for the specific procedure whose name precedes the asterisk. In addition, timings are invalid for any procedure or block that is resumed by a bad GO TO.

Statistics on presence bit actions can be accumulated by specifying SET PBITS as the statistics option. The PBITS option can be SET and RESET in various places in the program.

For each block where PBITS is invoked, the statistics report contains the first 25 characters of the identifiers, the processor time accumulated for the block, the number

## Compiling Programs

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of times the block is executed, the average processor time, and the number of initial and other presence bit operations.

If the PBITS option is not specified, the presence bit statistics are not accumulated. The statistics report contains the first six characters of the identifier, the processor time accumulated for the block, the number of times the block is entered, and the average time spent per entry.

Using the STATISTICS option, especially when PBITS is specified, can significantly increase the amount of code generated for each specified block. This, in turn, can cause a *SEGMENT TOO LARGE* error. To avoid this error, reduce the amount of code enclosed by each BEGINSEGMENT/ENDSEGMENT pair. Or, if the program segmentation is not user-controlled, force part of the block into a new segment by enclosing that part of the code in a block. For more information on program segmentation, refer to the BEGINSEGMENT option earlier in this section.

For any procedure or block that has statistics gathered, the timings can be broken down to the label level within that procedure or block by using the LABELS syntax. The word LABELS can be preceded by SET or RESET; if both are omitted, SET is assumed. For example, the following begins timing of label breakpoints:

```
$ SET STATISTICS (LABELS)
```

The following ends timing of label breakpoints:

```
$ SET STATISTICS (RESET LABELS)
```

The words SET or RESET inside the parentheses affect only the LABELS specification.

### STOP Option

```
— STOP —<text>—————|
```

(Type: Binder command)

During autobinding, the STOP option is passed directly to the Binder program for analysis. The format and function of this option are the same as those of the Binder STOP statement and are described in the *A Series Binder Programming Reference Manual*.

### TADS Option

```
— TADS —————|
  ( ( /1\— FREQUENCY , _____ )
    ( /1\— REMOTE —<file identifier> ) )
```

(Type: Boolean, Default value: FALSE)

When the TADS option is TRUE, special debugging code and tables are generated as part of the object code file. The tables are generated to support the symbolic debugging environment of the ALGOL Test and Debug System (TADS). For more information

on ALGOL TADS, refer to the *A Series ALGOL Test and Debug System (TADS) Programming Guide*.

The `FREQUENCY` option causes additional code and tables to be generated for coverage and frequency analysis. This option must be specified if either the `TADS FREQUENCY` command or the `TADS COVERAGE` command is to be used to determine the number of times individual statements have been executed or which statements have not been executed.

The `REMOTE` option allows TADS to share a remote file with the program being tested. Sharing a file might be necessary, because only one remote input file can be open for each station. A remote file shared with TADS cannot be explicitly opened by the program or an `OPEN ERROR` results and a *FILE NOT CLOSED* error message is displayed. If specified, the `<file identifier>` must correspond to a file identifier declared in a `FILE` declaration occurring later in the outer block of the program. The file must have the attributes `KIND` equal to `REMOTE`, `UNITS` equal to `CHARACTERS`, and `FILEUSE` equal to `IO`. The `MAXRECSIZE` attribute must not be less than 72. The file must not be declared to be a direct file.

If the `AUTOBIND` option, the `MAKEHOST` option, or the `SEPCOMP` option is `TRUE` when the `TADS` option is assigned the value `TRUE`, then the `TADS` option is assigned the value `FALSE` and a warning message is given. Programs compiled with the `TADS` option equal to `TRUE` cannot assign `TRUE` to the `MAKEHOST` option, the `AUTOBIND` option, or the `SEPCOMP` option, and they cannot be used as input files to the Binder program.

The interaction between the outer lexicographical level and the `TADS` option is as follows:

- If the `LEVEL` option has not been encountered when the `TADS` option is set to `TRUE`, the outer lexicographical level of the program is set to 2 and the code file produced contains TADS code.
- If the `LEVEL` option is not equal to 2 when the `TADS` option is set to `TRUE`, the `TADS` option is assigned the value `FALSE` and the warning message *TADS CANNOT BE SET WITH A LEVEL > 2* is given. The code file produced does not contain TADS code.
- If the `TADS` option is `TRUE` when the `LEVEL` option is assigned a value not equal to 2, the warning message *A LEVEL > 2 IS INVALID WHEN TADS IS SET* is given, the `LEVEL` option is ignored, and the code file produced contains TADS code.

The `TADS` option must appear before the first syntactic item in a program.

### TARGET Option

The `TARGET` option generates code suited for a specific computer system or group of systems and should be used to specify all machines on which the code file needs to run. The generated code file can be used on all the machines specified in the `TARGET` option.

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---

— TARGET — = —<primary identifier>—————→  
←————— , —————→  
→ [ ( —<secondary identifier>— ) ]

<primary identifier>

—<target identifier>—————→

<secondary identifier>

—<target identifier>—————→

<target identifier>

THIS	—————→
ALL	—————→
A17	—————→
A16	—————→
A15	—————→
A12	—————→
A10	—————→
A9	—————→
A6	—————→
A5	—————→
A4	—————→
A3	—————→
A2	—————→
A1	—————→
MICROA	—————→
B7900	—————→
B7000	—————→
LEVEL4	—————→
LEVEL2	—————→
LEVEL1	—————→
LEVEL0	—————→

(Type: Value, Default value: installation-defined)

The code file generated is optimized for the machine or group of machines identified by the primary identifier, subject to the compatibility constraints of the machine or group of machines identified by the secondary identifier. That is, the code file is optimized for the machine or machines listed as the primary identifier, but no operator is generated that is not supported by all the machines listed as secondary identifiers.

The various target identifiers work in the following ways:

- A target identifier that names a specific machine (for example, A4) optimizes a code file to be run on that machine so that the code file receives the characteristics for that machine.
- The THIS identifier is a synonym for the target identifier of the machine on which the code file is compiled.
- The ALL identifier indicates that the code file must be able to be run on all currently supported machines. Note that the code generated when TARGET is equal to ALL changes as older machines are no longer supported and/or new ones are added. LEVEL0 is presently a synonym for ALL.

- B7000 is a synonym for B7900.
- The LEVEL1 identifier encompasses the A9 and A10 target identifiers. LEVEL1 code files also run on LEVEL2 machines.
- The LEVEL2 identifier encompasses the MICROA, A1, A2, A3, A4, A5, A6, A12, A15, and A17 target identifiers. LEVEL2 code files also run on LEVEL1 machines.
- The LEVEL4 identifier encompasses the A16 target identifier. Unless a secondary target identifier other than A16 of LEVEL4 is specified, code files compiled with a primary target identifier of either A16 or LEVEL4 might not run on machines other than the A16.

The generated code can be run on any computer that is code compatible with the specified family.

The TARGET option must appear before the first record that is not a compiler control record in the source program.

The default TARGET option is installation defined. For information on the way an installation defines the default target computer family, refer to the *A Series System Commands Operations Reference Manual*.

### TIME Option

— TIME \_\_\_\_\_|

(Type: Boolean, Default value: FALSE)

When TRUE, the TIME option causes trailer information, such as the number of errors, the number of code segments, and the compilation time, to be printed on the printer listing. Because this trailer information is also printed when the LIST option is TRUE, the value of the TIME option is effective only when the LIST option is FALSE.

### USE Option

— USE —<text>\_\_\_\_\_|

(Type: Binder command)

During autobinding, the USE option is passed directly to the Binder program for analysis. The format and function of this option are the same as those of the Binder USE statement and are described in the *A Series Binder Programming Reference Manual*.

### USER Option

—<identifier>\_\_\_\_\_|

(Type: Boolean, Default value: FALSE)



### Examples

The following example sets the current version to 25.010.0010.

```
$ VERSION 25.010.0010
```

The following example increments the current version by 01 in the version increment, by 001 in the cycle increment, and assigns 0010 to the patch number. For example, if the existing version is 25.010.0005 and this VERSION option is compiled, the resulting version is 26.011.0010.

```
$ VERSION +01.+001.010
```

### VOID Option

— VOID \_\_\_\_\_|

(Type: Boolean, Default value: FALSE)

When TRUE, the VOID option causes all source input other than compiler control records from both the TAPE and CARD files to be ignored by the compiler until the VOID option is assigned the value FALSE. The ignored source input is neither listed nor included in the updated source file, regardless of the values of the LIST option and the NEW option. Once the VOID option is assigned TRUE, it can be assigned FALSE only by a compiler control record in the CARD file.

### VOIDT Option

VOIDT \_\_\_\_\_|  
 DELETE

(Type: Boolean, Default value: FALSE)

DELETE is a synonym that can be used for the VOIDT option.

If the MERGE option is TRUE and the VOIDT option is TRUE, all source input from the TAPE file is ignored by the compiler until the VOIDT option is assigned the value FALSE. Therefore, while the VOIDT option is TRUE, only primary source input from the file CARD is compiled. The ignored input is neither listed nor included in the updated source file, regardless of the values of the LIST option and the NEW option. Once the VOIDT option is assigned TRUE, it can be assigned FALSE only by a compiler control record in the CARD file. If the MERGE option is FALSE, the value of the VOIDT option is ignored.

### WARNSUPR Option

— WARNSUPR \_\_\_\_\_|

(Type: Boolean, Default value: FALSE)

When TRUE, the WARNSUPR option prevents warning messages from being given.



### WRITEAFTER Option

— WRITEAFTER \_\_\_\_\_|

(Type: Boolean, Default value: FALSE)

The WRITEAFTER option provides the ability to designate whether carriage control is performed before or after a write operation. The option can be assigned values repeatedly in order to select before-write or after-write carriage control for individual files and I/O statements.

Normally in ALGOL, carriage control is performed following a write operation.

Carriage control is done before a particular write operation if the WRITEAFTER option is TRUE when the I/O statement is compiled or if the I/O statement explicitly references a file whose declaration was compiled when the WRITEAFTER was TRUE.

For disk files, notwithstanding any value of the WRITEAFTER option, the carriage control action is always taken before a nonbinary write operation.

The WRITEAFTER option does not apply to direct files or direct I/O statements.

### XDECS Option

— XDECS \_\_\_\_\_|

(Type: Boolean, Default value: TRUE if either the XREF option or the XREFFILES option is TRUE, FALSE otherwise)

When the compiler is saving cross-reference information because the XREF option or the XREFFILES option is TRUE, only identifiers declared while the XDECS option is TRUE are included in the cross-reference information. This option is assigned TRUE when the XREF option or the XREFFILES option is assigned TRUE and can be assigned a value as many times as desired. If the XDECS option is assigned the value TRUE and both the XREF option and the XREFFILES option are FALSE, the XDECS option is assigned FALSE and a syntax error is given.

For more information on cross-referencing, refer to “XREF Option” later in this section.

### XREF Option

— XREF <linewidth> \_\_\_\_\_|

<linewidth>

An integer between 72 and 160.

(Type: Boolean, Default value: FALSE)

Depending on the values of several related compiler control options, the compiler optionally generates cross-reference information containing an alphabetized list of identifiers that appear in the program and, for each identifier, the type of the item named by that identifier, the sequence number of the source input record on which the identifier is declared, the sequence numbers of the input records on which the identifier is referenced, and other relevant information. The following factors can be controlled through the use of compiler control options:

- Whether or not the compiler saves cross-reference information as it is processing the source input
- Which identifiers and which references to these identifiers are cross-referenced
- Whether or not the SYSTEM/XREFANALYZER program is initiated automatically by the compiler
- If SYSTEM/XREFANALYZER is automatically initiated, whether it is to produce printed output, disk files suitable for input to SYSTEM/INTERACTIVEXREF and the Editor, or both

The compiler saves cross-reference information if either the XREF option or the XREFFILES option or both options are TRUE. This information is discarded if any syntax errors occur during compilation. If used, these options should be assigned TRUE before any source input has been processed. Once assigned TRUE, these options cannot be assigned FALSE.

The identifiers and their references to be cross-referenced can be selected by the XDECS option and the XREFS option, respectively. Neither of these options can be used if cross-reference information is not being saved by the compiler (that is, if both the XREF option and the XREFFILES option are FALSE).

When the compiler is saving cross-reference information, this information is written to a disk file in raw form. Before this information can be printed or read by SYSTEM/INTERACTIVEXREF and the Editor, it must be analyzed by SYSTEM/XREFANALYZER. If the NOXREFLIST option is FALSE, the compiler automatically initiates SYSTEM/XREFANALYZER to process the raw cross-reference file. If the NOXREFLIST option is TRUE, SYSTEM/XREFANALYZER is not initiated, and the compiler's raw file is left on disk with the title "XREF/<code file name>", where <code file name> is the name of the object code file produced by the compiler; this file can be analyzed at a later time by running SYSTEM/XREFANALYZER directly.

If the compiler initiates SYSTEM/XREFANALYZER (that is, if the NOXREFLIST option is FALSE), the program produces either a printed listing or a pair of disk files suitable for the Editor and SYSTEM/INTERACTIVEXREF. If the XREF option is TRUE, a listing is produced. If the XREFFILES option is TRUE, the pair of disk files is produced; these files are titled XREFFILES/<code file name>/XREFS and XREFFILES/<code file name>/XDECS. If both the XREF option and the XREFFILES option are TRUE, both a listing and the disk files are produced.

The line width, in characters, of the listing produced by SYSTEM/XREFANALYZER can be specified by the <linewidth> construct. If not specified, the line width is 132.

User options are included in the cross-reference information.

### XREFFILES Option

— XREFFILES —————|

(Type: Boolean, Default value: FALSE)

When TRUE, the XREFFILES option causes cross-reference information to be saved by the compiler and causes the SYSTEM/XREFANALYZER program, if it is initiated by the compiler, to produce files that can be used by the Editor and SYSTEM/INTERACTIVEXREF. These files have the titles XREFFILES/<code file name>/XDECS and XREFFILES/<code file name>/XREFS, where <code file name> is the name of the object code file that the compiler is generating.

For more information on cross-referencing, refer to “XREF Option” earlier in this section.

### XREFS Option

— XREFS —————|

(Type: Boolean, Default value: TRUE if either the XREF option or the XREFFILES option is TRUE, FALSE otherwise)

When the compiler is saving cross-reference information because the XREF option or the XREFFILES option is TRUE, only identifier references that are encountered while the XREFS option is TRUE are included in the cross-reference information. This option is assigned TRUE when the XREF option or the XREFFILES option is assigned TRUE, and it can be assigned a value as many times as desired. If the XREFS option is assigned the value TRUE when both the XREF option and the XREFFILES option are FALSE, then the XREFS option is assigned FALSE and a syntax error is given.

For more information on cross-referencing, refer to “XREF Option” earlier in this section.

### \$ Option

— \$ —————|  
┌ LISTDOLLAR └

(Type: Boolean, Default value: FALSE)

If both the LIST option and the \$ option are TRUE, the printer listing includes all compiler control records. If the LIST option is true but the \$ option is FALSE, only compiler records with a double dollar sign (\$\$) appear in the printer listing. If the LIST option is FALSE, the value of the \$ option is ignored.

LISTDOLLAR is a synonym that can be used for the \$ option. The use of \$ causes the compiler to issue a warning because the \$ option will be deimplemented in a future release. The \$ option is no longer allowed in column 2.

# Section 7

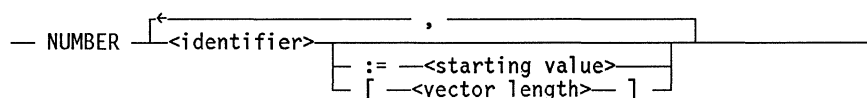
## Compile-Time Facility

The compile-time facility is used to conditionally and iteratively compile ALGOL source data. This section describes the declaration and use of compile-time variables, compile-time identifiers, compile-time statements, an extension to the DEFINE declaration, and compiler control options that pertain to the compile-time facility.

The compile-time facility is available in DCALGOL, BDMSALGOL, and DMALGOL.

### Compile-Time Variable

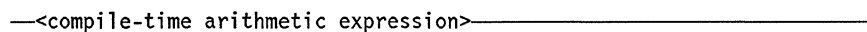
**<compile-time variable declaration>**



**<number identifier>**

An <identifier> that is associated with a compile-time variable in a compile-time variable declaration.

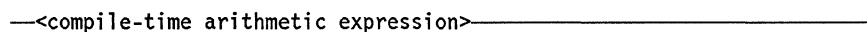
**<starting value>**



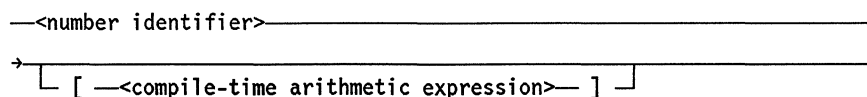
**<compile-time arithmetic expression>**

Any <arithmetic expression> that can be fully evaluated at compile time. A compile-time arithmetic expression consists of constants and <compile-time variable> s.

**<vector length>**



**<compile-time variable>**



An identifier declared in a compile-time variable declaration is a number variable, or an arithmetic compile-time variable. A compile-time variable represents a single-precision

## Compile-Time Facility

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arithmetic value. It can be used wherever an arithmetic value is allowed and represents the value most recently assigned to it. The value of a compile-time variable can be changed at any time during compilation by using the compile-time 'LET statement. A compile-time variable can be declared with a starting value; if a starting value is not explicitly declared, the starting value is zero.

If a compile-time variable is declared with a vector length, a vector, or array, of compile-time variables is created. When an identifier declared in this way is used, it must be subscripted by a compile-time arithmetic expression with a value in the range 0 through (vector length - 1). The value of the vector length must be in the range 1 to 1023.

## Compile-Time Identifier

<compile-time identifier>

—<identifier>— ' —<number identifier>—————|

A compile-time identifier can appear anywhere an identifier can be used, including declarations. No blank characters can appear between the identifier and the apostrophe ('). The created identifier consists of the identifier, followed by an apostrophe, followed by numeric characters corresponding to the value of the number identifier, with leading zeros suppressed.

## Compile-Time Statements

<compile-time statement>

—<compile-time begin statement>—————|  
|<compile-time define statement>|  
|<compile-time for statement>|  
|<compile-time if statement>|  
|<compile-time invoke statement>|  
|<compile-time let statement>|  
|<compile-time thru statement>|  
|<compile-time while statement>|

Compile-time statements begin with an apostrophe ('), which distinguishes them from other ALGOL constructs. They are recognized at a very primitive level in the compiler and can, therefore, appear almost anywhere (for example, between any two ALGOL language components).

The compile-time statements are intended to provide a method for altering the normal flow of compilation, primarily by conditional and iterative compilation.

Compile-time statements are terminated in the same manner as ALGOL statements.

Note that through the use of compile-time variables, a compile-time arithmetic or Boolean expression can be fully evaluated at compilation time and yet not have the same value each time it is evaluated.

## BEGIN Statement

**<compile-time begin statement>**

— 'BEGIN —<compile-time text>— 'END —<end remark>—————|

**<compile-time text>**

Any ALGOL source text, including any complete compile-time statement.

A 'BEGIN statement delimits a portion of ALGOL source text. It is normally used in conjunction with 'FOR statements, 'IF statements, and 'THRU statements. If the 'BEGIN statement is executed, the compiler processes all the delimited text; otherwise, the compiler skips (ignores) the text. Anything following the 'END up to the first special character, END, ELSE, 'END, 'ELSE, or UNTIL is considered to be an <end remark> and is ignored.

## DEFINE Statement

**<compile-time define statement>**

— 'DEFINE —<identifier>— = —<compile-time statement>—————|

**<compile-time define identifier>**

An <identifier> that is associated with a compile-time statement in a compile-time define statement.

The 'DEFINE statement declares an identifier to represent a compile-time statement.

The compile-time statement is processed when it is referenced by the identifier in a subsequent 'INVOKE statement.

## FOR Statement

**<compile-time for statement>**

— 'FOR —<number identifier>— := —————→  
 →<compile-time arithmetic expression>— STEP —————→  
 →<compile-time arithmetic expression>— UNTIL —————→  
 →<compile-time arithmetic expression>— DO —<compile-time statement>—|

The 'FOR statement provides iterative compilation of ALGOL source input. The value of the compile-time arithmetic expression following STEP can be positive or negative but must not be equal to zero.

The action of this statement is similar to that of the non-compile-time FOR statement. One exception is that the compile-time arithmetic expressions following STEP and

## Compile-Time Facility

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UNTIL are evaluated only once, at the beginning of the 'FOR statement, and are not reevaluated, even though their compile-time components can change value.

### IF Statement

**<compile-time if statement>**

```
— 'IF —<compile-time Boolean expression>— THEN —————→  
→<compile-time statement>└── 'ELSE —<compile-time statement>┘
```

**<compile-time Boolean expression>**

Any <Boolean expression> that can be fully evaluated at compilation time. A compile-time Boolean expression consists of constants and <compile-time variable> s.

The 'IF statement provides conditional compilation of ALGOL source input.

If the value of the compile-time Boolean expression is TRUE, then the compile-time statement following THEN is processed; if it is FALSE, the compile-time statement following 'ELSE is processed, if present. In either case, compilation continues with the statement following the 'IF statement.

### INVOKE Statement

**<compile-time invoke statement>**

```
— 'INVOKE —<compile-time define identifier>—————┘
```

The 'INVOKE statement causes the compile-time statement previously associated with the compile-time define identifier in a 'DEFINE statement to be processed.

### LET Statement

**<compile-time let statement>**

```
— 'LET —<compile-time variable>— := —————→  
→<compile-time arithmetic expression>—————┘
```

The 'LET statement is used to modify the value of a compile-time variable. If the compile-time variable was declared using the <vector length> construct, it must be subscripted by a compile-time arithmetic expression with a value in the range 0 to (vector length - 1).

## THRU Statement

<compile-time thru statement>

```

— 'THRU —<compile-time arithmetic expression>— DO —————>
→<compile-time statement>—————|
    
```

The 'THRU statement provides iterative compilation of ALGOL source input. The compile-time arithmetic expression must have a value greater than or equal to zero.

The compile-time statement following DO is processed < compile-time arithmetic expression > times. If this value is zero, the 'THRU statement is skipped.

## WHILE Statement

<compile-time while statement>

```

— 'WHILE —<compile-time Boolean expression>— DO —————>
→<compile-time statement>—————|
    
```

The 'WHILE statement provides iterative compilation of ALGOL source input. The compile-time Boolean expression is evaluated at the beginning of the statement. If it is TRUE, the compile-time statement is processed, the compile-time Boolean expression is evaluated again, and this sequence is repeated. Whenever the compile-time Boolean expression is FALSE, the 'WHILE statement is finished, and compilation continues with the following statement.

## Extension to the Define Declaration

The following extension to the DEFINE declaration is available when using the compile-time facility.

<definition>

```

—<identifier>—┌──────────────────┐┌ = ───┐<compile-time text>—>
                 └<formal symbol part>┘└ := ─┘
→ ; —————|
    
```

If a define identifier is declared using the assignment operator (:=), then any compile-time statements in the compile-time text are evaluated once at the time of, and in the scope of, the DEFINE declaration. Otherwise, the compile-time items in the compile-time text are evaluated on each invocation of the define identifier.

Compile-time text does not include the compile-time DEFINE statement, when used as the < definition > in a DEFINE declaration. A compile-time DEFINE statement cannot be embedded within an ordinary DEFINE declaration.



## Compile-Time Compiler Control Options

The following compiler control options are available only in the compile-time facility. For more information on compiler control options and the printer listing file of the compiler, see Section 6, “Compiling Programs.”

### CTLIST Option

— CTLIST \_\_\_\_\_|

(Type: Boolean, Default value: FALSE)

If both the LIST option and the CTLIST option are TRUE, all input records processed are written to the printer listing. In particular, during iterative compile-time statements, input records that are compiled repeatedly are listed repeatedly. These input records are identified by an asterisk (\*) just to the left of the sequence number. If the LIST option is TRUE but the CTLIST option is FALSE, input records are written to the printer listing only the first time they are compiled. The value of the CTLIST option is ignored if the LIST option is FALSE.

### CTMON Option

— CTMON \_\_\_\_\_|

(Type: Boolean, Default value: FALSE)

If both the LIST option and the CTMON option are TRUE, all assignments to compile-time variables are monitored and written to the printer listing. The current value of a compile-time variable when it is referenced and the new value when it is changed are listed. If the LIST option is TRUE and the CTMON option is FALSE, this monitor information does not appear in the printer listing. The value of the CTMON option is ignored if the LIST option is FALSE.

### CTTRACE Option

— CTRACE \_\_\_\_\_|

(Type: Boolean, Default value: FALSE)

If both the LIST option and the CTTRACE option are TRUE, values of certain expressions that are components of compile-time statements are written to the printer listing. If the LIST option is TRUE and the CTTRACE option is FALSE, this information does not appear in the printer listing. The value of the CTTRACE option is ignored if the LIST option is FALSE.

### LISTSKIP Option

— LISTSKIP \_\_\_\_\_|

(Type: Boolean, Default value: TRUE)

If both the LIST option and the LISTSKIP option are TRUE, all records are written to the printer listing whether or not they are skipped. Skipped records are denoted in the listing by the word SKIP to the right of the sequence number. If the LIST option is TRUE and the LISTSKIP option is FALSE, source records that are skipped by the compile-time facility are not written to the printer listing. The value of the LISTSKIP option is ignored if the LIST option is FALSE.



# Section 8

## Library Facility

The library facility is a feature that can be used to structure processes. A library is a program containing one or more library objects that can be accessed by other programs, which are referred to as calling programs. A library object is an object that is shared by a library and one or more user programs and is exported from the library using an export declaration. Exported procedures are called entry points into the library. Unlike a regular program, which is always entered at the beginning, a library can be entered at any entry point.

Libraries provide all the benefits of procedures plus the added advantages that they can be reused and shared by a number of programs. Consolidating logically related functions into a library can make programming easier and program structure more visible. A call on a procedure in a library is equivalent to a call on a procedure in the calling program.

Libraries offer the following improvements over binding:

- Interlanguage communication is significantly improved.
- Standard packages of functions, such as plotting and statistics, need not be copied into any calling programs.

Libraries offer the following improvements over installation intrinsics:

- A library can have its own global files, databases, transaction bases, and so on.
- Libraries can contain initialization and termination code.
- Libraries can themselves call other libraries.
- Individual users can create their own libraries without possessing special privileges.
- Libraries can be written in more languages than can the installation intrinsics.
- More than one version of a library can be in use at a time.

## Operating the Components of the Library Facility

The components of the library facility can be used to perform a variety of tasks. Following are descriptions of the library facility components and the features they offer.

### Library Programs

A library program specifies entry points (procedures) for use by calling programs. It makes use of EXPORT declarations and FREEZE statements. A procedure in a library is specified to be an entry point by appearing in an EXPORT declaration. A library program becomes a library after execution of a FREEZE statement.

### Calling Programs

A calling program calls entry points provided by a library. It uses LIBRARY declarations and PROCEDURE declarations that contain the <library entry point specification> construct.

A library can itself function as a calling program and can call other libraries. A library cannot reference itself, but circular references are allowed with the following restrictions:

- A circular linkage can be made only if all libraries are frozen and at least one of the libraries was frozen TEMPORARY or PERMANENT at the time it linked to its neighbor in the circle.
- A circular reference of indirectly provided objects is not allowed. An indirectly provided object is an object imported from another library and then exported.

### Library Directories and Templates

The directory and the template are data structures built by the compilers. They contain the information used by the operating system to match entry points in a library with entry points declared in a calling program.

When a program exports entry points and contains a FREEZE statement, the object code file for that program contains a library directory. One directory exists for each block that contains an EXPORT declaration. After a library freezes (executes a FREEZE statement), only one directory is in effect until the library program finishes executing.

A library directory contains a description of all the entry points in the library. This description includes the following information:

- The name of the entry point
- The type of the entry point
- A description of the entry point parameters
- Information on how the entry point is provided. For more information, see “Linkage Provisions” later in this section.

When a program declares a library and entry points in that library, the object code file for the program contains a library template that describes the library and the declared entry points. One template exists for each library declared in the calling program. A template contains the following information:

- A description of the attributes of the library
- A description of all the entry points of the library that are declared by the program. Each description includes the following information:
  - The name of the entry point
  - The type of the entry point

- A description of the entry point parameters

The SETACTUALNAME function can be used to change the name of an entry point in an unlinked library template. For more information, refer to “SETACTUALNAME Function” in Section 5, “Expressions and Functions.”

## Library Initiation

On the first call on an entry point of a library or at an explicit linkage request, the calling program is suspended. The description of the entry point in the library template of the calling program is compared to the description of the entry point with the same name in the library directory associated with the referenced library.

If the entry point does not exist in the library, or if the two entry point descriptions are not compatible, a run-time error is given and the calling program is terminated. If the entry point exists and the two entry point descriptions are compatible, the operating system automatically initiates the library program (if it has not already been initiated). The library program runs normally until it executes a FREEZE statement, which makes the entry points available. All of the entry points of the library that are declared in the calling program are linked to the calling program, and the calling program resumes execution.

If a calling program declares an entry point that does not exist in the library, no error is generated when the library is initiated; however, a subsequent call on that entry point causes a *MISSING ENTRY POINT* run-time error, and the calling program is terminated.

A library can be specified to be permanent or temporary. A permanent library remains available until it is terminated either by the Operator Display Terminal (ODT) commands DS (Discontinue) or THAW, or by execution of a CANCEL statement. A temporary library remains available as long as users of the library remain. A temporary library that is no longer in use unfreezes and resumes running as a regular program.

The PERMANENT or TEMPORARY specifications of the FREEZE statement control the duration of a library. Any running program that executes a FREEZE statement becomes a library. When a library is initiated by explicitly running the library program instead of by calling an entry point, the FREEZE statement should specify PERMANENT. If TEMPORARY is specified, the library immediately unfreezes because it has no users. After a library unfreezes, it must not execute another FREEZE statement in an attempt to become a library again.

The CONTROL specification of the FREEZE statement controls the nature of the freeze. The program is set up as a permanent library, but after the freeze operation has been performed, control is transferred to the specified procedure, known as the control procedure. The control procedure must be untyped and must have no parameters.

Once the control procedure is in control, the library can keep track of the number of its users through the task attribute LIBRARYUSERS. The library can unfreeze itself by changing the task attribute STATUS to VALUE(GOINGAWAY). After this change, the library is equivalent to a thawing library. When the control procedure is exited,

the library unfreezes if there are no users. If there are users, the library becomes an ordinary library, and a warning message is issued.

Because a library program initially runs as a regular program, the flow of execution can be such that the execution of a FREEZE statement is conditional and can occur anywhere in the program.

If a calling program causes a library program to be initiated and the library program terminates without executing a FREEZE statement (for example, because it was not actually a library program and, thus, had no FREEZE statement), the attempted linkage to the library entry points cannot be made, and the calling program is terminated.

Linkage to a library can be requested explicitly by using the LINKLIBRARY function. For more information, see “LINKLIBRARY Function” in Section 5, “Expressions and Functions.”

## Linkage Provisions

Entry points declared in a calling program are linked to corresponding entry points provided by a library in one of three ways:

- Directly
- Indirectly
- Dynamically

The library program specifies the form of linkage. Indirect and dynamic linkages allow linkage to be established to libraries other than the library specified by the calling program. The calling program can control the library invocation to which it is linked only by specifying the object code file title or the function name of the library or, for dynamic linkage, by specifying the LIBPARAMETER library attribute. Depending on the value of the LIBACCESS library attribute, the TITLE attribute or FUNCTIONNAME attribute is used to specify the object code file title of the library. For more information about library attributes, see “Library Attributes” later in this section.

Direct linkage occurs when the library program contains the procedure that is named in the EXPORT declaration of the library.

Indirect linkage occurs when the library program exports a procedure that is declared as an entry point of another library. The operating system then attempts to link the calling program to this second library, which can provide the entry point directly, indirectly, or dynamically.

Dynamic linkage allows a library program to determine at link time which library task the calling program will be linked to. The library program must provide a selection procedure that accepts the value of the LIBPARAMETER library attribute as a parameter. Based on the value of LIBPARAMETER, the selection procedure selects and initiates a library task. The selection procedure must also accept, as a second parameter, a procedure. This procedure, which is provided by the operating system to verify that the library task is valid and complete, must be called before the selection procedure is exited. The operating system calls the selection procedure at link time. For a more

detailed explanation and examples of libraries that provide dynamic linkage, see “Library Examples” later in this section.

The restrictions on the complexity of indirect and dynamic linkages are as follows:

- Eventually, a library must provide the entry point directly.
- The chain of referenced libraries must never become circular.

### Discontinuing Linkage

A program can delink from a library program by using either the CANCEL statement or the DELINKLIBRARY function.

The CANCEL statement causes the library program to unfreeze and resume running as a regular program. The CANCEL statement can be used only on PRIVATE and SHARED BY RUN UNIT libraries.

The DELINKLIBRARY function affects only the linkage between the program executing the DELINKLIBRARY function and the specified library. Any other programs linked to the specified library are not affected. For more information, see “DELINKLIBRARY Function” in Section 5, “Expressions and Functions.”

### Error Handling

Any fault caused and ignored by a procedure in a library that is invoked by a calling program is treated as a fault in the calling program. If ignored by the calling program, this fault causes the calling program to be terminated but has no effect on the status of the library.

If a library program faults or is otherwise terminated before executing a FREEZE statement, then all calling programs that are waiting to link to that library program are also terminated.

If a library is terminated while calling programs are linked to it, those calling programs are also terminated.

The first call on an entry point in a library causes library linkage to be made. In this phase, an attempt is made to locate and establish links to all entry points declared by the calling program. If an entry point declared in the calling program does not exist in the library, its linkage cannot be established, and any subsequent calls to that entry point result in a *MISSING ENTRY POINT* error. This error continues to occur whenever a calling program links to that instance of the library and calls that entry point. Thus, it is advisable to remove that instance of the library (by either a THAW or DS (Discontinue) ODT command) and initiate a correct version of the library. For more information, refer to the *A Series System Commands Operations Reference Manual* for a description of these commands.





## Referencing Libraries

To use a library, the calling program does the following:

- Declares the library in a `LIBRARY` declaration, specifying the attributes of the library
- Declares the entry points of the library in `PROCEDURE` declarations with library entry point specification parts

When an entry point is invoked or at an explicit linkage request, the operating system automatically creates the library linkage. If the library program has not already been initiated, the operating system initiates it; then, when the library is frozen, the operating system links the library to the calling program. The operating system attempts to make linkages to all entry points referenced in a library at the time that the library is first invoked.

The `LINKLIBRARY` function can be used to determine whether or not the calling program is currently linked to, or is capable of being linked to, a particular library program. If the calling program is not currently linked but is capable of being linked, the linkage is performed. During the linkage process, an attempt is made to link to every entry point exported from the library whose name matches an entry point declared in the calling program. Only those names that match are checked for correct function type, number of parameters, and parameter types. Therefore, the `LINKLIBRARY` function does not check that every entry point declared in the calling program is also exported from the library. For more information, see “`LINKLIBRARY` Function” in Section 5, “Expressions and Functions.”

The `CANCEL` statement and the `DELINKLIBRARY` function can be used to terminate the linkage between a calling program and a library. The `CANCEL` statement causes the library to unfreeze and resume running as a regular program regardless of whether it is temporary or permanent. Only `PRIVATE` libraries or `SHAREDBYRUNUNIT` libraries can be canceled. The `DELINKLIBRARY` function has no effect on any other users of the library. For more information, see “`DELINKLIBRARY` Function” in Section 5, “Expressions and Functions.”

The `SETACTUALNAME` function determines whether or not the name of a particular library entry point can be changed in the template to a particular character string and, if possible, makes the change. The name of an entry point of a linked library cannot be modified. Therefore, a linked library must be delinked before the `SETACTUALNAME` function can be called to change the name of any of its entry points. For more information, see “`SETACTUALNAME` Function” in Section 5, “Expressions and Functions.”

## Library Attributes

Libraries, like files, have attributes that can be assigned values and tested programmatically.

The calling program can change library attributes dynamically; however, since the operating system ignores any changes made to library attributes of linked libraries,

these changes must not be made while the program is linked to the library. Any library attribute changes must be made before the calling program has linked to the library or after the library has been delinked from the program.

The pointer-valued and string-valued attributes can be used both as string or pointer primary attributes and as string or pointer expressions. For example, the following attributes are available:

```
LIB.TITLE := <EBCDIC literal>;  
  
LIB.INTNAME := <string variable>;  
  
REPLACE POINTER BY LIB.TITLE;  
  
REPLACE LIB.TITLE BY <EBCDIC literal>;  
  
REPLACE LIB.INTNAME BY <string variable>;  
  
REPLACE LIB.FUNCTIONNAME BY <pointer> FOR <length>;
```

The following paragraphs describe the library attributes. The first line of each description tells whether the attribute can be read or written or both, and gives the type and the default value, if any.

### **FUNCTIONNAME**

(Read/Write, EBCDIC pointer-valued)

FUNCTIONNAME specifies the system function name used to find the target object code file for the library. For more information, refer to the LIBACCESS attribute in this section.

### **INTNAME**

(Read/Write, EBCDIC pointer-valued)

INTNAME specifies the internal identifier for the library.

### **LIBACCESS**

(Read/Write, mnemonic-valued, Default value: BYTITLE)

LIBACCESS specifies the way a library object code file is accessed when a library is called. LIBACCESS has one of the following mnemonic values:

- BYTITLE.  
The TITLE attribute of the library is used to locate the object code file.
- BYFUNCTION.

The value of the FUNCTIONNAME attribute of the library is used to access the operating system library function table, and the object code file associated with that FUNCTIONNAME is used.

- BYINITIATOR.

The object code file that initially caused the library to freeze is used. Note that BYINITIATOR causes a circular linkage between two libraries.

### LIBPARAMETER

(Read/Write, EBCDIC string-valued)

LIBPARAMETER is used to transmit information from the calling program to the selection procedures of libraries that provide entry points dynamically.

### TITLE

(Read/Write, EBCDIC pointer-valued)

TITLE specifies the object code file title of the library. For more information, refer to "LIBACCESS" earlier in this section.

### Example 1 of Library Attributes

The following program shows the use of the LIBACCESS, TITLE, and FUNCTIONNAME library attributes.

```
BEGIN
  % LIBRARY1, DECLARED BELOW, IS NOT A SUPPORT LIBRARY.  ITS LIBACCESS
  % ATTRIBUTE, SET TO BYTITLE, INDICATES THAT THE TITLE ATTRIBUTE
  % IS USED TO LOCATE THE LIBRARY'S CODE FILE.

  LIBRARY LIBRARY1(TITLE="OBJECT/LIBRARY1.",LIBACCESS=BYTITLE);
  REAL PROCEDURE PROC1;
    LIBRARY LIBRARY1;
  REAL PROCEDURE PROC2;
    LIBRARY LIBRARY1;
  REAL PROCEDURE PROC3;
    LIBRARY LIBRARY1;

  % THE LIBRARY DECLARED BELOW IS A SUPPORT LIBRARY.  ITS LIBACCESS
  % ATTRIBUTE, SET TO BYFUNCTION, INDICATES THAT THE FUNCTIONNAME
  % ATTRIBUTE OF THE LIBRARY IS LOOKED UP IN THE MCP LIBRARY FUNCTION
  % TABLE, AND THE CODE FILE ASSOCIATED WITH THE FUNCTIONNAME,
  % SYSTEMLIB, IS USED.

  LIBRARY LIBRARY2(FUNCTIONNAME="SYSTEMLIB.",LIBACCESS=BYFUNCTION);
  PROCEDURE SYSTEMLIBPROC;
    LIBRARY LIBRARY2;
  % EXECUTABLE STATEMENTS FOLLOW.
END.
```

### Example 2 of Library Attributes

Family substitution can occur when the library is linked by title. In this situation, it is desirable to link by function to an initialized library or to control the family substitution as shown in the following program sample.

```
% THE FOLLOWING SEQUENCE LINKS A LIBRARY TO A CODE FILE ON "DISK"  
% WHEN FAMILY SUBSTITUTION KEEPS THE LIBRARY FROM LINKING.  
  
REPLACE POINTER(SAVFAM[0],8) BY MYSELF.FAMILY;  
REPLACE MYSELF.FAMILY BY ".";  
LINKLIBRARY(LIB1);  
REPLACE MYSELF.FAMILY BY POINTER(SAVEFAM[0],8);
```

For information on the FAMILY attribute, see the *A Series Task Attributes Programming Reference Manual*.

## Entry Point Type Matching

Library entry points can be either typed or untyped, and they can have parameters. Type matching is performed on entry points during library linkage. If the description of an entry point in the template does not match the description of the entry point in the directory, the linkage is not made, and the calling program is terminated. Matching is based on several factors: the procedure type, the number of parameters, the parameter types, and the ways in which the parameters are passed. Parameters are passed as call-by-value, call-by-reference, or call-by-name.

An ALGOL library entry point can be any of the following:

- ASCII string procedure
- Boolean procedure
- Complex procedure
- Double procedure
- EBCDIC string procedure
- Hexadecimal string procedure
- Integer procedure
- Real procedure
- Untyped procedure

The parameters of an ALGOL library entry point can be any of the following:

- Boolean variable, array, or direct array
- Double variable, array, or direct array
- Real variable, array, or direct array
- Integer variable, array, or direct array

- Complex variable or array
- EBCDIC string variable or array
- ASCII string variable or array
- Hexadecimal string variable or array
- EBCDIC character array or direct array
- ASCII character array or direct array
- Hexadecimal character array or direct array
- Event variable or array
- Task variable or array
- File or direct file
- Pointer
- A fully-specified procedure (declared using FORMAL) with the above restrictions on its possible parameters and type

## Parameter Passing

If a library program declares a parameter to be call-by-name, the calling program can declare the parameter to be call-by-name, call-by-reference, or call-by-value. If a library program declares a parameter to be call-by-reference, the calling program can declare the parameter to be call-by-name, call-by-reference, or call-by-value. If a library program declares a parameter to be call-by-value, the calling program can declare the parameter only to be call-by-value.

Figure 8-1 illustrates the parameter passing rules.

Library Program	Calling Program		
	Name	Reference	Value
Name	X	X	X
Reference	X	X	X
Value			X

**Figure 8–1. Parameter Passing Rules**

In ALGOL programs, parameters are declared to be either call-by-value or call-by-name. In ALGOL library programs, parameters to entry points that are declared to be call-by-value are described in the directory as call-by-value; parameters declared to be call-by-name are described in the directory as call-by-reference, except for formal procedures and Boolean, complex, double, integer, and real variables, which are described in the directory as call-by-name.

## Library Facility

---

In ALGOL calling programs, parameters to entry points that are declared to be call-by-value are described in the template as call-by-value; parameters declared to be call-by-name are described in the template as call-by-reference, except for Boolean, complex, double, integer, and real variables, which are described in the template as call-by-name.

An array parameter in ALGOL that is declared with any of its lower bounds as an asterisk (\*) lower bound is described in the template or directory as  $N + 1$  parameters, where  $N$  is the number of dimensions of the formal array. The first parameter is the array itself, followed by the  $N$  lower bounds described as call-by-value integer variables.

## Library Examples

This section gives examples of libraries and calling programs that call these libraries.

### Library: OBJECT/FILEMANAGER/LIB

The following library program illustrates dynamic linkage. This library provides a set of file management routines. The users of this library assign the title of the file to be used to the LIBPARAMETER attribute. LIBPARAMETER is then used at link time to determine to which library task the user is to be linked.

```

    $ SHARING = PRIVATE

BEGIN
  TASK ARRAY LIBTASKS[0:10];      % PROVIDES UP TO 11 DIFFERENT LIBRARY
                                % TASKS
  STRING ARRAY FILETITLES[0:10]; % LIBPARAMETER FOR EACH OF THE TASKS

  PROCEDURE FILEMANAGER(TASKINDEX);
  VALUE TASKINDEX;
  INTEGER TASKINDEX;

      BEGIN
        PROCEDURE READFILE;
          BEGIN
            .
            .
            .
          END READFILE;
        PROCEDURE WRITEFILE;
          BEGIN
            .
            .
          END WRITEFILE;

        EXPORT READFILE,WRITEFILE;
        FREEZE(TEMPORARY);
        FILETITLES[TASKINDEX] := ".";
      
```

```
END FILEMANAGER;

PROCEDURE SELECTION(USERSFILE,MCPCHECK);
VALUE USERSFILE;
EBCDIC STRING USERSFILE;
PROCEDURE MCPCHECK(T); TASK T; FORMAL;

BEGIN
INTEGER TASKINDEX;
BOOLEAN FOUND;
% LOOK AT ALL THE FILETITLES, CHECKING TO SEE IF A LIBRARY TASK
% HAS ALREADY BEEN INITIATED FOR FILE TITLE USERSFILE.

WHILE NOT FOUND AND (TASKINDEX LEQ 10) DO
BEGIN
IF FILETITLES[TASKINDEX] = USERSFILE THEN
FOUND := TRUE
ELSE
TASKINDEX := *+1;
END;

IF NOT FOUND THEN
BEGIN
% A LIBRARY TASK DOES NOT EXIST FOR THIS FILE TITLE.
WHILE NOT FOUND DO % FIND AN UNUSED TASK
BEGIN
TASKINDEX := 0;
WHILE NOT FOUND AND (TASKINDEX LEQ 10) DO
IF LIBTASKS[TASKINDEX].STATUS LEQ 0 THEN
FOUND := TRUE
ELSE
TASKINDEX := *+1;
IF NOT FOUND THEN
% WAIT A SECOND AND MAYBE A LIBRARY TASK WILL GO TO EOT.
WAIT((1));
END;

PROCESS FILEMANAGER(TASKINDEX) [LIBTASKS[TASKINDEX]];
WHILE LIBTASKS[TASKINDEX].STATUS NEQ VALUE(FROZEN) DO
WAIT((1));
FILETITLES[TASKINDEX] := USERSFILE;
END;

MCPCHECK(LIBTASKS[TASKINDEX]);
END SELECTION;

PROCEDURE READFILE;
BY CALLING SELECTION;
PROCEDURE WRITEFILE;
BY CALLING SELECTION;

EXPORT READFILE,WRITEFILE;
```



## Library Facility

---

```
FREEZE (TEMPORARY);  
END.
```

At library linkage time, the procedure SELECTION is invoked. SELECTION accepts two parameters, USERSFILE and MCPCHECK.

USERSFILE is passed the value of the LIBPARAMETER attribute, which was assigned a value by the calling program. The SELECTION procedure checks to see if a library task has been initiated for the file specified by USERSFILE. If it has, then the calling program is linked to that task. If no library task exists for that file, then a new library task is initiated and the calling program is linked to it.

Only one call is made on the SELECTION procedure per linkage; that is, all links to entry points in this library are resolved during linkage. Therefore, any changes made to any library attributes after linkage is made are ignored. The attributes can be changed if the library is delinked.

MPCHECK is a procedure that is provided by the operating system and must be called before exiting the SELECTION procedure. The parameter to MCPCHECK is the task variable of the library task to which the calling program is to be linked. MCPCHECK verifies that the task is valid and complete. The actual library linkage is not performed until SELECTION has been exited.

### Calling Program #1

The following calling program invokes the dynamic library OBJECT/FILEMANAGER/LIB previously described. In this example, the user has set the LIBPARAMETER attribute to MYFILE, which is the name of the file to be accessed. At library linkage time, which occurs during the call on READFILE, the library procedure SELECTION is invoked. All links to the library's entry points are resolved during linkage. Changes to the library attributes are ignored after linkage is made. However, the program can delink from the library and change the library attributes before any relinking.

```

BEGIN
  LIBRARY L (TITLE="OBJECT/FILEMANAGER/LIB.");
  PROCEDURE READFILE;
    LIBRARY L;
  PROCEDURE WRITEFILE;
    LIBRARY L;

  L.LIBPARAMETER := "MYFILE";

  READFILE;                % LINKAGE IS MADE

  CANCEL(L);                % LINKAGE IS BROKEN

  L.LIBPARAMETER := "OTHERFILE"; % LIBPARAMETER CAN BE CHANGED
                                % BECAUSE THE LIBRARY HAS BEEN
                                % CANCELED.

  WRITEFILE;                % LINKAGE IS MADE AGAIN AND NEW
                                % VALUE OF LIBPARAMETER IS USED

END.

```

### Library: OBJECT/SAMPLE/LIBRARY

The following ALGOL library, compiled as OBJECT/SAMPLE/LIBRARY, provides its entry points directly.

```

BEGIN
  ARRAY MSG[0:120];

  INTEGER PROCEDURE FACT(N);
  INTEGER N;

  BEGIN
    IF N LSS 1 THEN
      FACT := 1
    ELSE
      FACT := N * FACT(N - 1);
    END; % OF FACT

  PROCEDURE DATEANDTIME(TOARRAY,WHERE);
  ARRAY TOARRAY[*];
  INTEGER WHERE;

  BEGIN
    REAL T;
    POINTER PTR;

    T := TIME(7);
    PTR := POINTER(TOARRAY,8) + WHERE;
    CASE T.[5:6] OF
      BEGIN

```

## Library Facility

---

```
Ø: REPLACE PTR:PTR BY "SUNDAY, ";
1: REPLACE PTR:PTR BY "MONDAY, ";
2: REPLACE PTR:PTR BY "TUESDAY, ";
3: REPLACE PTR:PTR BY "WEDNESDAY, ";
4: REPLACE PTR:PTR BY "THURSDAY, ";
5: REPLACE PTR:PTR BY "FRIDAY, ";
6: REPLACE PTR:PTR BY "SATURDAY, ";
END;
REPLACE PTR BY T.[35:6] FOR 2 DIGITS, "-",
          T.[29:6] FOR 2 DIGITS, "-",
          T.[47:12] FOR 4 DIGITS, ", ",
          T.[23:6] FOR 2 DIGITS, ":",
          T.[17:6] FOR 2 DIGITS, ":",
          T.[11:6] FOR 2 DIGITS;
END; % OF DATEANDTIME

EXPORT FACT,DATEANDTIME AS "DAYTIME";
REPLACE POINTER(MSG,8) BY
  " - SAMPLE LIBRARY STARTED",
  " " FOR 94;
DATEANDTIME(MSG,6Ø);
DISPLAY(MSG);
FREEZE(TEMPORARY);
REPLACE POINTER(MSG,8)+19 BY "ENDED ";
DATEANDTIME(MSG,6Ø);
DISPLAY(MSG);
END.
```

In this library program, two procedures are exported, making them entry points that can be called by calling programs. The two procedures, FACT and DATEANDTIME, are contained within the library program, so they are provided directly.

In the EXPORT declaration, the procedure DATEANDTIME is given the name DAYTIME in an AS clause. In the directory built for this library, the name of this entry point will be DAYTIME. Calling programs must use the name DAYTIME to call this entry point.

## Library: OBJECT/SAMPLE/DYNAMICLIB

The following ALGOL library, compiled as OBJECT/SAMPLE/DYNAMICLIB, illustrates dynamic and indirect library linkage. This library references the library OBJECT/SAMPLE/LIBRARY previously described.

```
BEGIN
  TASK LIB1TASK,LIB2TASK;
  LIBRARY SAMLIB(TITLE="OBJECT/SAMPLE/LIBRARY.");

  % ENTRY POINT PROVIDED INDIRECTLY
  INTEGER PROCEDURE FACT(N);
  INTEGER N;
  LIBRARY SAMLIB;
```

```
% POSSIBLY CALLED BY THE SELECTION PROCEDURE
PROCEDURE DYNLIB1;
  BEGIN % PRINTS DATE WITH TIME
    LIBRARY SAMLIB(TITLE="OBJECT/SAMPLE/LIBRARY.");
    % ENTRY POINT PROVIDED INDIRECTLY
    PROCEDURE DAYTIME(TOARRAY,WHERE);
    ARRAY TOARRAY[*];
    INTEGER WHERE;
      LIBRARY SAMLIB;

    EXPORT DAYTIME;
    FREEZE(TEMPORARY);
    END; % OF DYNLIB1

% POSSIBLY CALLED BY THE SELECTION PROCEDURE
PROCEDURE DYNLIB2;
  BEGIN % PRINTS DATE WITHOUT TIME.
    % ENTRY POINT PROVIDED DIRECTLY
    PROCEDURE DAYTIME(TOARRAY,WHERE);
    ARRAY TOARRAY[*];
    INTEGER WHERE;

    BEGIN
      REAL T;
      T := TIME(7);
      REPLACE POINTER(TOARRAY,8) + WHERE
        BY T.[35:6] FOR 2 DIGITS, "-",
          T.[29:6] FOR 2 DIGITS, "-",
          T.[47:12] FOR 4 DIGITS;
    END; % OF DAYTIME

    EXPORT DAYTIME;
    FREEZE(TEMPORARY);
    END; % OF DYNLIB2

% THE SELECTION PROCEDURE
PROCEDURE THESELECTIONPROC(LIBPARSTR,NAMINGPROC);
VALUE LIBPARSTR;
EBCDIC STRING LIBPARSTR;
PROCEDURE NAMINGPROC(LIBTASK); TASK LIBTASK; FORMAL;

BEGIN
  IF LIBPARSTR EQL "WITH TIME" THEN
    BEGIN
      IF LIB1TASK.STATUS NEQ VALUE(FROZEN) THEN
        PROCESS DYNLIB1 [LIB1TASK];
        NAMINGPROC(LIB1TASK);
        DISPLAY(" *** CALLING DYNLIB1 ");
      END
    ELSE
      BEGIN
        IF LIB2TASK.STATUS NEQ VALUE(FROZEN) THEN
```

## Library Facility

---

```
        PROCESS DYNLIB2 [LIB2TASK];
        NAMINGPROC(LIB2TASK);
        DISPLAY(" *** CALLING DYNLIB2 ");
        END;
    END; % OF THE SELECTION PROCEDURE

% ENTRY POINT PROVIDED DYNAMICALLY
PROCEDURE DAYTIME(TOARRAY,WHERE);
ARRAY TOARRAY[*];
INTEGER WHERE;
    BY CALLING THESELECTIONPROC;

EXPORT FACT, % PROVIDED INDIRECTLY
        DAYTIME; % PROVIDED DYNAMICALLY
FREEZE(TEMPORARY);
END.
```

## Calling Program #2

The following calling program invokes OBJECT/SAMPLE/DYNAMICLIB, the library described previously.

```
BEGIN
    LIBRARY MYLIB(TITLE="OBJECT/SAMPLE/DYNAMICLIB.");
    INTEGER PROCEDURE FAKTORIAL(N);
    INTEGER N;
        LIBRARY MYLIB(ACTUALNAME="FACT");

    PROCEDURE DAYTIME(A,W);
    ARRAY A[*];
    INTEGER W;
        LIBRARY MYLIB;

    REAL T;
    ARRAY DATIME[0:120];

    MYLIB.LIBPARAMETER := "WITH TIME";
    REPLACE POINTER(DATIME[0],8) BY
        " 13 FACTORIAL IS ",
        FAKTORIAL(13) FOR 12 DIGITS,
        " - ";
    DAYTIME(DATIME[*],40);
    DISPLAY(DATIME[0]);
END.
```

In this program, the declaration of the library entry point FAKTORIAL specifies that the ACTUALNAME of the entry point is FACT. In the template built for the library MYLIB, the name of this entry point is FACT, so for linkage to occur, the directory of the library OBJECT/SAMPLE/DYNAMICLIB must contain an entry point named FACT. However, within the program, the entry point is referred to as FAKTORIAL.

## Library: MCPSUPPORT

The following example provides a possible structure on which to build an ALGOL program using the `EVENT_STATUS` entry point of the MCPSUPPORT library.

The `EVENT_STATUS` function is exported from the operating system as an unprotected REAL function that, when given an event, returns the following information. All undefined bits are zero.

Bits	Meaning
[42:39]	Lock owner, if event is unavailable
[ 3: 2]	Event usage: 0 = Normal event 1 = Event reserved for use by operating system 2 = Interrupt attached to event 3 = Event reserved for use by operating system
[ 1: 1]	Event unavailable (procured)
[ 0: 1]	Event happened (caused)

Using the `EVENT_STATUS` function is the only safe means of finding the owner of an event. The value returned in the Lock Owner field is the same kind of value that is returned by the `PROCESSID` function. In fact, if the task that owns the lock referenced the `PROCESSID` function, the value returned would be the same as the value in the Lock Owner field. UNSAFE NEWP programs that manipulate events directly should be avoided since different systems use varying event formats.

```
BEGIN
  TASK TASKA, TASKB;
  REAL STACKA, STACKB, EVSTATUS;
  EVENT XYZ_LOCK;

  %THE FOLLOWING DECLARATIONS MAKE IT POSSIBLE TO USE THE EVENT_STATUS
  %FUNCTION IN AN ALGOL PROGRAM. NOTE THAT THE LIBACCESS ATTRIBUTE IS
  %EQUAL TO BYFUNCTION.

  LIBRARY MCPSUPPORT (LIBACCESS = BYFUNCTION);

  REAL PROCEDURE EVENT_STATUS (EV);
    EVENT EV;
    LIBRARY MCPSUPPORT;

  % THE FIELDS FOR EVENT_STATUS RESULT ARE:

  DEFINE ES_OWNERSTACKF = [18:15] ;;
         ES_EVENTUSAGEF = [3:2] ;;
         ES_UNAVAILABLEF = [1:1] ;;
         ES_HAPPENEDF = [0:1] ;;
  PROCEDURE A;
```

## Library Facility

---

```
BEGIN
  STACKA:= PROCESSID;

  PROCURE(XYZ_LOCK);

  LIBERATE(XYZ_LOCK);
END;

PROCEDURE B;
BEGIN
  STACKB:= PROCESSID;

  PROCURE(XYZ_LOCK);

  LIBERATE(XYZ_LOCK);
END;

PROCESS A [TASKA];
PROCESS B [TASKB];

EVSTATUS:= EVENT_STATUS(XYZ_LOCK);
IF EVSTATUS.ES_OWNERSTACKF = STACKA THEN
  BEGIN
    % XYZ_LOCK WAS OWNED BY TASKA AT THE TIME
    % THE EVENT_STATUS CALL WAS MADE.
  END
ELSE
  IF EVSTATUS.ES_OWNERSTACKF = STACKB THEN
    BEGIN
      % XYZ_LOCK WAS OWNED BY TASKB AT THE TIME
      % THE EVENT_STATUS CALL WAS MADE.
    END;

  WHILE (TASKA.STATUS > VALUE(TERMINATED))
    AND (TASKB.STATUS > VALUE(TERMINATED)) DO
    WAITANDRESET(MYSELF.EXCEPTIONEVENT);
  END.
```

# Section 9

## Internationalization

Internationalization refers to the Unisys software, firmware, and hardware features that enable you to develop and run application systems that can be customized to meet the needs of a specific language, culture, or business environment. The internationalization features provide support for several character sets, different international business and cultural conventions, extensions to data communications protocols, and the ability to use one or more natural languages concurrently.

This section describes the internationalization features you can use to customize an application for the language and conventions of a particular locality. Using these features to write or modify an application is termed *localization*. The MultiLingual System (MLS) environment enables you to localize your applications. Some of the localization methods included in the MLS environment include translating messages to another language, choosing a particular character set to be used for data processing, and defining date, time, number, and currency formats for a particular business application.

In addition to the information described in this section, refer to the *A Series MultiLingual System (MLS) Administration, Operations, and Programming Guide* for information. The *MLS Guide* provides definitions for, and detailed information about, the ccversions, character sets, languages, and conventions provided by Unisys. It also provides procedures for setting system values for the internationalization features.

The system requires a Mark 3.9 or later operating system to use many of the features in the MLS environment. Programs that use the internationalization features might not compile or run on earlier operating systems. All programs that ran on the previous release will continue to run. Refer to the *MLS Guide* for additional information about MLS environment installation requirements.

### Accessing the Internationalization Features

You can use the following two methods separately or together to localize your programs. Both of these methods are fully described later in this section.

- ALGOL provides language syntax that eases localization of your program. For example, picture clauses can be used to specify currency symbols.
- The system provides a system library, CENTRALSUPPORT, that contains procedures for localizing a program. The procedures can be accessed through calls. When a call occurs, input parameters describe the type of information that is needed or the action that is to be performed. Output parameters are returned with the result of the procedure call. For example, a program can call the procedure CNV\_FORMATTIME to format the time according to the language and convention specified in a program.



A program must designate that it uses internationalization features; otherwise, it will not access them. A program is not affected by the features described in this section unless a program specifically invokes them. Any programs that already exist and do not make use of internationalization features are not affected by the features.

### Using the Ccsversion, Language, and Convention Default Settings

The program can choose the specific ccsversion, language, and convention default settings that it needs by setting the input parameters. The system also has default settings for the internationalization features. The default settings can be accessed by the program. See “Understanding the Hierarchy for Default Settings” later in this section for information on the available levels and on the features supported at each level.

The current default settings for the system can be determined by using one of the following two methods:

- The program calls the CENTRALSTATUS procedure in the CENTRALSUPPORT library.
- A system administrator, a privileged user, or a user who is allowed to use the system console can use MARC menus and screens or the SYSTEMOPTIONS system command. Refer to the *MLS Guide* or the *A Series Menu-Assisted Resource Control (MARC) Operations Guide* for the instructions to display the default ccsversion, language, or convention with MARC.

The system default settings provided by Unisys are as follows:

Feature	Default
Ccsversion	ASeriesNative
Language	English
Convention	ASeriesNative

Before you can change the default settings for localization, you must consider the feature and the level at which the feature is defined. As an example, the ccsversion can be changed only at the system operations level. A program can avoid making specific settings by taking advantage of the default settings. For example, if the system-defined ccsversion is France, the language is Francais, and the convention is FranceListing, the program can use those default settings without coding the settings within the program. A program can use the default settings with the use of predefined values as input parameters. These parameters tell the procedure to use the current default setting. See “Input Parameters” later in this section for specific information on those parameters.

## Understanding the Hierarchy for Default Settings

The default settings for the internationalization features can be established at the following levels:

Task	Established at task initiation
Session	Handled by MARC or CANDE commands or by programs which support sessioning
Usercode	Established in the USERDATAFILE file
System	Established with a system or MARC command

There is a priority associated with these levels. A setting at the task level overrides a setting at the session level. A setting at the session level overrides a setting at the usercode level. A setting at the usercode level overrides a setting at the system level, and so on. A default language and convention can be established at any level, but the default ccsversion can be established only at the system level.

Two task attributes enable you to change the language, the convention, or both. These attributes are the LANGUAGE and the CONVENTION task attributes. By using these attributes, you have the option to select from among multiple languages and conventions when running a program. Information on the use of task attributes is provided in the *A Series Task Attributes Programming Reference Manual*.

The LANGUAGE task attribute establishes the language used by a program at run time. The CONVENTION task attribute establishes the convention used by a program at run time. For example, an international bank might have a program to print bank statements for customers in different countries. This program could have a general routine to format dates, times, currency, and numerics according to the selected conventions. To print a bank statement for a French customer, this program could set the CONVENTION task attribute to FranceBureautique and process the general routine. For a customer in Sweden, the program could set the CONVENTION task attribute to Sweden and process the general routine.

As you code your program you can use the defaults in both the source code and the calls to the CENTRALSUPPORT library, or you can use the settings of your choice. The task level and system level are probably the most useful levels for your program. Because the language and convention features have task attributes defined, you can access or set these task attributes in your program.

## Understanding the Components of the MLS Environment

The following four components of the MLS environment support different languages and cultures:

- Coded character sets
- Ccsversions
- Languages

- Conventions

The following paragraphs describe the function of each of these components.

### Coded Character Sets and Ccsversions

A coded character set is a set of rules that establishes a character set and the one-to-one relationship between the characters of the set and their code values. The same character set can exist with different encodings. For example, the LATIN1-based character set can be encoded in an International Organization for Standardization (ISO) format or an EBCDIC format. Coded character sets are defined in the *MLS Guide*. A coded character set name or number is given to each unique coded character set definition.

A coded character set name or number can also be used to set the INTMODE or EXTMODE file attribute values for a file. For more information on how to use the INTMODE and EXTMODE file attributes, see the *A Series File Attributes Programming Reference Manual*.

A ccsversion is a collection of information necessary to apply a coded character set in a given country, language, or line of business. This information includes the processing requirements such as data classes, lowercase-to-uppercase mapping, ordering of characters, and the presentation set and escapement rules necessary for output. A ccsversion name and number is given to each unique group of information. A ccsversion name or number can also be used to set the CCSVERSION file attribute for a file. For more information, refer to the *A Series File Attributes Programming Reference Manual*.

Each A Series system includes a data file, SYSTEM/CCSFILE, containing all coded character sets and ccsversions that are supported on the system. You cannot choose a coded character set directly, but by choosing a ccsversion, you implicitly designate the default coded character set for your system.

Data can be entered and manipulated in only one coded character set and ccsversion at a time. Although there are many ccsversions which can be accessed, there is only one ccsversion active for the entire system at one time. This is called the system default ccsversion. See “Using the Ccsversion, Language, and Convention Default Settings” and “Understanding the Hierarchy for Default Settings” earlier in this section.

Several ways exist to determine which coded character sets and ccsversions are available on your system.

- Look in the *MLS Guide*. Your system might have a subset of the ones defined in that guide.
- Use the MARC menus and screens or the system command SYSTEMOPTIONS. Refer to the *MLS Guide* or the *A Series System Commands Operations Reference Manual*.
- Call the CCSVSN\_NAMES\_NUMS procedure.

You might want to refer to the *MLS Guide* for a complete understanding of ccsversions and the relationship of a coded character set and a ccsversion.

All coded character set and ccsversion information on your system can be accessed by calling CENTRALSUPPORT library procedures. To call these CENTRALSUPPORT library procedures, an ALGOL program should first include a file provided by Unisys that declares all the library procedures. This file is called \*SYMBOL/INTL/ALGOL/PROPERTIES. The procedures can then be used in the program. The file also contains DEFINES for some input parameters and DEFINES for the results returned from the procedures. The method for including \*SYMBOL/INTL/ALGOL/PROPERTIES in your ALGOL program is shown in each of the CENTRALSUPPORT library procedures detailed later in this section. If the file is not included, any library procedure that is used must be declared individually in the program.

Many of the procedures require the specification of a coded character set or ccsversion as an input parameter. A program can choose a specific coded character set or ccsversion by calling the procedures using the name or number of the coded character set or the ccsversion as an input parameter. For example, by calling the VSNORDERING\_INFO procedure with the ccsversion name ASeriesNative, then calling the VSNORDERING\_INFO procedure again with the ccsversion name SWISS your program could access data in the ASeriesNative ccsversion and then access data in the SWISS ccsversion. A program can also use the system default setting by using predefined values as input parameters. See “Input Parameters” later in this section for specific information about those parameters.

## Mapping Tables

A mapping table is used to map one group of characters to another group of characters or another representation of the original characters. Many CENTRALSUPPORT library procedures store coded character set and ccsversion information in ALGOL translate tables as a way of defining, processing, and mapping data. For example, a translate table can exist to translate lowercase characters to uppercase characters.

The internationalization procedures provide you with access to translate tables that apply to data specified in coded character sets or specified ccsversions. These translate tables are as follows:

- Mapping data from one coded character set to another coded character set
- Mapping data from lowercase to uppercase characters
- Mapping data from uppercase to lowercase characters
- Mapping data from alternative numeric digits defined in a ccsversion to numeric digits defined in U.S. EBCDIC
- Mapping data from numeric digits in U.S. EBCDIC to alternative numeric digits defined in a ccsversion
- Mapping characters to their escapement values

You must use procedures from the CENTRALSUPPORT library to access these translate tables or to process data using these tables. For example, you use the CCSTOCCS\_TRANS\_TEXT procedure to translate data from one coded character set to another coded character set. You use the VSNTRANS\_TEXT procedure to map lowercase data to uppercase.

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See the *MLS Guide* for definitions of mapping tables for each coded character set and `ccsversion`.

### Data Classes

A data class is a group of characters sharing common attributes such as alphabetic, upon which membership tests can be made. A truth set is a method of storing the declared set of characters upon which membership tests can be made. Many CENTRALSUPPORT library procedures store `ccsversion` information in ALGOL truth set tables as a way to define `ccsversion` data classes.

The internationalization features provide you with access to truth sets that apply to a `ccsversion`. These truth sets are as follows:

- `Ccsversion alphabetic`
- `Ccsversion numeric`
- `Ccsversion graphics`
- `Ccsversion spaces`
- `Ccsversion lowercase`
- `Ccsversion uppercase`

The alphabetic truth set contains those characters that are considered to be alphabetic for a specified `ccsversion`. The numeric truth set contains those characters that are considered to be numbers for a specified `ccsversion`, and so on.

You can use procedures from the CENTRALSUPPORT library to access these truth sets or to process data using these truth sets. For example, if a program manipulates an employee identification number such as 555962364, it might then need to verify that the text is all numeric. The program can call the `VSNINSPECT_TEXT` CENTRALSUPPORT library procedure to compare the text to the numeric truth set. This procedure returns the information that the text is or is not all numeric.

Refer to the *MLS Guide* for definitions of `ccsversion`s and data classes.

### Text Comparisons

A text comparison can be required for sorting text, or for comparing relationships between two pieces of text.

The traditional method for handling text comparisons is based on a strict binary comparison of the character values. The binary method of comparison is not meaningful when used for sorting text if the binary ordering of the coded characters does not match the ordering sequence of the alphabet of the language. This situation is the case for most coded character sets.

Because the binary method is not sufficient for all usage requirements, Unisys supports the definitions of two other levels of ordering.

The first level is called Ordering. Each character gets an ordering sequence value (OSV). An OSV is an integer from 0 through 255, assigned to each code position in a character set. The OSV signifies a relative ordering value of a character. An OSV of 0 indicates that the character comes before a character with an OSV of 1. More than one character can be assigned the same OSV.

The second level is called Collating. Each character gets an OSV and a priority sequence value (PSV). A PSV is an integer from 1 to 15 that is assigned to each code position in a character set. The PSV is a relative priority value within each OSV. Each character with a unique OSV has a PSV of 1; however, if 2 characters have the same OSV, they will have different PSVs for additional differentiation.

In comparing two strings of data, a comparison which uses only 1 level, the Ordering level, is called an equivalent comparison. A comparison which utilizes both levels, Ordering and Collating, is called a logical comparison.

You can use the following three types of text comparisons by calling the procedures of the CENTRALSUPPORT library.

Order Type	Explanation
Binary	A comparison based on the hexadecimal code values of the characters
Equivalent	A comparison based on the ordering sequence values (OSVs) of the characters
Logical	A comparison based on the OSVs plus the priority sequence values (PSVs) of the characters

In addition to the three types of ordering, Unisys also supports the following two types of character substitution.

Substitution	Explanation
Many to One	A predetermined string of up to three characters can be ordered as if it were one character, assigning it a single OSV and PSV pair. Even if a character is part of a predetermined string of characters that are ordered as a single value, the character still has an OSV and a PSV pair assigned to it to allow for cases in which the character appears in other strings or individually. For example, in Spanish, the letter pair <i>ch</i> is ordered as if it were a single letter, different from either <i>c</i> or <i>h</i> , and ordering between <i>c</i> and <i>d</i> .
One to Many	A single character can generate a string of two or three OSV and PSV pairs. For example, the $\beta$ (the German sharp S) character is ordered as though it were <i>ss</i> .

For a description of how the characters in each ccversion are ordered and how text comparisons work, see the *MLS Guide*.

## Providing Support for Natural Languages

The natural language feature enables users of an application program to communicate with the computer system in their natural language. A natural language is a human language in contrast to a computer programming language.

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A program must be written in the subset of the standard EBCDIC character set defined by the ALGOL language. Only the contents of string literals, data items with variable character data, or comments can be in a character set other than that subset.

If a program interacts with a user, has a user interface with screens or forms, displays messages or accepts user input, then those aspects of the program should be in the natural language of the user. For example, French would be the natural language of a person from France. Refer to the *MLS Guide* for a list of user interfaces, including screens or forms, that can be localized. The following text explains how to develop an ALGOL application program which supports messages in the natural language of the user.

Although you can use many natural languages, one is defined as the default for the entire system. You can override this default and access texts in another language, as long as they have been translated and identified to the system.

### Creating Messages for an Application Program

In the MLS environment, the messages handled by your application program are grouped into the following categories:

Message Category	Explanation
Output message	A message that an application program displays to the user. Some examples of output messages are error messages and prompts for input. An output message is localized so that it can be displayed in the language of the user.
Input message	A message received by an interactive program either from a user or from another program in response to a prompt for input. The input message might be in a language that the program cannot recognize. In this case, the message must be translated so that it can be understood by the program.

If you develop input and output messages within an output message array, you make the localization process easier. When messages are in an output message array, a translator can use the MSGTRANS utility to localize the messages into one or more natural languages. The MSGTRANS utility finds all output message arrays in a program and presents them to a translator for translation. If messages are not in output message arrays, a translator searches the source file for each message and then translates the message.

An output message array contains output messages to be used by the MLS environment. See “OUTPUTMESSAGE ARRAY Declaration” in Section 3, “Declarations.”

### Creating Multilingual Messages for Translation

The following are guidelines for creating messages that can be multilingual:

- Put all output messages in output message arrays.
- Allow more space for translated messages. Because the English language is more compact than many other natural languages, a message in English generally becomes about 33 percent longer after it is translated into another language. For example, if a program can display an 80-character message, an English message should be only 60 characters long so that the translated message can expand by one-third and not exceed the maximum display size.
- Accept or display any messages in the application program using the `MLSACCEPT` statement or the `MLSDISPLAY` statement. For more information, see Section 4, “Statements.”
- Use complete sentences for messages because phrases are difficult to translate accurately.
- Do not use abbreviations because they also are difficult to translate.

### Providing Support for Business and Cultural Conventions

The business and cultural features enable users of an application program to display and receive data according to local conventions. A convention consists of formatting instructions for date, time, numeric, currency, and page size.

Unisys provides standard convention definitions for many formatting styles. For example, some of the conventions are Denmark, Italy, Turkey, and UnitedKingdom1. These convention definitions contain information to create formats for time, date, numbers, currency, and page size required by a particular locality.

Each A Series system includes a data file named `*SYSTEM/CONVENTIONS` that contains all the convention definitions supported on the system. Although you can use many conventions, only one default convention is defined as the default for the entire system. This convention is called the system default convention. You can override this default and you can access all the conventions by calling the `CENTRALSUPPORT` library procedures. To display the names of the conventions available on the host computer, use the `CNV_NAMES CENTRALSUPPORT` library procedure. The *MLS Guide* provides complete information on all of the conventions supplied by Unisys.

If none of the conventions provided by Unisys meet your needs, you can define a new convention. You must use a template to define a convention. A template is a group of predefined control characters that describe the components for date, time, numeric, or currency. For example, the data item `02251990` and the template `!0o!/!dd!/!yyyy!` produce the formatted date, `02/25/1990`. To use some of the `CENTRALSUPPORT` library procedures, you must understand how templates are defined. The *MLS Guide* describes how to define and use a template.

### Using the Date and Time Features

Date and time features are provided by the `ALGOL` programming language and by several `CENTRALSUPPORT` library procedures.



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The ALGOL programming language has date and time features for standard use. The TIME function provides system date and time with various formats, for example YYDDD, MMDDYY, or HHMMSS. For more information, see “TIME function” in Section 5, “Expressions and Functions.”

Date and time punctuation can be specified in the PICTURE clause through string literals. For example:

```
PICTURE PDATE(99"/"99"/"99),  
PICTURE PTIME(99":"99":"99),
```

For more information, see “PICTURE Declaration” in Section 3, “Declarations.”

The ALGOL date and time features do not use the convention features for internationalization. The ALGOL internationalization features are limited in internationalizing programs. The user can call the CENTRALSUPPORT library procedures to format date and time items. The following types of procedures are available to format the date and time:

Procedure Type	Description
Convention	You supply the convention name and the value for the date or time. The procedure returns the date or time value in the format used by the convention. All the conventions are described in the <i>MLS Guide</i> .
Template	You supply the following: the format that you want for the date or time in a template parameter; the value for the date or time. You must use predefined control characters to create the template. These control characters are described in the <i>MLS Guide</i> .
System	The system supplies the date and time. There is a procedure that formats the system date, the system time, or both according to a convention and a procedure that formats the system date, the system time, or both according to a template that you supply.

You can use the CNV\_SYSTEMDATETIME procedure to display the system date and time according to the convention and language you choose. If you designate the ASeriesNative convention and the ENGLISH language, the date and time can be displayed as follows:

```
9:25 AM Monday, July 4, 1988
```

If you designate the FranceListing convention and the French language, the same date and time can be displayed as follows:

```
9h25, lundi 4 juillet 1988
```

## Using the Numeric and Currency Features

Numeric and currency features are provided by the ALGOL programming language and by several CENTRALSUPPORT library procedures.

The ALGOL programming language has numeric and currency features for standard use. ALGOL also provides the introduction codes that can be used to specify the thousands separator, the decimal sign, and a single character currency symbol in the PICTURE clause. For example:

```
PICTURE PAMOUNT(C/ N, U#, FFFDZZ9I99)
```

declares “/” as the thousands separator, “.” as the decimal sign, and “#” as the currency symbol for PAMOUNT.

For more information, see “PICTURE Declaration” in Section 3, “Declarations.”

ALGOL provides a DECIMALPOINTISCOMMA option for messages in output message arrays. This enables the user to replace commas with periods and periods with commas in message parameters. For more information, see “OUTPUTMESSAGE ARRAY Declaration” in Section 3, “Declarations.”

In addition to using the features in ALGOL, you can call the CENTRALSUPPORT library procedures to inquire about numeric symbols or to format currency amounts. All numeric or currency symbols can be retrieved with a CENTRALSUPPORT library call. Monetary amounts in real number form can be formatted according to different conventions.

You can use the CNV\_CURRENCYEDIT procedure to format a monetary value according to the convention you choose. If you designate the Greece convention, the monetary amount 12345.67 is formatted as DR.12 345,67.

### Using the Page Size Formatting Features

The CNV\_FORMSIZE CENTRALSUPPORT procedure enables you to retrieve default lines-per-page and characters-per-line values for a specified convention.

For example, the Netherlands convention definition specifies 70 lines as the default page length and 82 characters as the default page width, while the Zimbabwe convention definition specifies 66 lines as the default page length and 132 characters as the default page width.

## Summary of CENTRALSUPPORT Library Procedures

The CENTRALSUPPORT library procedures are integer-valued functions. The procedures return values in the output parameters and the functional result. The results returned by each procedure can be checked using standard programming practices. The results are useful in deciding if an error has occurred. The error results and their meanings are presented in the description of each procedure and at the end of this section.

The CENTRALSUPPORT library procedures are called by application programs and system software. An application program can call the CENTRALSUPPORT library procedures to perform the following tasks:

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- Determine the default settings on the host computer.
- Identify and validate character sets and ccsversion.
- Obtain information about a coded character set or a ccsversion.
- Check data against ccsversion data classes.
- Translate data using ccsversion mapping tables.
- Compare data.
- Manipulate text.
- Translate characters using ccsversion escapement.
- Obtain information about the convention contents.
- Add, modify and delete conventions.
- Format date and time.
- Format monetary and numeric data.
- Obtain default characteristics for hardcopy output.

Table 9-1 lists the CENTRALSUPPORT library procedures according to the tasks the procedures perform and describes the purpose of each procedure.

**Table 9–1. Functional Grouping of CENTRALSUPPORT Library Procedures**

Procedure Name	Purpose
<b>Identifying the Available Coded Character Sets and Ccversions</b>	
CCSVSN_NAMES_NUMS	Returns the names and numbers of all coded character sets or all ccsversion available on the host computer. The names and numbers are listed in two arrays. These arrays are ordered so that the names in the names array correspond to the numbers in the numbers array.
CENTRALSTATUS	Obtains the values of the default settings for internationalization features on the host computer. This procedure returns the names of the default ccsversion, language, and convention. It also returns the number of the default ccsversion.
VALIDATE_NAME_RETURN_NUM	Verifies that a designated coded character set or ccsversion name is valid on the host computer. If the coded character set or ccsversion is valid, the procedure returns the corresponding number for the designated coded character set or ccsversion.
VALIDATE_NUM_RETURN_NAME	Verifies that the designated coded character set or ccsversion number is valid on the host computer. If the coded character set or ccsversion is valid, the procedure returns the name of the coded character set or ccsversion.

continued

Table 9–1. Functional Grouping of CENTRALSUPPORT Library Procedures (cont.)

Procedure Name	Purpose
<b>Obtaining Coded Character Set and Ccsversion Information</b>	
CCSINFO	Provides basic information about a designated coded character set, including the number of bits per character (8 or 16), the coding format (for example, ISO or EBCDIC), and the space character.
VSNINFO	Returns the following information for a designated ccsversion: <ul style="list-style-type: none"> <li>• The number of the base character set to which the ccsversion applies</li> <li>• The escapement information</li> <li>• The characters in the spaces data class for the ccsversion</li> <li>• The array sizes required by the other ccsversion elements</li> </ul>
<b>Mapping Data from One Coded Character Set to Another</b>	
CCSTOCCS_TRANS_TABLE	Returns a translation table used to translate data appearing in one designated character set to another designated character set. The result is a one-to-one mapping of the characters.
CCSTOCCS_TRANS_TABLE_ALT	Returns a coded character set to coded character set translate table. The procedure provides an alternative to CCSTOCCS_TRANS_TABLE.
CCSTOCCS_TRANS_TEXT	Translates data from one character set to another character set by using a translate table. Characters are translated using a one-to-one mapping between the two character sets.

continued

**Table 9–1. Functional Grouping of CENTRALSUPPORT Library Procedures (cont.)**

Procedure Name	Purpose
<b>Processing Data According to a Ccsversion</b>	
VSNINSPECT_TEXT	<p>Compares the input text to a designated ccsversion truth set to determine whether the characters in the text are in the truth set. This procedure can be used to determine if characters are in one of the following data classes:</p> <ul style="list-style-type: none"> <li>• Alphabetic</li> <li>• Lowercase</li> <li>• Numeric</li> <li>• Presentation</li> <li>• Spaces</li> <li>• Uppercase</li> </ul>
VSNTRANSTABLE	<p>Returns a translation table for a designated ccsversion. The type of translation table requested depends on the task to be performed.</p> <p>Translation tables can be requested to perform the following tasks:</p> <ul style="list-style-type: none"> <li>• Translate lowercase letters to uppercase letters.</li> <li>• Translate uppercase letters to lowercase letters.</li> <li>• Translate any digits 0 through 9 to any alternate digits (that is, one-to-one mapping of 0 through 9 to another representation for those digits).</li> <li>• Translate alternate digits to 0 through 9.</li> <li>• Translate characters to their character escapement direction value.</li> </ul>

continued

**Table 9–1. Functional Grouping of CENTRALSUPPORT Library Procedures (cont.)**

Procedure Name	Purpose
VSNTTRANS_TEXT	<p>Translates data using a designated ccsversion translate table. The type of table used determines the type of translation done. All translation is a one-to-one mapping of the characters.</p> <p>This procedure can be used to perform the following types of translations:</p> <ul style="list-style-type: none"> <li>• Lowercase to uppercase characters</li> <li>• Uppercase to lowercase characters</li> <li>• The digits 0 through 9 to alternate digits</li> <li>• Alternate digits to the digits 0 through 9</li> <li>• Characters to their character escapement direction value</li> </ul>
VSINTRUTHSET	<p>Returns a truth set for the designated ccsversion. The truth set contains the characters in a given data class for the ccsversion. Truth sets are available for the following data classes:</p> <ul style="list-style-type: none"> <li>• Alphabetic</li> <li>• Lowercase</li> <li>• Numeric</li> <li>• Presentation</li> <li>• Space</li> <li>• Uppercase</li> </ul>
<p><b>Comparing and Sorting Text</b></p>	
COMPARE_TEXT_USING_ORDER_INFO	<p>Compares two strings by using the ordering information returned by the VSNORDERING_INFO procedure. One of the following comparison methods can be chosen:</p> <ul style="list-style-type: none"> <li>• Equivalent comparison                     <p>This method is based on the ordering sequence values of the characters.</p> </li> <li>• Logical comparison                     <p>This method is based on the ordering sequence values and the priority sequence values of the characters.</p> </li> </ul>

continued

**Table 9–1. Functional Grouping of CENTRALSUPPORT Library Procedures (cont.)**

Procedure Name	Purpose
VSNCOMPARE_TEXT	<p>Compares two strings by using one of three comparison methods for a designated ccsversion. You can select one of the following comparison methods:</p> <ul style="list-style-type: none"> <li>• Binary comparison, which is based on the binary values of the characters</li> <li>• Equivalent comparison, which is based on the Ordering Sequence Values (OSVs) of the characters</li> <li>• Logical comparison, which is based on the OSVs and Priority Sequence Values (PSVs) of the characters</li> </ul>
VSNGETORDERINGFOR_ONE_TEXT	<p>Returns the ordering information for the input text. The ordering information determines how the input text is collated. It includes the ordering and priority sequence values of the characters and any substitution of characters to be made when the input text is sorted.</p> <p>One of the following types of ordering information can be chosen:</p> <ul style="list-style-type: none"> <li>• Equivalent ordering information, which comprises only the ordering sequence values</li> <li>• Logical ordering information, which comprises the ordering sequence values followed by the priority sequence values</li> </ul>
VSNORDERING_INFO	<p>Returns the ordering information for a designated ccsversion. The ordering information determines the way in which data is collated for the ccsversion. It includes the ordering and priority sequence values of the characters and any substitution of characters to be made when the designated ccsversion ordering is applied to a string of text.</p>
<b>Positioning Characters</b>	
VSNESCAPEMENT	<p>Rearranges the input text according to the escapement rules of the ccsversion.</p>
<b>Determining the Available Natural Languages</b>	
MCP_BOUND_LANGUAGES	<p>Returns the names of the languages that are currently bound to the MCP.</p>
<b>Accessing CENTRALSUPPORT Library Messages</b>	
GET_CS_MSG	<p>Returns the text of a CENTRALSUPPORT message associated with the designated error number.</p>

continued

Table 9–1. Functional Grouping of CENTRALSUPPORT Library Procedures (cont.)

Procedure Name	Purpose
<b>Identifying the Available Convention Definitions</b>	
CENTRALSTATUS	Obtains the values of the default settings for internationalization features on the host computer. This procedure returns the names of the default ccsversion, language, and convention. It also returns the number of the default ccsversion.
CNV_NAMES	Returns the names of the conventions available on the host computer.
CNV_VALIDATENAME	Indicates whether a designated convention name is currently defined on the host computer.
<b>Obtaining Information About Conventions</b>	
CNV_INFO	Returns a description of all the elements defined in a designated convention.
CNV_SYMBOLS	<p>Returns the numeric and monetary symbols defined for a designated convention. The symbols in the convention are</p> <ul style="list-style-type: none"> <li>● Numeric positive symbol</li> <li>● Numeric negative symbol</li> <li>● Numeric thousands separator symbol</li> <li>● Numeric decimal symbol</li> <li>● Numeric left enclosure symbol</li> <li>● Numeric right enclosure symbol</li> <li>● Numeric grouping specifications</li> <li>● International currency notation</li> <li>● Monetary positive symbol</li> <li>● Monetary negative symbol</li> <li>● Currency symbol</li> <li>● Monetary thousands separator symbol</li> <li>● Monetary decimal symbol</li> <li>● Monetary left enclosure symbol</li> <li>● Monetary right enclosure symbol</li> <li>● Monetary grouping specifications</li> </ul>

continued



**Table 9–1. Functional Grouping of CENTRALSUPPORT Library Procedures (cont.)**

Procedure Name	Purpose
<p>CNV_TEMPLATE</p>	<p>Returns the requested template for a designated convention. The template can be obtained for the following:</p> <ul style="list-style-type: none"> <li>• Long date format</li> <li>• Short date format</li> <li>• Numeric date format</li> <li>• Long time format</li> <li>• Numeric time format</li> <li>• Monetary format</li> <li>• Numeric format</li> </ul>
<p><b>Formatting Dates According to a Convention</b></p>	
<p>CNV_CONVERTDATE</p>	<p>Converts a formatted numeric date passed as a parameter to the procedure to the format YYYYMMDD. The numeric date must be formatted according to the numeric date format template defined in the designated convention.</p>
<p>CNV_DISPLAYMODEL</p>	<p>Returns either the date or time display model defined for a designated convention. The components for the model are translated to the designated language.</p>
<p>CNV_FORMATDATE</p>	<p>Formats a numeric date passed as a parameter to the procedure according to a designated convention and language. The date can be formatted using the long, short, or numeric date format defined in the convention.</p>
<p>CNV_FORMATDATETMP</p>	<p>Formats a numeric date passed as a parameter to the procedure according to a template and language passed as parameters of the procedure.</p>

continued

**Table 9–1. Functional Grouping of CENTRALSUPPORT Library Procedures (cont.)**

Procedure Name	Purpose
CNV_SYSTEMDATETIME	<p>Returns the system date and/or time formatted according to the designated convention and language. The following types of templates can be chosen:</p> <ul style="list-style-type: none"> <li>• Long date and long time</li> <li>• Long date and numeric time</li> <li>• Short date and long time</li> <li>• Short date and numeric time</li> <li>• Numeric date and long time</li> <li>• Numeric date and numeric time</li> <li>• Long date only</li> <li>• Short date only</li> <li>• Long time only</li> <li>• Numeric time only</li> </ul>
CNV_SYSTEMDATETIMETMP	<p>Returns the system date and/or time in the designated language, formatted according to a template passed as a parameter to this procedure.</p>

continued

**Table 9–1. Functional Grouping of CENTRALSUPPORT Library Procedures (cont.)**

Procedure Name	Purpose
<b>Formatting Times According to a Convention</b>	
CNV_CONVERTTIME	Converts a formatted numeric time passed as a parameter to the procedure to the format HHMMSS. The numeric time must be formatted according to the numeric time format template defined in the designated convention.
CNV_DISPLAYMODEL	Returns either the date or time display model defined for a designated convention. The components for the model are translated to the designated language.
CNV_FORMATTIME	Formats a time passed as a parameter to the procedure according to a designated convention and language. The time can be formatted using the long or numeric time format defined in the convention.
CNV_FORMATTIMETMP	Formats a time passed as a parameter to the procedure according to a template and language passed as parameters of the procedure.
CNV_SYSTEMDATETIME	Returns the system date and/or time formatted according to the designated convention and language. The following types of templates can be chosen: <ul style="list-style-type: none"> <li>• Long date and long time</li> <li>• Long date and numeric time</li> <li>• Short date and long time</li> <li>• Short date and numeric time</li> <li>• Numeric date and long time</li> <li>• Numeric date and numeric time</li> <li>• Long date only</li> <li>• Short date only</li> <li>• Long time only</li> <li>• Numeric time only</li> </ul>
CNV_SYSTEMDATETIMETMP	Returns the system date and/or time in the designated language, formatted according to a template passed as a parameter to this procedure.
<b>Formatting Numeric Data According to a Convention</b>	
CNV_CONVERTNUMERIC	Converts a string containing digits and numeric symbols to a real number.

continued

Table 9–1. Functional Grouping of CENTRALSUPPORT Library Procedures (cont.)

Procedure Name	Purpose
<b>Formatting Monetary Data According to a Convention</b>	
CNV_CONVERTCURRENCY	Converts a string containing digits and monetary symbols to a real number.
CNV_CURRENCYEDIT	Formats a monetary value passed as a parameter to the procedure according to the monetary formatting template defined in the designated convention.
CNV_CURRENCYEDITTMP	Formats a monetary value passed as a parameter to the procedure according to a template also passed as a parameter.
<b>Determining the Default Page Length and Width</b>	
CNV_FORMSIZE	Returns the default lines-per-page and characters-per-line values from a designated convention for formatting printer output.
<b>Adding, Modifying, and Deleting Conventions</b>	
CNV_ADD	Adds a new convention to the *SYSTEM/CONVENTIONS file. The new definition goes into effect immediately.
CNV_DELETE	Deletes an existing convention from the SYSTEM/CONVENTIONS file. The convention is deleted after the next halt/load. Only conventions that have been created by a user can be deleted. The standard conventions that Unisys provides cannot be deleted.
CNV_MODIFY	Modifies an existing convention in the *SYSTEM/CONVENTIONS file. The modified set becomes effective after the next halt/load. Only conventions that have been created by a user can be modified. The standard conventions that Unisys provides cannot be modified.

## Library Calls

The procedures in the CENTRALSUPPORT library can be accessed by using the following steps:

1. Use the INCLUDE compiler control option to include the file *\*SYMBOL/INTL/ALGOL/PROPERTIES* in a program. By using the INCLUDE option you can also include only portions of the file.
2. Call the procedure.

## Internationalization

---

An example of the call syntax necessary to invoke the CENTRALSUPPORT library is provided in the description of each procedure later in this section.

For general information about using library procedures, refer to Section 8, “Library Facility.”

For information about the INCLUDE compiler control option, refer to Section 6, “Compiling Programs.”

## Parameter Categories

The CENTRALSUPPORT library procedures return output parameters and procedure result values. The parameter types are further described on the following pages.

### Input Parameters

In many cases, the input parameter requires the program to supply the ccsversion name or number, the language name, or the convention name. This information can be obtained in the following ways:

- The *MLS Guide* describes all the possible ccsversions, languages, and conventions that Unisys provides. However, the system on which the program is running might have only a subset of these. There can also be customized conventions that are not listed in the *MLS Guide*. These can be identified by the next two options.
- A system administrator, a privileged user, or a person allowed to use the system console can use MARC menus and screens to list the options that exist on the system. The SYSTEMOPTIONS command can be used. For more information on the SYSTEMOPTIONS command, see the *A Series System Commands Operations Reference Manual*. The *MLS Guide* provides additional instructions needed to obtain this information.
- Procedures can be called in the CENTRALSUPPORT library that can return this information. If an application is being written to be used on another system, these library procedures can be used to verify that the ccsversion, language, or convention specified by the user is valid on that system.

For any procedure that accepts a ccsversion number as an input parameter, you can specify a -2 (or the constant value CCSVSNNOTSPECIFIEDV) as input to indicate that the system default value should be used. For any procedure that accepts a ccsversion name as an input parameter, you can specify all blanks or all zeros as inputs to indicate that the system default value should be used. For any procedure that accepts a language or convention name as an input parameter, you can specify all blanks or all zeros as inputs to indicate that the task attribute should be used. If the task attribute is not available, the CENTRALSUPPORT library searches down the hierarchy until a usable value is found.

### Input Parameters with Type Values

Many of the CENTRALSUPPORT procedures have a parameter that indicates the type of information to be applied or returned by the procedure. The values in these

parameters are referred to as type values. The values are common across all procedures of the library. The values used in the convention (CNV) procedures are common across all CNV procedures. The values used in the coded character set and ccsversion (VSN) procedures are common across all CCS and VSN procedures. The INCLUDE file contains DEFINES that map these constant integer type values to an identifier that can be used in your program.

For example, the TYP parameter is used in a number of procedures to indicate the type of date or time formatting to be used. The type value indicates the type of format to be used. For example, a value of 3 indicates the long time format. The DEFINE is CS\_LTIMEV.

### Output Parameters

These parameters contain the results of the procedure. For example, the DEST parameter of the CCSTOCCS\_TRANS\_TEXT procedure contains the translated text produced by the procedure. In the examples for each procedure described later in this section, not all output variables are printed. Representative output is shown.

### Result

All the library procedures return an integer that indicates whether an error occurred during the execution of the procedure. A returned value of CS\_DATAOKV (1) or CS\_FALSEV (1001) means that no error occurred. However, the CNV\_VALIDATENAME and VSNCOMPARE\_TEXT procedures are exceptions to this rule. For these procedures, the returned value can be 0 (zero), 1, or another value. A returned value of 0 means that no error occurred and the condition is FALSE. A returned value of 1 means that no error occurred and the condition is TRUE. Any other value means that an error occurred.

Each procedure lists the values that can be returned by that procedure. The meanings of these values are explained at the end of this section. These results can be used to call the GET\_CS\_MSG procedure and to display the error that occurred, or error routines can be coded to handle the possible errors.

Refer to “GET\_CS\_MSG” later in this section for more information about using that procedure.

The INCLUDE file contains DEFINES that map each integer result into a define identifier to be used by your program.

## Procedure Descriptions

The following pages describe the procedures in the CENTRALSUPPORT library that an ALGOL program can access.

The procedures are listed in alphabetical order. Each description includes a general overview of the procedure, an example showing how to call the procedure, and a description of the parameters used in the example.

## Internationalization

---

These procedures are found in the CENTRALSUPPORT library specification file \*SYMBOL/INTL/ALGOL/PROPERTIES, provided by Unisys. The file contains library name specifications, library subroutine specifications, library parameter specifications, library name declarations for type values, and error message values.

### CCSINFO

This procedure provides basic information about a designated coded character set, including the number of bits per character (8 or 16) and the coding format (for example, ASCII or EBCDIC).

This procedure can be used to determine the code format for a file that has its INTMODE set to a character set name. See the *MLS Guide* for a list of coded character sets available.

#### Example

This example calls the procedure CCSINFO to get information about the Latin1EBCDIC coded character set. The *MLS Guide* contains the information that the coded character set number for Latin1EBCDIC is 12. This number can also be retrieved by calling VALIDATE\_NAME\_RETURN\_NUM with the name Latin1EBCDIC.

BEGIN

```
$ INCLUDE INTL=" SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999
```

```
FILE OUT(KIND=DISK,UNITS=CHARACTERS,FILEUSE=IO,FILETYPE=0,NEWFILE,  
MAXRECSIZE=80,TITLE="OUT/ALGOL/CCSINFO.");
```

```
ARRAY CCS_ARY[0:4]  
      ,LINEOUT[0:14];
```

```
INTEGER CCS_NUM  
      ,RESULT;
```

```
CCS_NUM := 12; % Latin1EBCDIC CCS
```

```
RESULT := CCSINFO(CCS_NUM, CCS_ARY);
```

```
WRITE(OUT,<"RESULT = ",J4>,RESULT);
```

```
IF RESULT EQL CS_DATAOKV THEN
```

```
  BEGIN
```

```
    REPLACE LINEOUT BY " " FOR 80;
```

```
    WRITE(OUT,80,LINEOUT);
```

```
    WRITE(OUT,<"Field Meaning                Location      Value">);
```

```
    WRITE(OUT,<"-----                -----      -----">);
```

```
    WRITE(OUT,<"# of bits per character           [0]          ",J3>,  
          CCS_ARY[0]);
```

```
    WRITE(OUT,<"Repertoire Number                 [1]          ",J3>,  
          CCS_ARY[1]);
```

```
    WRITE(OUT,<"Encoding Number                   [2]          ",J3>,  
          CCS_ARY[2]);
```

```
    WRITE(OUT,<"Coding Format                       [3]          ",J3>,  
          CCS_ARY[3]);
```

```
    WRITE(OUT,<"Space Character (hexadecimal)     [4]          ",H12>,
```

```

        CCS_ARY[4]);
    END;
    CLOSE(OUT,LOCK);
END.

```

**Output**

RESULT = 1

Field Meaning	Location	Value
# of bits per character	[0]	8
Repertoire number	[1]	26
Encoding number	[2]	1
Coding format	[3]	3
Space character (hexadecimal)	[4]	404040404040

In this call, the parameters have the following meanings:

CCS\_NUM is an integer passed to the procedure. It contains the number of the coded character set about which information is requested. This coded character set number is the same as the values for INTMODE/EXTMODE of files.

CCS\_ARY is a real array returned by the procedure. It contains information about a coded character set from the character set and ccsversion file. The layout for return information in CCS\_ARY is as follows:

- word[0]            number of bits per character
- word[1]            repertoire number
- word[2]            encoding number
- word[3]            code format
  - ISO =            1
  - ASERIESEBCDIC = 2
  - STDEBCDIC       = 3
  - BTOS            = 4
  - PC               = 5
- word[4]            space character
- word[5]            extension facilities
- word[5].[47:02]    ISO extension facilities
  - % 0 means NONE
  - % 1 means UNISYS01
  - % 2 means non-UNISYS01

If word[5].[47:02] = 1 (UNISYS01) then



## Internationalization

---

word[5].[45:01]           % 0 means undefined G1 set  
                          % 1 means defined G1 set

If word[5].[45:01] = 1 (defined) then

word[5].[44:01]           % 0 means unregistered  
                          % 1 means registered

word[5].[43:04]           % reserved

word[5].[39:08]           % number of characters (94 or 96)  
                          in G1 set

If word[5].[44:01] = 1 (registered) then

word[5].[31:16]           % reserved

word[5].[15:16]           % number of characters in final byte:  
                          final byte starts at word 6

If word[5].[47:02] = 2 (non-UNISYS01) then

word[5].[45:30]           % reserved

word[5].[15:16]           % number of characters in the escape  
                          sequence: characters in the escape  
                          sequence begin at word 6

**Note:** *Extension facilities are the escape sequences in an ISO environment that are used to specify the code sets (such as C0, C1, G0, G1) from which ISO builds coded character sets. The escape sequences are defined in ISO standard 2022, titled Information Processing–ISO 7-Bit and 8-Bit Coded Character Sets – Code-extension Techniques.*

The recommended array size without escape sequences is 5 words. In all other cases, the recommended size is 30 words.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_DATAOKV (1)	CS_FAULTV (1001)
CS_FILE_ACCESS_ERRORV (1000)	CS_NO_NUM_FOUNDV (3003)
CS_SOFTERRV (1002)	

## CCSTOCCS\_TRANS\_TABLE

This procedure returns a translation table used to translate data appearing in one designated coded character set to another designated coded character set. The result is a one-to-one mapping of the characters.

When an application program performs a high volume of translations, this procedure can be used in combination with the TRANS\_TEXT\_USING\_TTABLE procedure instead of calling the CCSTOCCS\_TRANS\_TEXT procedure. The translation table from CCSTOCCS\_TRANS\_TABLE can be retained in working memory. The translation table is then passed as a parameter to TRANS\_TEXT\_USING\_TTABLE. Because the table is stored in working memory it does not have to be retrieved each time it is to be used.

### Example

This example reads input from a text file. The data in this input file is in an international coded character set, but that coded character set is unknown until the EXTMODE of the file is interrogated. The EXTMODE contains the coded character set number of the file. For this example, assume the data in the input file is encoded in Latin1EBCDIC, with a coded character set number of 12. The data is translated from the Latin1EBCDIC coded character set to the Latin1ISO coded character set and then displayed to the terminal (remote file). The *MLS Guide* can be used to determine that the coded character set number for Latin1ISO is 13. This number can also be retrieved by calling VALIDATE\_NAME\_RETURN\_NUM with the name Latin1ISO.

```
BEGIN

$ INCLUDE INTL="SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,FILEUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CCSTOCCS_T_TABLE.");
FILE INFILE(TITLE="ALGOL/CCSTOCCS_T_TABLE/INFILE.",FILEUSE=IN,
        DEPENDENTSPECS=TRUE);
ARRAY TTABLE_ARY[0:63]
        ,REC[0:14]
        ,TRANSREC[0:14];
INTEGER CCSNUMFROM
        ,CCSNUMTO
        ,RESULT;

OPEN(INFILE);
CCSNUMFROM := INFILE.EXTMODE; %capture the ccs number
CCSNUMTO := 13; %Latin1ISO
RESULT := CCSTOCCS_TRANS_TABLE(CCSNUMFROM, CCSNUMTO, TTABLE_ARY);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
    BEGIN
        WHILE NOT READ(INFILE, 15, REC) DO
            BEGIN
                REPLACE POINTER(TRANSREC) BY POINTER(REC) FOR 90 WITH
                    TTABLE_ARY[0];
```

```
        WRITE(OUT, 15, TRANSREC);
        END;
    END
ELSE
    WRITE(OUT, <"ERROR IN CREATING TRANSLATE TABLE">);
CLOSE(OUT, LOCK);
END.
```

### Output

RESULT = 1

In this call, the parameters have the following meanings:

CCSNUMFROM is an integer passed to the procedure. It contains the number of the coded character set that you are translating from.

CCSNUMTO is an integer passed to the procedure. It contains the number of the coded character set that you are translating to.

TTABLE\_ARY is a 64-word ALGOL translate table array in which the translate table is returned. For more information, see "TRANSLATE/TABLE Declaration" in Section 3, "Declarations."

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_DATA_NOT_FOUNDV (4002)	CS_DATAOKV (1)
CS_FAULTV (1001)	CS_FILE_ACCESS_ERRORV (1000)
CS_NO_NUM_FOUNDV (3003)	CS_SOFTERRV (1002)

## CCSTOCCS\_TRANS\_TABLE\_ALT

This procedure returns a coded character set to coded character set translate table. This procedure offers an alternative to the ALGOL translate table.

### Example

This example gets the Latin1EBCDIC coded character set to Latin1ISO coded character set translate table. The variable EXPAND is set to CS\_EXPAND\_HEXV. Therefore, an index into TTABLE\_ARY represents the hexadecimal code value of a source character, and the character at that index in the array is the destination character. The *MLS Guide* can be used to determine that the coded character set number for Latin1EBCDIC is 12 and the Latin1ISO is 13. These numbers can also be retrieved by calling VALIDATE\_NAME\_RETURN\_NUM with the coded character set names.

```

BEGIN

$ INCLUDE INTL="SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,FILEUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CCSTOCCS_T_TABLE/ALT.");
EBCDIC ARRAY TTABLE_ARY[0:255];
INTEGER CCSNUMFROM
        ,CCSNUMTO
        ,RESULT;

CCSNUMFROM := 12;
CCSNUMTO := 13;
RESULT := CCSTOCCS_TRANS_TABLE_ALT(CCSNUMFROM,CCSNUMTO,CS_EXPAND_HEXV,
        TTABLE_ARY);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
CLOSE(OUT,LOCK);
END.

```

**Output**

RESULT = 1

In this call, the parameters have the following meanings:

CCSNUMFROM is an integer passed to the procedure. It contains the number of the coded character that you are translating from.

CCSNUMTO is an integer passed to the procedure. It contains the number of the coded character set that you are translating to.

CS\_EXPAND\_HEXV is an integer that represents the value of the translate table form. It is one of two values:

Type Value	Value Name	Description
0	CS_EXPAND_HEXV	Do not expand
1	CS_EXPAND_HEXTOEBCDICV	Expand

TTABLE\_ARY is an EBCDIC array returned from the procedure. TTABLE\_ARY contains a translate table in one of two forms, depending on whether CS\_EXPAND\_HEXV or CS\_EXPAND\_HEXTOEBCDICV has been chosen. For either choice, the arrays are character oriented. If CS\_EXPAND\_HEXV is chosen, then the return array is 256 characters. The index into the array 0 through 255 represents the hex code of a source character, and the character at that index in the array is the destination character.

For example, in a standard EBCDIC to ASCII translate table, the 0 through 255 index represents the EBCDIC characters, while the ASCII codes are stored in the array at the proper index.

If `CS_EXPAND_HEXTOEBCDICV` is chosen, then the return array still represents 256 characters, but it is represented by 512 bytes. The destination characters are expanded from hex to their representation in EBCDIC.

For example, if 00, 01, 02 in the FROM set translates to 04, 6F, 83 in the TO set, then the first six array elements in the `TTABLE_ARY` will be F0F4 F6C6 F8F3.

The recommended array size is 256 characters if `CS_EXPAND_HEXV` is chosen. If `CS_EXPAND_HEXTOEBCDICV` is chosen, the recommended array size is 512.

`RESULT` is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

<code>CS_ARRAY_TOO_SMALLV (3001)</code>	<code>CS_BAD_ARRAY_DESCRIPTIONV (3000)</code>
<code>CS_BAD_DATA_LENv (3002)</code>	<code>CS_BAD_TYPE_CODEv (3006)</code>
<code>CS_DATA_NOT_FOUNDv (4002)</code>	<code>CS_DATAOKv (1)</code>
<code>CS_FAULTv (1001)</code>	<code>CS_FILE_ACCESS_ERRORv (1000)</code>
<code>CS_NO_NUM_FOUNDv (3003)</code>	<code>CS_SOFTERRv (1002)</code>

## CCSTOCCS\_TRANS\_TEXT

This procedure translates data specified in one coded character set to another coded character set by using a translation table. Characters are translated using a one-to-one mapping between two character sets.

For example, a program might translate text from the LATIN1EBCDIC coded character set to the LATIN1ISO coded character set. Refer to the *MLS Guide* for a list of the coded character set numbers that are available as inputs to this procedure.

Although there are many character set numbers, there is not a mapping table between every combination of coded character sets. The procedure returns an error indicating the data was not found if you pass two valid coded character set numbers for a table that does not exist. See the *MLS Guide* for the mapping tables available as input to this procedure.

### Example

This example takes a string encoded in the Latin1EBCDIC coded character set and translates it to the Latin1ISO coded character set. The *MLS Guide* can be used to determine that the coded character set number for Latin1EBCDIC is 12 and for Latin1ISO is 13. These numbers can also be retrieved by calling `VALIDATE_NAME_RETURN_NUM` with the coded character set names.

```
BEGIN
```

```
  $ INCLUDE INTL="SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999
```

```

DEFINE SOURCE_START = 0 #
      ,DEST_START = 0 #
      ,TRANS_LEN = SIZE(SOURCE) #;

FILE OUT(KIND=DISK,UNITS=CHARACTERS,FILEUSE=IO,FILETYPE=0,NEWFILE,
      MAXRECSIZE=80,TITLE="OUT/ALGOL/CCSTOCCS_T_TEXT.");
EBCDIC ARRAY SOURCE[0:6]
      ,DEST[0:6];
INTEGER CCSNUMFROM
      ,CCSNUMTO
      ,RESULT;

CCSNUMFROM := 12;                                %Latin1EBCDIC
CCSNUMTO := 13;                                  %Latin1ISO
REPLACE SOURCE[0] BY "pañuelo" FOR TRANS_LEN;

RESULT := CCSTOCCS_TRANS_TEXT(CCSNUMFROM, CCSNUMTO, SOURCE,
      SOURCE_START, DEST, DEST_START, TRANS_LEN);
WRITE(OUT, <"RESULT = ",J4>, RESULT);
IF RESULT EQL CS_DATAOKV THEN
      WRITE(OUT, <"DEST = ",A7>, DEST);
CLOSE(OUT,LOCK);
END.

```

**Output**

```

RESULT = 1
DEST = pañuelo

```

In this call, the parameters have the following meanings:

CCSNUMFROM is an integer passed to the procedure. It contains the number of the coded character set that you are translating from. The coded character sets and their numbers are described in the *MLS Guide*.

CCSNUMTO is an integer passed to the procedure. It contains the number of the coded character set that you are translating to. The coded character sets and their numbers are described in the *MLS Guide*.

SOURCE is an EBCDIC array containing the text to translate.

SOURCE\_START is an integer that specifies the offset (0 relative) where the translation starts.

DEST is an EBCDIC array in which the translated text is returned.

DEST\_START is an integer that specifies the offset (0 relative) where the output text is stored.

TRANS\_LEN is an integer that specifies the number of characters in SOURCE to translate, beginning at SOURCE\_START.

## Internationalization

---

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_DATA_NOT_FOUNDV (4002)	CS_DATAOKV (1)
CS_FAULTV (1001)	CS_FILE_ACCESS_ERRORV (1000)
CS_NO_NUM_FOUNDV (3003)	CS_SOFTERRV (1002)

## CCSVSN\_NAMES\_NUMS

This procedure returns a list of coded character set names and numbers or a list of ccsversion names and numbers that are available on the system. The user can specify the type of list as either a ccsversion or a coded character set. The names and numbers are listed in two arrays. These arrays are ordered so that the names in the names array correspond to the numbers in the numbers array.

This procedure might be used to create a menu that lists the ccsversions on the host computer from which a user can choose. It might also be used to verify that the ccsversion to be used by a program is available on the host computer.

### Example

This example returns a list of available ccsversion names and numbers on a system. This is an arbitrary list of three ccsversions and might not be the same on every system.

```
BEGIN

$ INCLUDE INTL="SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

DEFINE MAX_NAME_LEN = 17 #;

FILE OUT(KIND=DISK,UNITS=CHARACTERS,FILEUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CCSVSNAMESNUMS.");
EBCDIC ARRAY NAMES_ARY[0:(20*MAX_NAME_LEN) - 1]; %holds 20 names
INTEGER ARRAY NUMS_ARY[0:19]; %holds 20 numbers
ARRAY LINEOUT[0:14];
INTEGER TOTAL
        ,I
        ,RESULT;

RESULT := CCSVSN_NAMES_NUMS(CS_CCVERSIONV, TOTAL, NAMES_ARY,
        NUMS_ARY);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
BEGIN
REPLACE LINEOUT BY " " FOR 80;
WRITE(OUT, 80, LINEOUT);
```

```

WRITE(OUT, <"CCSVERSION NAME", T24,"CCSVERSION NUMBER">);
WRITE(OUT, <"-----", T24,"-----">);
FOR I := 0 STEP 1 UNTIL TOTAL-1 DO
    WRITE(OUT, <A17,T24,X8,J4>, NAMES_ARY[I*17], NUMS_ARY[I]);
END;
CLOSE(OUT,LOCK);
END.

```

**Output**

RESULT = 1

CCSVERSION NAME	CCSVERSION NUMBER
-----	-----
ASERIESNATIVE	0
SWISS	64
SWEDISH1	99

In this call, the parameters have the following meanings:

CS\_CCSVERSIONV represents an integer that requests the names and numbers of the ccsversions. This is one of two types of information that can be returned in the output parameters:

Value	Value Name	Meaning
0	CS_CHARACTERSETV	Return the names and numbers of the coded character sets
1	CS_CCSVERSIONV	Return the names and numbers of the ccsversions

TOTAL is an integer returned by the procedure that contains the number of coded character set or ccsversion entries that exist.

NAMES\_ARY is an EBCDIC array returned by the procedure. Each entry contains the name of a coded character set or ccsversion defined in the SYSTEM/CCSFILE. Each name takes 17 EBCDIC characters. The size of NAMES\_ARY should be 17 times the number of convention names you might have on the system. The *MLS Guide* names all the coded character sets and ccsversions.

NUMS\_ARY is an array of integers returned by the procedure that contains the coded character set or ccsversion numbers. NUMS\_ARY contains all the coded character set or ccsversion numbers defined in file SYSTEM/CCSFILE. Each element in NUMS\_ARY corresponds to an element in NAMES\_ARY. Each number uses one element of NUMS\_ARY. The *MLS Guide* gives all the numbers for the coded character sets and ccsversions.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS\_ARRAY\_TOO\_SMALLV (3001)                      CS\_BAD\_ARRAY\_DESCRIPTIONV (3000)

*continued*



*continued*

CS\_BAD\_TYPE\_CODEV (3006)

CS\_DATAOKV (1)

CS\_FAULTV (1001)

CS\_SOFTERRV (1002)

## CENTRALSTATUS

This procedure returns the name and number of the system default ccsversion, the name of the system default convention, and the name of the system default language.

This procedure might be used to provide a means for application users to inquire about the default settings on the host computer.

### Example

This example returns the current values for the system default ccsversion, language, and convention. These are arbitrary system values and might not be the same on every system.

BEGIN

```
$ INCLUDE INTL="SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,FILEUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CENTRALSTATUS.");
EBCDIC ARRAY SYS_INFO[0:50];
INTEGER ARRAY CONTROL_INFO[0:7];
ARRAY LINEOUT[0:14];
INTEGER RESULT;

RESULT := CENTRALSTATUS(SYS_INFO, CONTROL_INFO);
WRITE(OUT, <"RESULT = ", J4>, RESULT);
IF RESULT EQL CS_DATAOKV THEN
  BEGIN
    REPLACE LINEOUT BY " " FOR 80;
    WRITE(OUT, 80, LINEOUT);
    WRITE(OUT, <"SYSTEM DEFAULTS">);
    WRITE(OUT, <"-----">);
    WRITE(OUT, <"CCSVERSION:", T18, A17>, SYS_INFO[0]);
    WRITE(OUT, <"LANGUAGE:", T18, A17>, SYS_INFO[17]);
    WRITE(OUT, <"CONVENTION:", T18, A17>, SYS_INFO[34]);
    WRITE(OUT, 80, LINEOUT);
    WRITE(OUT, <"CONTROL ARRAY">);
    WRITE(OUT, <"FIELD MEANING", T40, "LOCATION", T52, "VALUE">);
    WRITE(OUT, <"-----", T40, "-----", T52, "-----">);
    WRITE(OUT, <"SYSTEM DEFAULT CCSVERSION NUMBER", T43, "[0]", T54, J4>,
          CONTROL_INFO[0]);
  END;
```

```

CLOSE(OUT,LOCK);
END.

```

**Output**

```

RESULT = 1

```

SYSTEM DEFAULTS

```

-----

```

```

CCSVERSION:    ASERIESNATIVE
LANGUAGE:      ENGLISH
CONVENTION:    ASERIESNATIVE

```

CONTROL ARRAY FIELD MEANING	LOCATION	VALUE
-----	-----	-----
SYSTEM DEFAULT CCSVERSION NUMBER	[0]	Ø

In this call, the parameters have the following meanings:

**SYS\_INFO** is an EBCDIC array returned by the procedure. It contains the system default ccsversion, language, and convention name in that order. Each name is 17 characters long. Names shorter than 17 characters are padded on the right with blanks. **SYS\_INFO** should 51 characters to hold 3 names of 17 characters each.

**CONTROL\_INFO** is an integer array returned by the procedure. It should be 8 words long. It contains the following information:

Location	Information
Word[0]	System default ccsversion number
Word[1] through [7]	Reserved

**RESULT** is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_DATAOKV (1)	CS_FAULTV (1001)
CS_SOFTERRV (1002)	

## CNV\_ADD

**CNV\_ADD** adds a new convention to the \*SYSTEM/CONVENTIONS file. The new definition is available immediately.

### Example

This example adds a new convention definition named Utopia to the SYSTEM/CONVENTIONS file.

```
BEGIN

$ INCLUDE INTL="SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,MYUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CNVADD.");
DEFINE MAX_NAME_LEN      = 17#;    % Maximum length of convention
                            % name

ARRAY ADD_ARY[0:62];
EBCDIC ARRAY CNV_NAME[0:MAX_NAME_LEN - 1];
INTEGER RESULT;

REPLACE CNV_NAME BY "UTOPIA";
ADD_ARY[0] := 12;                % Maximum digits
ADD_ARY[1] := 2;                  % # of fractional digits
ADD_ARY[2] := 2;                  % # of international frac digits
REPLACE POINTER(ADD_ARY[3]) BY "!UTA!";
REPLACE POINTER(ADD_ARY[5]) BY "!W!, !N! !D!, !Y!";
REPLACE POINTER(ADD_ARY[13]) BY "!1W!, !1N! !D!, !Y!";
REPLACE POINTER(ADD_ARY[21]) BY "!00!/!0D!/!Y!";
REPLACE POINTER(ADD_ARY[25]) BY "!0T!:!0M!:!0S!..!PPP!";
REPLACE POINTER(ADD_ARY[33]) BY "!0T!:!0M!:!0S!";
REPLACE POINTER(ADD_ARY[37]) BY "!C[$]N[-]T[, :0,3]D[.]#!";
REPLACE POINTER(ADD_ARY[45]) BY "!N[-]T[, :0,3]D[.]#!";
ADD_ARY[61] := 66;
ADD_ARY[62] := 132;
RESULT := CNV_ADD(CNV_NAME, ADD_ARY);
WRITE(OUT, <"RESULT = ", J4>, RESULT);
CLOSE(OUT, LOCK);

END.
```

### Output

```
RESULT = 1
```

In this call, the parameters have the following meanings:

**CNV\_NAME** is an EBCDIC array passed to the procedure. It contains the name of the convention to be added to the conventions file. If this parameter contains all blanks or zeros, the procedure uses the hierarchy to determine the convention to be used. Refer to the *MLS Guide* for the list of convention names and an explanation of the hierarchy.

**ADD\_ARY** is a real array passed to the procedure. It contains the convention definition to be added to conventions in memory and to the \*SYSTEM/CONVENTIONS file in use. For the procedure to work, all fields in **ADD\_ARY** must contain data, or an appropriate error result is returned. Data in **ADD\_ARY** is passed in fields as follows:

Field Meaning	Word
Maximum integer digits	0
Maximum decimal digits	1
Maximum international decimal digits	2
International currency notation	3
Long date template	5
Short date template	13
Numeric date template	21
Long time template	25
Numeric time template	33
Monetary template	37
Numeric template	45
Lines per page	61
Characters per line	62

The international currency notation field contains the international currency notation defined for the convention. The international currency notation is surrounded by a pair of matching delimiters that are not part of the notation. Any blanks inside the delimiters are significant and are treated as any other character. For example, the international currency notation for the ASERIESNATIVE convention is "USD "; the trailing blank is significant and the quotation marks are delimiters.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_BAD_ALT_FRAC_DIGITSV (3017)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_BAD_CPLV (3028)	CS_BAD_DATA_LENv (3002)
CS_BAD_FRACDIGITSV (3016)	CS_BAD_LDATETEMPV (3018)
CS_BAD_LPPV (3027)	CS_BAD_LTIMETEMPV (3021)
CS_BAD_MAXDIGITSV (3015)	CS_BAD_MONTEMPV (3023)
CS_BAD_NDATETEMPV (3020)	CS_BAD_NTIMETEMPV (3022)
CS_BAD_NUMTEMPV (3024)	CS_BAD_SDATETEMPV (3019)
CS_CNV_EXISTS_ERRV (3014)	CS_CNVFILE_NOTPRESENTV (3037)
CS_CONVENTION_NOT_FOUNDV (2002)	CS_DATAOKV (1)
CS_FAULTV (1001)	CS_FILE_ACCESS_ERRORV (1000)
CS_SOFTERRV (1002)	

### CNV\_CONVERTCURRENCY\_STAR

This procedure converts a string containing digits and monetary symbols to a real number.

#### Example

This example converts an EBCDIC string containing digits and monetary symbols to a real number. The ASERIESNATIVE ccsversion is used.

```
BEGIN

$ INCLUDE INTL="*SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,MYUSE=IO,FILETYPE=0,NEWFILE,
         MAXRECSIZE=80,TITLE="OUT/ALGOL/CNV_CONVERTCURSTAR.");
DEFINE MAX_NAME_LEN      = 17#;    % Maximum length of convention
                               % name
EBCDIC ARRAY CNV_NAME[0:MAX_NAME_LEN - 1], CC_ARY[0:9];
INTEGER VSN_NUM, CC_ARY_SIZE, CNV_NAME_SIZE, RESULT;
REAL AMT;

VSN_NUM := 0;
REPLACE CC_ARY BY "$12,345.67";
REPLACE CNV_NAME BY "ASERIESNATIVE";
CC_ARY_SIZE := SIZE(CC_ARY);
CNV_NAME_SIZE := SIZE(CNV_NAME);
RESULT := CNV_CONVERTCURRENCY_STAR(VSN_NUM, CC_ARY, CC_ARY_SIZE,
                                   CNV_NAME, CNV_NAME_SIZE, AMT);

WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
  WRITE(OUT,<"AMT    = ",F8.2>,AMT);
CLOSE(OUT,LOCK);
END.
```

#### Output

```
RESULT = 1
AMT     = 12345.67
```

In this call, the parameters have the following meanings:

VSN\_NUM is an integer passed to the procedure. It contains the number of the ccsversion that was in effect when the input string was created. If the input string contains alternate digits, then they will be translated to their corresponding 0-9 numbers. Refer to the *MLS Guide* for a list of the ccsversion numbers. The values allowed for VSN\_NUM and the meanings of the values are as follows:

Value	Meaning
Greater than or equal to 0	Use the specified ccsversion number.
-2	Use the system default ccsversion. If the system default ccsversion is not available, an error is returned.

CC\_ARY is an EBCDIC array that contains the input string of digits and monetary symbols.

CC\_ARY\_SIZE is an integer that contains the total number of bytes in CC\_ARY.

CNV\_NAME is an EBCDIC array that is passed to the procedure. It contains the name of the convention to be used to format the input string. If this parameter contains all blanks or zeros, the procedure uses the hierarchy to determine the convention to be used. Refer to the *MLS Guide* for the list of convention names and an explanation of the hierarchy.

CNV\_NAME\_SIZE is an integer that contains the total number of bytes in CNV\_NAME.

AMT is a real number that is returned by the procedure. It contains the converted real number.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_BAD_DATA_LENv (3002)	CS_BAD_INPUTVALV (3035)
CS_CONVENTION_NOT_FOUNDV (2002)	CS_DATA_NOT_FOUNDV (4002)
CS_DATAOKV (1)	CS_FAULTV (1001)
CS_FILE_ACCESS_ERRORV (1000)	CS_SOFTERRV (1002)

## CNV\_CONVERTDATE\_STAR

This procedure converts a formatted numeric date passed as a parameter to the procedure to the format YYYYMMDD. The numeric date must be formatted according to the numeric date format template defined in the designated convention set.

### Example

This example converts a date from ASERIESNATIVE numeric form to standard input form. The ASERIESNATIVE ccsversion is used.

```
BEGIN
    $ INCLUDE INTL="*SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999
```

```
FILE OUT(KIND=DISK,UNITS=CHARACTERS,MYUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CNVCONVERTDATSTAR.");
DEFINE MAX_NAME_LEN      = 17#;    % Maximum length of convention
                                % name
EBCDIC ARRAY CNV_NAME[0:MAX_NAME_LEN - 1], CD_ARY[0:9], DATE_ARY[0:7];
INTEGER VSN_NUM, CD_ARY_SIZE, CNV_NAME_SIZE, DATE_ARY_SIZE, RESULT;

VSN_NUM := 0;
REPLACE CD_ARY BY "09/15/1990";
REPLACE CNV_NAME BY "ASERIESNATIVE";
CD_ARY_SIZE := SIZE(CD_ARY);
CNV_NAME_SIZE := SIZE(CNV_NAME);
DATE_ARY_SIZE := SIZE(DATE_ARY);
RESULT := CNV_CONVERTDATE_STAR(VSN_NUM, CD_ARY, CD_ARY_SIZE,
                              CNV_NAME, CNV_NAME_SIZE,
                              DATE_ARY, DATE_ARY_SIZE);

WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
  WRITE(OUT,<"DATE_ARY = ",C8>,DATE_ARY);
CLOSE(OUT,LOCK);
END.
```

### Output

```
RESULT = 1
DATE_ARY = 19900915
```

In this call, the parameters have the following meanings:

VSN\_NUM is an integer passed to the procedure. It contains the ccsversion number that was in effect when date was formatted. If the input string contains alternate digits, then they will be translated to their corresponding 0-9 numbers. Refer to the *MLS Guide* for a list of the ccsversion numbers. The values allowed for VSN\_NUM and the meanings of the values are as follows:

Value	Meaning
Greater than or equal to 0	Use the specified ccsversion number.
-2	Use the system default ccsversion. If the system default ccsversion is not available, an error is returned.

CD\_ARY is an EBCDIC array passed to the procedure. It contains the formatted date.

CD\_ARY\_SIZE is an integer that contains the total number of bytes in CD\_ARY.

CNV\_NAME is an EBCDIC array passed to the procedure. It contains the name of the convention from which the date formatting templates are retrieved.

CNV\_NAME\_SIZE is an integer that contains the total number of bytes in CNV\_NAME.

DATE\_ARY is an EBCDIC array returned by the procedure. It contains the converted date in the form YYYYMMDD.

DATE\_ARY\_SIZE is an integer that contains the total number of bytes in DATE\_ARY.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_BAD_DATA_LENv (3002)	CS_BADDATEINPUTV (3012)
CS_BAD_TEMPCHARV (3011)	CS_BAD_TYPE_CODEV (3006)
CS_CONVENTION_NOT_FOUNDV (2002)	CS_DATA_NOT_FOUNDV (4002)
CS_DATAOKV (1)	CS_FAULTV (1001)
CS_FILE_ACCESS_ERRORV (1000)	CS_SOFTERRV (1002)

## CNV\_CONVERTNUMERIC\_STAR

This procedure converts a string containing digits and numeric symbols to a real number.

### Example

This example converts an EBCDIC string containing digits and numeric symbols to a real number. The ASERIESNATIVE ccsversion is used.

```
BEGIN

$ INCLUDE INTL="*SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,MYUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CNV_CONVERTNUMSTAR.");
DEFINE MAX_NAME_LEN      = 17#;    % Maximum length of convention
                                % name
EBCDIC ARRAY CNV_NAME[0:MAX_NAME_LEN - 1], CC_ARY[0:9];
INTEGER VSN_NUM, CC_ARY_SIZE, CNV_NAME_SIZE, RESULT;
REAL AMT;

VSN_NUM := 0;
REPLACE CC_ARY BY "12,345.67";
REPLACE CNV_NAME BY "ASERIESNATIVE";
CC_ARY_SIZE := SIZE(CC_ARY);
CNV_NAME_SIZE := SIZE(CNV_NAME);
RESULT := CNV_CONVERTNUMERIC_STAR(VSN_NUM, CC_ARY, CC_ARY_SIZE,
                                CNV_NAME, CNV_NAME_SIZE, AMT);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
    WRITE(OUT,<"AMT      = ",F8.2>,AMT);
CLOSE(OUT,LOCK);
END.
```



### Output

RESULT = 1  
AMT = 12345.67

In this call, the parameters have the following meanings:

VSN\_NUM is an integer that is passed to the procedure. It contains the number of the ccsversion that was in effect when the input string was created. If the input string contains alternate digits, then they will be translated to their corresponding 0-9 numbers. Refer to the *MLS Guide* for a list of the ccsversion numbers. The values allowed for VSN\_NUM and the meanings of the values are as follows:

Value	Meaning
Greater than or equal to 0	Use the specified ccsversion number.
-2	Use the system default ccsversion. If the system default ccsversion is not available, an error is returned.

CC\_ARY is an EBCDIC array that is passed to the procedure. It contains the string of digits and numeric symbols to be converted.

CC\_ARY\_SIZE is an integer that contains the total number of bytes in CC\_ARY.

CNV\_NAME is an EBCDIC array that is passed to the procedure. It contains the name of the convention to be used to format the input string.

CNV\_NAME\_SIZE is an integer that contains the total number of bytes in CNV\_NAME.

AMT is a result returned by the procedure. It contains the converted real number.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_BAD_DATA_LENv (3002)	CS_BAD_INPUTVALV (3035)
CS_CONVENTION_NOT_FOUNDV (2002)	CS_DATA_NOT_FOUNDV (4002)
CS_DATAOKV (1)	CS_FAULTV (1001)
CS_FILE_ACCESS_ERRORV (1000)	CS_SOFTERRV (1002)

## CNV\_CONVERTTIME\_STAR

This procedure converts a formatted numeric time passed as a parameter to the procedure to the format HHMMSS. The numeric time must be formatted according to the numeric time format template defined in the designated convention.

**Example**

This example converts a time from ASERIESNATIVE numeric form to standard input form. The ASERIESNATIVE ccsversion is used.

```
BEGIN
$ INCLUDE INTL="*SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,MYUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CNVCONVERTTIMSTAR.");
DEFINE MAX_NAME_LEN      = 17#;    % Maximum length of convention
                                % name
EBCDIC ARRAY CNV_NAME[0:MAX_NAME_LEN - 1], CT_ARY[0:7], TIME_ARY[0:5];
INTEGER VSN_NUM, CT_ARY_SIZE, CNV_NAME_SIZE, TIME_ARY_SIZE, RESULT;

VSN_NUM := 0;
REPLACE CT_ARY BY "11:49:58";
REPLACE CNV_NAME BY "ASERIESNATIVE";
CT_ARY_SIZE := SIZE(CT_ARY);
CNV_NAME_SIZE := SIZE(CNV_NAME);
TIME_ARY_SIZE := SIZE(TIME_ARY);
RESULT := CNV_CONVERTTIME_STAR(VSN_NUM, CT_ARY, CT_ARY_SIZE,
                                CNV_NAME, CNV_NAME_SIZE,
                                TIME_ARY, TIME_ARY_SIZE);

WRITE(OUT,<"RESULT  = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
    WRITE(OUT,<"TIME_ARY = ",C6>,TIME_ARY);
CLOSE(OUT,LOCK);
END.
```

**Output**

```
RESULT  = 1
TIME_ARY = 114958
```

In this call, the parameters have the following meanings:

VSN\_NUM is an integer passed to the procedure. It contains the ccsversion number that was in effect when the time was formatted. If the input string contains alternate digits, then they will be translated to their corresponding 0-9 numbers. Refer to the *MLS Guide* for a list of the ccsversion numbers. The values allowed for VSN\_NUM and the meanings of the values are as follows:

Value	Meaning
Greater than or equal to 0	Use the specified ccsversion number.
-2	Use the system default ccsversion. If the system default ccsversion is not available, an error is returned.

CT\_ARY is an EBCDIC array passed to the procedure. It contains the formatted time.

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---

CT\_ARY\_SIZE is an integer that contains the total number of bytes in CT\_ARY.

CNV\_NAME is an EBCDIC array passed to the procedure. It contains the name of the convention that was used to format the input time. If this parameter contains all blanks or zeros, the procedure uses the hierarchy to determine the convention to be used. Refer to the *MLS Guide* for the list of convention names and an explanation of the hierarchy.

CNV\_NAME\_SIZE is an integer that contains the total number of bytes in CNV\_NAME.

TIME\_ARY is an EBCDIC array returned by the procedure. It contains the converted time in the form HHMMSS.

TIME\_ARY\_SIZE is an integer that contains the total number of bytes in TIME\_ARY.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_BAD_DATA_LENv (3002)	CS_BADTIMEINPUTV (3013)
CS_CONVENTION_NOT_FOUNDV (2002)	CS_DATA_NOT_FOUNDV (4002)
CS_DATAOKV (1)	CS_FAULTV (1001)
CS_FILE_ACCESS_ERRORV (1000)	CS_SOFTERRV (1002)

## CNV\_CURRENCYEDIT

This procedure converts a real number that represents a currency value to a formatted monetary string. The string contains the currency value with formatting symbols included. The formatting performed by the procedure is done according to the convention specified. The *MLS Guide* describes all the conventions and the type of currency formatting associated with each convention.

The procedure might be used to print a report with the numeric and currency formats for the Costa Rican convention (e.g. CRC 89.99) or for the Norway convention (e.g. NKR 89.99).

### Example

The following example converts a real number and edits monetary symbols from convention Denmark into an EBCDIC string.

```
BEGIN
$ INCLUDE INTL="*SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999
FILE OUT(KIND=DISK,UNITS=CHARACTERS,MYUSE=IO,FILETYPE=0,NEWFILE,
MAXRECSIZE=80,TITLE="OUT/ALGOL/CNVCUREDIT.");
```

```

DEFINE MAX_NAME_LEN      = 17#;    % Maximum length of convention
                                % name
EBCDIC ARRAY CNV_NAME[0:MAX_NAME_LEN - 1], CE_ARY[0:29];
INTEGER CE_LEN, RESULT;
REAL AMT;

AMT := 12345.67;
REPLACE CNV_NAME BY "DENMARK";
RESULT := CNV_CURRENCYEDIT(AMT, CNV_NAME, CE_LEN, CE_ARY);
WRITE(OUT, <"RESULT = ", J4>, RESULT);
IF RESULT EQL CS_DATAOKV THEN
    WRITE(OUT, <"CE_ARY = ", C30>, CE_ARY);
CLOSE(OUT, LOCK);
END.

```

**Output**

```

RESULT = 1
CE_ARY = Kr.12.345,67

```

In this call, the parameters have the following meanings:

AMT is a real number passed to the procedure. It contains the value of the currency.

CNV\_NAME is an EBCDIC array passed to the procedure. It contains the name of the convention to be used to format the currency value. If this parameter contains all blanks or zeros, the procedure uses the hierarchy to determine the convention to be used. Refer to the *MLS Guide* for the list of convention names and an explanation of the hierarchy.

CE\_LEN is an integer returned by the procedure. It contains the number of characters in CE\_ARY.

CE\_ARY is an EBCDIC array returned by the procedure. It contains the formatted value.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_BAD_ARRAY_DESCRIPTIONV (3000)	CS_BAD_DATA_LEN (3002)
CS_CONVENTION_NOT_FOUNDV (2002)	CS_DATAOKV (1)
CS_FAULTV (1001)	CS_SOFTERRV (1002)

## CNV\_CURRENCYEDITTMP

This procedure receives a real number and formats it to represent a currency value according to the template specified in the TEMP\_ARY parameter. The template can be retrieved for any convention from the CNV\_TEMPLATE procedure. It can also be

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created by the user. CE\_ARY contains the formatted currency value. The *MLS Guide* describes the symbols used to create a template.

### Example

This example converts a real number and edits in numeric symbols which are passed in as a monetary template. The currency symbol is retrieved from the monetary template in the ASERIESNATIVE convention and edited into the EBCDIC string.

```
BEGIN

$ INCLUDE INTL="*SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,MYUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CNVCUREDITTMP.");
DEFINE MAX_NAME_LEN      = 17#;      % Maximum length of convention
                                % name
EBCDIC ARRAY CNV_NAME[0:MAX_NAME_LEN - 1], CE_ARY[0:29],
            TMP_ARY[0:47];
INTEGER CE_LEN, RESULT;
REAL AMT;

AMT := 12345.67;
REPLACE CNV_NAME BY "ASERIESNATIVE";
REPLACE TMP_ARY BY "!CN[-]T[,;0,3]D[.]#!";
RESULT := CNV_CURRENCYEDITTMP(AMT, TMP_ARY, CNV_NAME, CE_LEN, CE_ARY);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
    WRITE(OUT,<"CE_ARY = ",C30>,CE_ARY);
CLOSE(OUT,LOCK);
END.
```

### Output

```
RESULT = 1
CE_ARY = $12,345.67
```

In this call, the parameters have the following meanings:

AMT is a real number passed to the procedure. It contains the value of the currency.

TMP\_ARY is an EBCDIC array passed to the procedure. It contains the formatting template used to format the currency value.

CNV\_NAME is an EBCDIC array passed to the procedure. It contains the name of the convention to be used. When a caller-supplied monetary template (in TMP\_ARY) contains one or more control characters in simple form (control character without a symbol definition enclosed in square brackets ([]) following it), symbols associated with those control characters are retrieved from the monetary template in the convention specified by CNV\_NAME.

For example, if a caller-provided monetary template is *!N[-]CT[,;0,3]D[.]#!* and CNV\_NAME contains *Sweden*, then the local currency symbol is retrieved from the monetary template in Sweden convention and the amount 12345.67 is edited into a formatted string as *Kr.12,134.67*.

CE\_LEN is an integer returned by the procedure. It contains the length of the formatted value in the output array.

CE\_ARY is an EBCDIC array returned by the procedure. It contains the formatted monetary value.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_BAD_ARRAY_DESCRIPTIONV (3000)	CS_BAD_DATA_LEN (3002)
CS_DATAOKV (1)	CS_FAULTV (1001)
CS_SOFTERRV (1002)	

## CNV\_DELETE

This procedure deletes an existing convention definition from the \*SYSTEM/CONVENTIONS file. The convention is deleted after the next halt/load.

Note that this procedure can be used to delete only conventions that have been created by a user. Unisys-provided convention sets cannot be deleted.

### Example

This example deletes a convention named Utopia from the conventions file.

```
BEGIN

$ INCLUDE INTL="*SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,MYUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CNVDELETE.");
DEFINE MAX_NAME_LEN      = 17#;    % Maximum length of convention
                                % name
EBCDIC ARRAY CNV_NAME[0:MAX_NAME_LEN - 1];
INTEGER RESULT;

REPLACE CNV_NAME BY "UTOPIA";
RESULT := CNV_DELETE(CNV_NAME);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
CLOSE(OUT,LOCK);

END.
```

### Output

RESULT = 1

In this call, the parameters have the following meanings:

CNV\_NAME is an EBCDIC array passed to the procedure. It contains the name of the convention to be deleted from the conventions file.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_BAD_ARRAY_DESCRIPTIONV (3000)	CS_BAD_DATA_LEN (3002)
CS_CNVFILE_NOTPRESENTV (3037)	CS_CNV_NOTAVAILV (3036)
CS_DATAOKV (1)	CS_FAULTV (1001)
CS_FILE_ACCESS_ERRORV (1000)	CS_SOFTERRV (1002)

## CNV\_DISPLAYMODEL

This procedure returns a display model for either the numeric date or the numeric time, whichever one is requested in the TYP parameter. A display model is a format that can be displayed to the user to show the form of the requested input. For example, YY/DD/MM is a display model that shows a user that the date must be entered in that form. The procedure creates the display model according to the convention and language specified.

### Example

This example obtains a date display model from the ASERIESNATIVE convention. The display model is translated to English and returned in DM\_ARY.

```
BEGIN

$ INCLUDE INTL="*SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,MYUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CNVDSPMODEL.");
DEFINE MAX_NAME_LEN      = 17#;    % Maximum length of convention
                                % name
EBCDIC ARRAY CNV_NAME[0:MAX_NAME_LEN - 1], DM_ARY[0:9],
            LANG_NAME[0:MAX_NAME_LEN - 1];
INTEGER DM_LEN, RESULT;

REPLACE CNV_NAME BY "ASERIESNATIVE";
REPLACE LANG_NAME BY "ENGLISH";
RESULT := CNV_DISPLAYMODEL(CS_DATE_DISPLAYMODELV, CNV_NAME, LANG_NAME,
                        DM_LEN, DM_ARY);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
```

```

IF RESULT EQL CS_DATAOKV THEN
  WRITE(OUT, <"DM_ARY = ", C10>, DM_ARY);
CLOSE(OUT, LOCK);
END.

```

**Output**

```

RESULT = 1
DM_ARY = mm/dd/yyyy

```

In this call, the parameters have the following meanings:

CS\_DATE\_DISPLAYMODELV represents an integer that requests that the display model for the numeric date be returned. It is one of two display model options:

Value	Value Name	Meaning
0	CS_DATE_DISPLAYMODELV	The display model is for a numeric date.
1	CS_TIME_DISPLAYMODELV	The display model is for a numeric time.

CNV\_NAME is an EBCDIC array passed to the procedure. It contains the name of the convention from which the date or time model is retrieved. If this parameter contains all blanks or zeros, the procedure uses the hierarchy to determine the convention to be used. Refer to the *MLS Guide* for the list of convention names and the explanation of the hierarchy.

LANG\_NAME is an EBCDIC array passed to the procedure. It contains the language name to be used in formatting the date or time. If this parameter contains all blanks or zeros, the procedure uses the hierarchy to determine the language to be used. Refer to the *MLS Guide* for information about determining the valid language names and an explanation of the hierarchy.

DM\_LEN is an integer that contains the number of characters in DM\_ARY.

DM\_ARY is an EBCDIC array returned to the procedure. It contains the requested display model.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_BAD_DATA_LEN (3002)	CS_BAD_TYPE_CODEV (3006)
CS_CONVENTION_NOT_FOUNDV (2002)	CS_DATAOKV (1)
CS_FAULTV (1001)	CS_LANGUAGE_NOT_FOUNDV (2001)
CS_SOFTERRV (1002)	



## CNV\_FORMATDATE

This procedure formats a date, specified in DATE\_ARY, according to the convention specified in CNV\_NAME. The formatted date is returned in FD\_ARY in the language specified by LANG\_NAME.

### Example

This example formats the date in numeric form using the Netherlands convention. The system default language is specified.

```
BEGIN

$ INCLUDE INTL="*SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,MYUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CNVFORMATDATE.");
DEFINE MAX_NAME_LEN      = 17#;    % Maximum length of convention
                                % name
EBCDIC ARRAY CNV_NAME[0:MAX_NAME_LEN - 1], DATE_ARY[0:7], FD_ARY[0:9],
            LANG_NAME[0:MAX_NAME_LEN - 1];
INTEGER FD_LEN, RESULT;

REPLACE DATE_ARY BY "17760704";
REPLACE CNV_NAME BY "NETHERLANDS";
RESULT := CNV_FORMATDATE(CS_NDATEV, DATE_ARY, CNV_NAME, LANG_NAME,
                        FD_LEN, FD_ARY);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
    WRITE(OUT,<"FD_ARY = ",C10>,FD_ARY);
CLOSE(OUT,LOCK);
END.
```

### Output

```
RESULT = 1
FD_ARY = 4.7.76
```

In this call, the parameters have the following meanings:

CS\_NDATEV represents an integer that requests a numeric date format to be returned. It is one of three date format options:

Value	Value Name	Meaning
0	CS_LDATEV	Use the long date format.
1	CS_SDATEV	Use the short date format.
2	CS_NDATEV	Use the numeric date format.

DATE\_ARY is an EBCDIC array passed to the procedure. It contains the date to be formatted. The date must be in the form YYYYMMDD, left justified. The fields of the array have fixed positions. Blanks or zeros must be used in any fields that are omitted.

CNV\_NAME is an EBCDIC array passed to the procedure. It contains the name of the convention to be used to edit the date value. The maximum length of each name is 17 characters. If this parameter contains all blanks or zeros, the procedure uses the hierarchy to determine the convention to be used. Refer to the *MLS Guide* for the list of convention names and the explanation of the hierarchy.

LANG\_NAME is an EBCDIC array passed to the procedure. It contains the language to be used in formatting the date. The maximum length of each name is 17 characters. If this parameter contains all blanks or zeros, the procedure uses the hierarchy to determine the language to be used. Refer to the *MLS Guide* for information about determining the valid language names on the system and an explanation of the hierarchy.

FD\_LEN is an integer returned by the procedure. It contains the length of the formatted date.

FD\_ARY is an EBCDIC array returned by the procedure that contains the formatted date.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_BAD_DATA_LENv (3002)	CS_BADDATEINPUTV (3012)
CS_BAD_TYPE_CODEv (3006)	CS_CONVENTION_NOT_FOUNDV (2002)
CS_DATAOKV (1)	CS_FAULTV (1001)
CS_FIELD_TRUNCATEDV (2003)	CS_LANGUAGE_NOT_FOUNDV (2001)
CS_SOFTERRV (1002)	

## CNV\_FORMATDATETMP

This procedure formats a date, specified in DATE\_ARY, according to a template, specified in TMP\_ARY. The template can be retrieved for any convention from the CNV\_TEMPLATE procedure. It can also be created by the user. The formatted date is returned in the language specified in LANG\_NAME.

### Example

This example formats a date using a template provided by the calling program. The formatted date is translated into English and returned in FD\_ARY. The date consists of an unabridged name of a day of the week, an abbreviated month name, a numeric day of the month, a day of the month suffix “rd”, and a numeric year.

```
BEGIN

$ INCLUDE INTL="*SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,MYUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CNVFMTDATETMP.");
DEFINE MAX_NAME_LEN      = 17#;    % Maximum length of convention
                                % name
EBCDIC ARRAY TMP_ARY[0:47], DATE_ARY[0:7], FD_ARY[0:44],
        LANG_NAME[0:MAX_NAME_LEN - 1];
INTEGER FD_LEN, RESULT;

REPLACE DATE_ARY BY "19901003";
REPLACE TMP_ARY BY "!W!, !1N!. !DE!, !YYYY!";
REPLACE LANG_NAME BY "ENGLISH";
RESULT := CNV_FORMATDATETMP(DATE_ARY, TMP_ARY, LANG_NAME,
        FD_LEN, FD_ARY);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
    WRITE(OUT,<"FD_ARY = ",C45>,FD_ARY);
CLOSE(OUT,LOCK);
END.
```

### Output

```
RESULT = 1
FD_ARY = Wednesday, Oct. 3rd, 1990
```

In this call, the parameters have the following meanings:

**DATE\_ARY** is an EBCDIC array passed to the procedure. It contains the date to be formatted. The date must be in the form **YYYYMMDD**. The fields of the array have fixed positions. Blanks or zeros must be used in any fields that are omitted.

**TMP\_ARY** is an EBCDIC array passed to the procedure. It contains the template used to format the date. The template must use the control characters described in the *MLS Guide*.

**LANG\_NAME** is an EBCDIC array passed to the procedure. It contains the language to be used in formatting the date. Refer to the *MLS Guide* for information about determining the valid language names on the system on which the user program is running.

**FD\_LEN** is an integer returned by the procedure. It contains the length of the formatted date.

**FD\_ARY** is an EBCDIC array returned by the procedure. It contains the formatted date.

**RESULT** is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result

values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_BAD_DATA_LENv (3002)	CS_BADDATEINPUTV (3012)
CS_BAD_TEMPCHARV (3011)	CS_BAD_TEMPLENV (3030)
CS_DATAOKV (1)	CS_FAULTV (1001)
CS_FIELD_TRUNCATEDV (2003)	CS_LANGUAGE_NOT_FOUNDV (2001)
CS_SOFTERRV (1002)	

## CNV\_FORMATTIME

This procedure formats a user-supplied time and identifies the kind of template to be retrieved from the named convention and used to format time. The formatted time is returned in the user-specified language.

### Example

This example formats the time in numeric form using the Belgium convention. The formatted time is returned in FT\_ARY.

```
BEGIN
$ INCLUDE INTL="*SYMBOL/INTL/ALGOL/PROPERTIES." 100000000 - 49999999
FILE OUT(KIND=DISK,UNITS=CHARACTERS,MYUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CNVFMTTIME.");
DEFINE MAX_NAME_LEN      = 17#;    % Maximum length of convention
                                % name
EBCDIC ARRAY CNV_NAME[0:MAX_NAME_LEN - 1], FT_ARY[0:7],
            LANG_NAME[0:MAX_NAME_LEN - 1], TIME_ARY[0:9];
INTEGER FT_LEN, RESULT;

REPLACE TIME_ARY BY "114958";
REPLACE LANG_NAME BY "ENGLISH";
REPLACE CNV_NAME BY "BELGIUM";
RESULT := CNV_FORMATTIME(CS_NTIMEV, TIME_ARY, CNV_NAME, LANG_NAME,
                        FT_LEN, FT_ARY);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
    WRITE(OUT,<"FT_ARY = ",C8>,FT_ARY);
CLOSE(OUT,LOCK);
END.
```

### Output

```
RESULT = 1
FT_ARY = 11:49:58
```

In this call, the parameters have the following meanings:

CS\_NTIMEV represents an integer that requests the numeric time format be returned. It is one of two options:

Value	Value Name	Meaning
3	CS_LTIMEV	Use the long time format.
4	CS_NTIMEV	Use the numeric time format.

TIME\_ARY is an EBCDIC array passed to the procedure. It contains the time to be formatted in the form HHMMSS, left justified. The fields of the array have fixed positions. Blanks or zeros must be used in any fields that are omitted.

CNV\_NAME is an EBCDIC array passed to the procedure. It contains the name of the convention to be used to edit the time value. If this parameter contains all blanks or zeros, the procedure uses the hierarchy to determine the convention to be used. Refer to the *MLS Guide* for the list of convention names and the explanation of the hierarchy.

LANG\_NAME is an EBCDIC array passed to the procedure. It contains the language to be used in formatting the time. If this parameter contains all blanks or zeros, the procedure uses the hierarchy to determine the language to be used. Refer to the *MLS Guide* for information about determining the valid language names on the system being used and the explanation of the hierarchy.

FT\_LEN is an integer that contains the length of FT\_ARY.

FT\_ARY is an EBCDIC array returned by the procedure. It contains the time value formatted according to the specified convention and language.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_BAD_DATA_LEN (3002)	CS_BAD_TEMPCHARV (3011)
CS_BADTIMEINPUTV (3013)	CS_BAD_TYPE_CODEV (3006)
CS_CONVENTION_NOT_FOUNDV (2002)	CS_DATAOKV (1)
CS_FAULTV (1001)	CS_FIELD_TRUNCATEDV (2003)
CS_LANGUAGE_NOT_FOUNDV (2001)	CS_SOFTERRV (1002)

## CNV\_FORMATTIMETMP

This procedure formats a time value, specified in TIME\_ARY, according to a template, specified by TMP\_ARY. The template can be retrieved for any convention from the CNV\_TEMPLATE procedure. It can also be created by the user. The formatted time is returned in the language specified in LANG\_NAME.

**Example**

This example formats a caller-supplied time, using a template also passed in by the calling program. Alphabetic time components are translated into English and returned in FT\_ARY.

```
BEGIN

$ INCLUDE INTL="*SYMBOL/INTL/ALGOL/PROPERTIES." 100000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,MYUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CNVFMTTIMETMP.");
DEFINE MAX_NAME_LEN      = 17#;    % Maximum length of convention
                                % name
EBCDIC ARRAY TMP_ARY[0:47], FT_ARY[0:44], TIME_ARY[0:9],
        LANG_NAME[0:MAX_NAME_LEN - 1];
INTEGER FT_LEN, RESULT;

REPLACE TIME_ARY BY "114958";
REPLACE TMP_ARY BY "!T! !I! !M! !K! !S! !R!";
REPLACE LANG_NAME BY "ENGLISH";
RESULT := CNV_FORMATTIMETMP(TIME_ARY, TMP_ARY, LANG_NAME,
        FT_LEN, FT_ARY);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
    WRITE(OUT,<"FT_ARY = ",C45>,FT_ARY);
CLOSE(OUT,LOCK);
END.
```

**Output**

```
RESULT = 1
FT_ARY = 11 hours 49 minutes 58 seconds
```

In this call, the parameters have the following meanings:

TIME\_ARY is an EBCDIC array passed to the procedure. It contains the time to be formatted in the form HHMMSSPPPP. The partial seconds field, PPPP, is optional. The fields of the array have fixed positions. Blanks or zeros must be used in any fields that are omitted.

TMP\_ARY is an EBCDIC array passed to the procedure in which the template to be used to format the time is specified. Refer to the *MLS Guide* for information about creating a template.

LANG\_NAME is an EBCDIC array passed to the procedure. It contains the language to be used in formatting the time. If this parameter contains all blanks or zeros, the procedure uses the hierarchy to determine the language to be used. Refer to the *MLS Guide* for information about determining the valid language names on the system that is used by the program and the explanation of the hierarchy.

## Internationalization

---

FT\_LEN is an integer returned by the procedure. It contains the length of the formatted time.

FT\_ARY is an EBCDIC array returned by the procedure. It contains the time value formatted according to the specified template and language.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_BAD_DATA_LENv (3002)	CS_BAD_TEMPCHARV (3011)
CS_BAD_TEMPLENV (3030)	CS_BADTIMEINPUTV (3013)
CS_DATAOKV (1)	CS_FAULTV (1001)
CS_FIELD_TRUNCATEDV (2003)	CS_LANGUAGE_NOT_FOUNDV (2001)
CS_SOFTERRV (1002)	

## CNV\_FORMSIZE

This procedure returns the default lines per page and default characters per line values from the specified convention. Each convention provides values for these items to be used by default with printed output.

### Example

This example obtains default lines per page and characters per line from the Denmark convention.

```
BEGIN

$ INCLUDE INTL="*SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,MYUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CNVFORMSIZE.");
DEFINE MAX_NAME_LEN      = 17#;    % Maximum length of convention
                                % name
EBCDIC ARRAY CNV_NAME[0:MAX_NAME_LEN - 1];
INTEGER LPP, CPL, RESULT;

REPLACE CNV_NAME BY "DENMARK";
RESULT := CNV_FORMSIZE(CNV_NAME, LPP, CPL);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
  BEGIN
    WRITE(OUT,<"Lines per Page      = ",J2>,LPP);
    WRITE(OUT,<"Characters per Line = ",J2>,CPL);
  END;
```

```
CLOSE(OUT,LOCK);
END.
```

### Output

```
RESULT = 1
Lines per Page      = 70
Characters per Line = 82
```

In this call, the parameters have the following meanings:

CNV\_NAME is an EBCDIC array passed to the procedure. It contains the name of the convention to be used to specify the printer form default sizes. If this parameter contains all blanks or zeros, the procedure uses the hierarchy to determine the convention to be used. Refer to the *MLS Guide* for the list of convention names and the explanation of the hierarchy.

LPP is an integer returned by the procedure. It contains the number of lines allowed per page for the specified convention.

CPL is an integer returned by the procedure. It contains the number of characters allowed per line for the specified convention.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_BAD_ARRAY_DESCRIPTIONV (3000)	CS_CONVENTION_NOT_FOUNDV (2002)
CS_DATAOKV (1)	CS_FAULTV (1001)
CS_SOFTERRV (1002)	

## CNV\_INFO

This procedure returns the definition of the specified convention. The definition can be retrieved from memory or from the \*SYSTEM/CONVENTIONS file.

### Example

This example retrieves the UnitedKingdom1 convention definition from the \*SYSTEM/CONVENTIONS file and returns it in INFO\_ARY.

```
BEGIN

$ INCLUDE INTL="*SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,MYUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CNVINFO.");
DEFINE MAX_NAME_LEN      = 17#;    % Maximum length of convention
                                % name
```





**Output**

RESULT = 1

Field Meaning	Location	Value
Max. Integer Digits	[0]	12
Max. Fractional Digits	[1]	2
Max. International Fractional Digits	[2]	2
International Currency Notation	[3:4]	"\$ "
Long Date Template	[5:12]	!W!, !DE! !N!, !YYYY!
Short Date Template	[13:20]	!D! !1N! !0Y!
Numeric Date Template	[21:24]	!D!.!00!.!0Y!
Long Time Template	[25:32]	!H!:!0M!:!0S!.!PP! !A!
Numeric Time Template	[33:36]	!H!:!0M!
Monetary Template	[37:44]	!C[\$]T[.,:0,3]D[.]#N[-]!
Numeric Template	[45:52]	!T[.,:0,3]D[.]#N[-]!
Reserved	[53:60]	
Lines per Page	[61]	70
Characters per Line	[62]	82

In this call, the parameters have the following meanings:

CS\_CNVFILE\_INFOV represents an integer that requests that convention information be retrieved from the file in use, \*SYSTEM/CONVENTIONS. It is one of two options:

Value	Value Name	Type of Information Returned
0	CS_CNVMEM_INFOV	Convention information is retrieved from the memory (current working set).
1	CS_CNVFILE_INFOV	Convention information is retrieved from the file in use (*SYSTEM/CONVENTIONS).

Two copies of convention information reside on the system. One copy is in memory and is stored in the CENTRALSUPPORT library during initialization. The other copy is on disk and is stored in the \*SYSTEM/CONVENTIONS file.

CNV\_NAME is an EBCDIC array that contains the name of the convention set for which a definition is requested. If this parameter contains all blanks or zeros, the procedure uses the hierarchy to determine the convention to be used. Refer to the *MLS Guide* for the list of convention names and the explanation of the hierarchy.

INFO\_LEN is an integer that contains the number of characters in INFO\_ARY.

INFO\_ARY is a real array passed to the procedure. It contains the convention definition to be added to conventions in memory and to the \*SYSTEM/CONVENTIONS file in use. For the procedure to work, all fields in INFO\_ARY must contain data, or an appropriate error result is returned. Data in INFO\_ARY is passed in fields as follows:

## Internationalization

---

Field Meaning	Word
Maximum integer digits	0
Maximum decimal digits	1
Maximum international decimal digits	2
International currency notation	3
Long date template	5
Short date template	13
Numeric date template	21
Long time template	25
Numeric time template	33
Monetary template	37
Numeric template	45
Lines per page	61
Characters per line	62

The international currency notation field contains the international currency notation defined for the convention. The international currency notation is surrounded by a pair of matching delimiters that are not part of the symbol. Any blanks inside the delimiters are significant and are treated as any other character. For example, the international currency notation for the ASERIESNATIVE convention is "USD "; the trailing blank is significant and the quotation marks are delimiters.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_BAD_DATA_LENv (3002)	CS_CONVENTION_NOT_FOUNDV (2002)
CS_DATAOKV (1)	CS_FAULTV (1001)
CS_INCOMPLETE_DATAV (2004)	CS_SOFTERRV (1002)

## CNV\_MODIFY

This procedure modifies an existing convention in the \*SYSTEM/CONVENTIONS file. The modified set becomes effective after the next halt/load.

Note that this procedure can be used to modify only conventions that have been created by a user. The Unisys-provided conventions cannot be modified.

**Example**

This example modifies the short date and monetary templates in a convention named Utopia.

```
BEGIN

$ INCLUDE INTL="*SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,MYUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CNVMODIFY.");
DEFINE MAX_NAME_LEN      = 17#;    % Maximum length of convention
                                % name

DEFINE
    SHORTDATETEMP        = 5#;    % MODMASK bit position
    MONETARYTEMP         = 9#;    % MODMASK bit position
ARRAY MOD_ARY[0:62];
EBCDIC ARRAY CNV_NAME[0:MAX_NAME_LEN - 1];
INTEGER RESULT;
REAL MODMASK;

REPLACE CNV_NAME BY "UTOPIA";
MODMASK := 0 & 1 [SHORTDATETEMP:1] % set bits to show what fields
          & 1 [MONETARYTEMP:1]; % contain data in MOD_ARY
REPLACE POINTER(MOD_ARY[13]) BY "!1W!, !1N! !DE!, !YYYY!";
REPLACE POINTER(MOD_ARY[37]) BY "!N[-]C[UTA]T[.:0,3]D[.,]#!";
RESULT := CNV_MODIFY(CNV_NAME, MODMASK, MOD_ARY);
WRITE(OUT, <"RESULT = ", J4>, RESULT);
CLOSE(OUT, LOCK);

END.
```

**Output**

```
RESULT = 1
```

In this call, the parameters have the following meanings:

**CNV\_NAME** is an EBCDIC array that is passed to the procedure. It contains the name of the convention to be modified. If this parameter contains all blanks or zeros, the procedure uses the hierarchy to determine the convention to be used. Refer to the *MLS Guide* for the list of convention names and the explanation of the hierarchy.

**MODMASK** is a real number that is passed to the procedure. It provides a mask that indicates the fields to be modified in the specified convention.

Any or all bits in positions 0 through 12 can be set to indicate which fields should be modified. Each bit is associated with a unique field in **MOD\_ARY**. If the bit is equal to 1, then the data in the corresponding field in **MOD\_ARY** is validated and stored in the designated convention. Bit 0 in **MODMASK** corresponds to the first field in **MOD\_ARY**, bit 1 to field 2, and so on.

## Internationalization

---

MOD\_ARY is a real array passed to the procedure. It contains the convention definition to be added to conventions in memory and to the \*SYSTEM/CONVENTIONS file in use. For the procedure to work, all fields in MOD\_ARY must contain data, or an appropriate error result is returned. Data in MOD\_ARY is passed in fields as follows:

Field Meaning	Word
Maximum integer digits	0
Maximum decimal digits	1
Maximum international decimal digits	2
International currency notation	3
Long date template	5
Short date template	13
Numeric date template	21
Long time template	25
Numeric time template	33
Monetary template	37
Numeric template	45
Lines per page	61
Characters per line	62

The international currency notation field contains the international currency notation defined for the convention. The international currency notation is surrounded by a pair of matching delimiters that are not part of the notation. Any blanks inside the delimiters are significant and are treated as any other character. For example, the international currency notation for the ASERIESNATIVE convention is "USD "; the trailing blank is significant and the quotation marks are delimiters.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_BAD_ALT_FRAC_DIGITSV (3017)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_BAD_CPLV (3028)	CS_BAD_DATA_LEN (3002)
CS_BAD_FRACDIGITSV (3016)	CS_BAD_LDATETEMPV (3018)
CS_BAD_LPPV (3027)	CS_BAD_LTIMETEMPV (3021)
CS_BAD_MAXDIGITSV (3015)	CS_BAD_NDATETEMPV (3020)
CS_BAD_NTIMETEMPV (3022)	CS_BAD_MONTEMPV (3023)
CS_BAD_NUMTEMPV (3024)	CS_BAD_SDATETEMPV (3019)
CS_CONVENTION_NOT_FOUNDV (2002)	CS_CNVFILE_NOTPRESENTV (3037)
CS_CNV_NOTAVAILV (3036)	CS_DATAOKV (1)

*continued*

*continued*

CS_DEL_PERMANENT_CNV_ERRV (3040)	CS_FAULTV (1001)
CS_FILE_ACCESS_ERRORV (1000)	CS_SOFTERRV (1002)

## CNV\_NAMES

This procedure returns a list of convention names and the total number of conventions that are available on the system. This list includes any conventions that are defined.

### Example

This example obtains the names of conventions currently available on the system. The result shows an arbitrary list of selected convention names.

```
BEGIN

$ INCLUDE INTL="*SYMBOL/INTL/ALGOL/PROPERTIES." 100000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,MYUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CNVNAMES.");
DEFINE MAX_NUM_NAMES      = 45#,      % Maximum number of names
        MAX_NAME_LEN      = 17#,      % Maximum length of convention
                                % name

ARRAY LINEOUT[0:14];
EBCDIC ARRAY NAMES_ARY[0:MAX_NUM_NAMES*MAX_NAME_LEN - 1];
INTEGER I, RESULT, TOTAL;

RESULT := CNV_NAMES(TOTAL, NAMES_ARY);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
  BEGIN
    REPLACE LINEOUT BY " " FOR 80;
    WRITE(OUT,80,LINEOUT);
    WRITE(OUT,<"Convention Names">);
    WRITE(OUT,<"-----">);
    WHILE I <= TOTAL DO
      BEGIN
        WRITE(OUT,<C17>,NAMES_ARY[I*17]);
        I := * + 1;
      END;
    END;
    CLOSE(OUT,LOCK);
  END.
```

### Output

```
RESULT = 1
```

## Internationalization

---

### Convention Names

-----  
ASERIESNATIVE  
Netherlands  
Denmark  
UnitedKingdom1  
Turkey  
Norway  
Sweden  
Greece  
FranceListing  
FranceBureautique  
EuropeanStandard

In this call, the parameters have the following meanings:

TOTAL is an integer returned by the procedure. It contains the total number of conventions that reside on the system being used.

NAMES\_ARY is an EBCDIC array returned by the procedure. It contains the convention definition names. Each name uses one element of NAMES\_ARY. Each name can be up to 17 characters long and is left justified in the field. Any parts of the array that are not used are filled with blanks.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS\_ARRAY\_TOO\_SMALLV (3001)                      CS\_DATAOKV (1)  
CS\_FAULTV (1001)

## CNV\_SYMBOLS

This procedure returns a list of numeric and monetary symbols defined for a specified convention.

SYMLEN\_ARY and SYM\_ARY are parallel arrays. Each entry in SYMLEN\_ARY specifies the length of the symbol (in characters) in the corresponding entry in SYM\_ARY. If an entry in SYMLEN\_ARY is 0 (zero), it indicates that the symbol is not defined and the corresponding entry in SYM\_ARY is filled with blanks. If an entry in SYMLEN\_ARY is not 0 (zero), but the corresponding entry in SYM\_ARY is all blanks, then the number of blanks specified by the SYMLEN\_ARY entry constitutes the symbol.

The monetary and numeric symbols defined in the monetary and numeric templates for a convention are returned in fixed-length fields in SYM\_ARY. Each field is 12 bytes long, except where noted.

The following table shows the symbols that are returned in SYM\_ARY and the offset of the field in which the symbol is returned for the monetary symbols:

<b>Monetary Symbol</b>	<b>Offset in Bytes</b>
International currency notation	0
National currency symbol	12
Thousands separator	24
Decimal symbol	36
Positive sign	48
Negative sign	60
Left enclosure	72
Right enclosure	84

The following table shows the symbols that are returned and the offset of the field in which the symbol is returned for the numeric symbols:

<b>Numeric Symbol</b>	<b>Offset in Bytes</b>
Thousands separator	96
Decimal symbol	108
Positive sign	120
Negative sign	132
Left enclosure	144
Right enclosure	156
Monetary grouping	168
Numeric grouping	192

The monetary and numeric groupings each occupy two adjacent fields (24 bytes) in SYM\_ARY. The monetary and numeric groupings, when present, are character strings consisting of unsigned integers separated by commas. The integers specify the number of digits in each group. They appear exactly as they are declared in the monetary and numeric templates, including embedded commas.

The following table shows the offset in bytes of the fields in the record SYMLEN\_ARRAY, which contain the symbol lengths for the monetary and numeric symbols.

<b>Offset</b>	<b>Contains Length of</b>
0	International currency notation
1	National currency symbol
2	Monetary thousands separator
3	Monetary decimal symbol
4	Monetary positive symbol
5	Monetary negative symbol

*continued*



## Internationalization

---

*continued*

Offset	Contains Length of
6	Monetary left enclosure symbol
7	Monetary right enclosure symbol
8	Numeric thousands separator
9	Numeric decimal symbol
10	Numeric positive symbol
11	Numeric negative symbol
12	Numeric left enclosure symbol
13	Numeric right enclosure symbol
14	Monetary grouping
15	Numeric grouping

### Example

This example obtains monetary and numeric symbols, monetary and numeric grouping specifications, and the international currency notation defined for the Norway convention.

```
BEGIN
```

```
$ INCLUDE INTL="*SYMBOL/INTL/ALGOL/PROPERTIES." 100000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,MYUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CNVSYMBOLS.");
DEFINE MAX_NAME_LEN          = 17#;      % Maximum length of convention
                                % name

ARRAY LINEOUT[0:14];
EBCDIC ARRAY CNV_NAME[0:MAX_NAME_LEN - 1], SYM_ARY[0:215];
INTEGER ARRAY SYMLEN_ARY[0:16];
INTEGER RESULT, TOTAL;

REPLACE CNV_NAME BY "NORWAY";
RESULT := CNV_SYMBOLS(CNV_NAME, TOTAL, SYMLEN_ARY, SYM_ARY);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
  BEGIN
    REPLACE LINEOUT BY " " FOR 80;
    WRITE(OUT,80,LINEOUT);
    WRITE(OUT,<"Field Meaning                               Symbols Length  ",
          "Convention Symbols">);
    WRITE(OUT,<"-----                               -----  ",
          "-----">);
    WRITE(OUT,<"International Currency Notation: ",J4,"          ",
          " ",C12>,SYMLEN_ARY[0],SYM_ARY[0]);
```

```

WRITE(OUT,<"National Currency Symbol:      ",J4,"      ",
      " ",C12>,SYMLEN_ARY[1],SYM_ARY[1*12]);
WRITE(OUT,<"Monetary Thousands Separator:  ",J4,"      ",
      " ",C12>,SYMLEN_ARY[2],SYM_ARY[2*12]);
WRITE(OUT,<"Monetary Decimal Symbol:       ",J4,"      ",
      " ",C12>,SYMLEN_ARY[3],SYM_ARY[3*12]);
WRITE(OUT,<"Monetary Positive Symbol:        ",J4,"      ",
      " ",C12>,SYMLEN_ARY[4],SYM_ARY[4*12]);
WRITE(OUT,<"Monetary Negative Symbol:         ",J4,"      ",
      " ",C12>,SYMLEN_ARY[5],SYM_ARY[5*12]);
WRITE(OUT,<"Monetary Left Enclosure Symbol:    ",J4,"      ",
      " ",C12>,SYMLEN_ARY[6],SYM_ARY[6*12]);
WRITE(OUT,<"Monetary Right Enclosure Symbol:     ",J4,"      ",
      " ",C12>,SYMLEN_ARY[7],SYM_ARY[7*12]);
WRITE(OUT,<"Numeric Thousands Separator:         ",J4,"      ",
      " ",C12>,SYMLEN_ARY[8],SYM_ARY[8*12]);
WRITE(OUT,<"Numeric Decimal Symbol:               ",J4,"      ",
      " ",C12>,SYMLEN_ARY[9],SYM_ARY[9*12]);
WRITE(OUT,<"Numeric Positive Symbol:              ",J4,"      ",
      " ",C12>,SYMLEN_ARY[10],SYM_ARY[10*12]);
WRITE(OUT,<"Numeric Negative Symbol:              ",J4,"      ",
      " ",C12>,SYMLEN_ARY[11],SYM_ARY[11*12]);
WRITE(OUT,<"Numeric Left Enclosure Symbol:        ",J4,"      ",
      " ",C12>,SYMLEN_ARY[12],SYM_ARY[12*12]);
WRITE(OUT,<"Numeric Right Enclosure Symbol:       ",J4,"      ",
      " ",C12>,SYMLEN_ARY[13],SYM_ARY[13*12]);
WRITE(OUT,<"Monetary Grouping Specification:     ",J4,"      ",
      " ",C24>,SYMLEN_ARY[14],SYM_ARY[14*12]);
WRITE(OUT,<"Numeric Grouping Specification:      ",J4,"      ",
      " ",C24>,SYMLEN_ARY[15],SYM_ARY[16*12]);

END;
CLOSE(OUT,LOCK);
END.

```

**Output**

RESULT = 1

Field Meaning	Symbols Length	Convention Symbols
International Currency Notation:	3	NKR
National Currency Symbol:	3	KR.
Monetary Thousands Separator:	1	,
Monetary Decimal Symbol:	1	,
Monetary Positive Symbol:	Ø	
Monetary Negative Symbol:	1	-
Monetary Left Enclosure Symbol:	Ø	
Monetary Right Enclosure Symbol:	Ø	
Numeric Thousands Separator:	1	,
Numeric Decimal Symbol:	1	,
Numeric Positive Symbol:	Ø	
Numeric Negative Symbol:	1	-

## Internationalization

---

Numeric Left Enclosure Symbol:	Ø	
Numeric Right Enclosure Symbol:	Ø	
Monetary Grouping Specification:	1	3
Numeric Grouping Specification:	1	3

In this call, the parameters have the following meanings:

CNV\_NAME is an EBCDIC array passed to the procedure. It contains the name of the convention to be used to retrieve the monetary and numeric symbols. If this parameter contains all blanks or zeros, the procedure uses the hierarchy to determine the convention to be used. Refer to the *MLS Guide* for the list of convention names and the explanation of the hierarchy.

TOTAL is an integer returned by the procedure. It contains the total number of symbols returned.

SYMLEN\_ARY is an integer returned by the procedure. It contains the lengths of all symbols being returned in SYMBOLS.

SYM\_ARY is an EBCDIC array returned by the procedure. Each element of the array contains blanks or a symbol defined in the monetary and numeric template for the specified convention. The corresponding entry in SYMLEN\_ARY contains the length of each symbol.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_BAD_DATA_LENv (3002)	CS_CONVENTION_NOT_FOUNDV (2002)
CS_DATAOKV (1)	CS_FAULTV (1001)
CS_INCOMPLETE_DATAV (2004)	CS_SOFTERRV (1002)

## CNV\_SYSTEMDATETIME

This procedure obtains the current system date and time and formats them according to the specified convention. Date and time components are translated to the natural language designated in LANG\_NAME. The system computes both the date and time from the result of a single TIME(6) function call. Thus, the possibility that the date and time are split across midnight does not exist.

### Example

This example formats system date and time according to formatting definitions in the ASERIESNATIVE convention. The form of date and time is specified by CS\_LDATENTIMEV (long date and numeric time). Formatted date and time are translated to English and returned in SDT\_ARY.

```
BEGIN
```

```

$ INCLUDE INTL="*SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,MYUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CNVSYSDATETIME.");
DEFINE MAX_NAME_LEN      = 17#;    % Maximum length of convention
                                % name
EBCDIC ARRAY CNV_NAME[0:MAX_NAME_LEN - 1], SDT_ARY[0:59],
            LANG_NAME[0:MAX_NAME_LEN - 1];
INTEGER DATE_LEN, RESULT, SDT_LEN;

REPLACE CNV_NAME BY "ASERIESNATIVE";
REPLACE LANG_NAME BY "ENGLISH";
RESULT := CNV_SYSDATETIME(CS_LDATENTIMEV, CNV_NAME, LANG_NAME,
                        DATE_LEN, SDT_LEN, SDT_ARY);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
    WRITE(OUT,<"SDT_ARY = ",C60>,SDT_ARY);
CLOSE(OUT,LOCK);
END.

```

**Output**

```

RESULT = 1
SDT_ARY = Friday, November 9, 1990 10:31:30

```

In this call, the parameters have the following meanings:

CS\_LDATENTIMEV represents an integer that requests the long date and time format to be returned. It is one of eleven options:

Value	Value Name	Meaning
0	CS_LDATEV	Use the long date format.
1	CS_SDATEV	Use the short date format.
2	CS_NDATEV	Use the numeric date format.
3	CS_LTIMEV	Use the long time format.
4	CS_NTIMEV	Use the numeric time format.
5	CS_LDATELTIMEV	Use the long date and long time format.
6	CS_LDATENTIMEV	Use the long date and numeric time format.
7	CS_SDATELTIMEV	Use the short date and long time format.
8	CS_SDATENTIMEV	Use the short date and numeric time format.
9	CS_NDATELTIMEV	Use the numeric date and long time format.
10	CS_NDATENTIMEV	Use the numeric date and numeric time format.

CNV\_NAME is an EBCDIC array passed to the procedure. It contains the name of the convention to be used to edit the date and time value. If this parameter contains all blanks or zeros, the procedure uses the hierarchy to determine the convention to be

used. Refer to the *MLS Guide* for the list of convention names and the explanation of the hierarchy.

LANG\_NAME is an EBCDIC array passed to the procedure. It contains the language to be used in formatting the date and time value. If this parameter contains all blanks or zeros, the procedure uses the hierarchy to determine the language to be used. Refer to the *MLS Guide* for information about determining the valid language names on the system being used and the explanation of the hierarchy.

DATE\_LEN is an integer returned by the procedure. It specifies the length of the formatted date portion of the date and/or time. If this parameter is 0 (zero), there is no formatted date in the output. If both date and time are presented in the output, the formatted date is separated from the formatted time by a blank. The extra character is reflected in the length of the formatted date.

SDT\_LEN is an integer returned by the procedure that specifies the total length of the formatted date and/or time.

SDT\_ARY is an EBCDIC array returned by the procedure that contains the formatted date and/or time. The recommended size of this array is 96 characters.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_BAD_TYPE_CODEV (3006)	CS_CONVENTION_NOT_FOUNDV (2002)
CS_DATAOKV (1)	CS_FAULTV (1001)
CS_FIELD_TRUNCATEDV (2003)	CS_INCOMPLETE_DATAV (2004)
CS_LANGUAGE_NOT_FOUNDV (2001)	CS_SOFTERRV (1002)

## CNV\_SYSTEMDATETIMETMP

This procedure obtains the system date and time and formats them according to a template and language supplied by the program. The template can be retrieved for any convention from the CNV\_TEMPLATE procedure. It can also be created by the user. The system obtains the date and time from a single TIME(6) function call to avoid the possibility of splitting the date and time across a day boundary.

### Example

This example formats system date and time according to a template provided by the calling program in TEMP\_ARY. The formatted date and time are translated to English and returned in SDT\_ARY. DTEMP\_LEN is set to the length of date template in TEMP\_ARY.

```

BEGIN

$ INCLUDE INTL="*SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,MYUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CNVSYSDATETIMTMP.");
DEFINE MAX_NAME_LEN      = 17#;    % Maximum length of convention
                                % name
EBCDIC ARRAY TEMP_ARY[0:47], SDT_ARY[0:59],
            LANG_NAME[0:MAX_NAME_LEN - 1];
INTEGER DATE_LEN, DTEMP_LEN, RESULT, SDT_LEN;
POINTER PTR;

REPLACE PTR:TEMP_ARY BY "!W!, !N! !D!, !YYYY! "; % Long date template
DTEMP_LEN := OFFSET(PTR);
REPLACE PTR BY "!0T!;!0M!;!0S!"; % Numeric time template
REPLACE LANG_NAME BY "ENGLISH";
RESULT := CNV_SYSDATETIMTMP(TEMP_ARY, LANG_NAME, DTEMP_LEN,
                            DATE_LEN, SDT_LEN, SDT_ARY);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
    WRITE(OUT,<"SDT_ARY = ",C60>,SDT_ARY);
CLOSE(OUT,LOCK);
END.

```

### Output

```

RESULT = 1
SDT_ARY = Friday, November 9, 1990 10:31:44

```

In this call, the parameters have the following meanings:

**TEMP\_ARY** is an EBCDIC array passed to the procedure. It contains the template, left justified. If both date and time templates are present, the date template must appear first.

**LANG\_NAME** is an EBCDIC array passed to the procedure. It contains the language to be used in formatting the date and time value. If this parameter contains all blanks or zeros, the procedure uses the hierarchy to determine the language to be used. Refer to the *MLS Guide* for information about determining the valid language names on the system being used and the explanation of the hierarchy.

**DTEMP\_LEN** is an integer passed to the procedure. It specifies the length of the date template in **TEMP\_ARY**. If **DTEMP\_LEN** is 0 (zero), there is no date template in **TEMP\_ARY**. If both a date and time template are specified, then the date template must appear first in **TEMP\_ARY**. The date and time are formatted if both date and time templates are present. The date is formatted if only the date template is present, and the time is formatted if only the time template is present.

**DATE\_LEN** is an integer returned by the procedure that contains the length of the formatted date portion of date and time. This parameter is 0 (zero) if there is no formatted date in the output. If both the date and time are presented in the output, the

formatted date is separated from the formatted time by a blank. The extra character is reflected in the length of the formatted date.

SDT\_LEN is an integer returned by the procedure that contains the length of the formatted date and time.

SDT\_ARY is an EBCDIC array returned by the procedure. It contains the formatted date and/or time.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_BAD_DATA_LENv (3002)	CS_BAD_TEMPCHARV (3011)
CS_DATAOKV (1)	CS_FAULTV (1001)
CS_FIELD_TRUNCATEDV (2003)	CS_LANGUAGE_NOT_FOUNDV (2001)
CS_SOFTERRV (1002)	

## CNV\_TEMPLATE

This procedure returns the requested type of formatting template retrieved from the convention that is specified in CNV\_NAME.

This procedure might be used to improve the performance of programs. By retrieving and storing a template to be used in many places, the performance of a program can be improved by eliminating the calls to the CENTRALSUPPORT library.

### Example

The following retrieves a monetary editing template from the convention Turkey. The template is returned in TMP\_ARY.

```
BEGIN

$ INCLUDE INTL="*SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,MYUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/CNVTEMPLATE.");
DEFINE MAX_NAME_LEN      = 17#;    % Maximum length of convention
                                % name
EBCDIC ARRAY CNV_NAME[0:MAX_NAME_LEN - 1], TMP_ARY[0:47];
INTEGER TMP_LEN, RESULT;

REPLACE CNV_NAME BY "TURKEY";
RESULT := CNV_TEMPLATE(CS_MONETARY_TEMPV, CNV_NAME, TMP_LEN, TMP_ARY);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
```

```

WRITE(OUT,<"TMP_ARY = ",C48>,TMP_ARY);
CLOSE(OUT,LOCK);
END.

```

**Output**

```

RESULT = 1
TMP_ARY = !T[.:0,3]D[,]#N[-]Ç[T]!

```

In this call, the parameters have the following meanings:

CS\_MONETARY\_TEMPV represents an integer that requests the type of template to be returned. It is one of seven options:

Value	Value Name	Template to be Retrieved
0	CS_LONGDATE_TEMPV	Long date
1	CS_SHORTDATE_TEMPV	Short date
2	CS_NUMDATE_TEMPV	Numeric date
3	CS_LONGTIME_TEMPV	Long time
4	CS_NUMTIME_TEMPV	Numeric time
5	CS_MONETARY_TEMPV	Monetary
6	CS_NUMERIC_TEMPV	Numeric

CNV\_NAME is an EBCDIC array passed to the procedure that contains the name of the convention that is specified. If this parameter contains all blanks or zeros, the procedure uses the hierarchy to determine the convention to be used. Refer to the *MLS Guide* for the list of convention names and the explanation of the hierarchy.

TMP\_LEN is an integer returned from the procedure that contains the number of characters in TMP\_ARY.

TMP\_ARY is an EBCDIC array returned by the procedure that contains the the requested template.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_BAD_DATA_LEN (3002)	CS_BAD_TYPE_CODEV (3006)
CS_CONVENTION_NOT_FOUNDV (2002)	CS_DATAOKV (1)
CS_FAULTV (1001)	CS_SOFTERRV (1002)



### CNV\_VALIDATENAME

This procedure returns a value in `RESULT` that indicates whether or not the convention name specified in `CNV_NAME` is currently defined on the system.

This procedure might be used to ensure that a convention used as an input parameter exists on the system on which the program is running.

#### Example

This example determines whether or not a convention named Sweden is currently available to `CENTRALSUPPORT`.

```
BEGIN

$ INCLUDE INTL="*SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,MYUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/VALIDATENAME.");
DEFINE MAX_NAME_LEN      = 17#;    % Maximum length of convention
                                % name
EBCDIC ARRAY CNV_NAME[0:MAX_NAME_LEN - 1];
INTEGER RESULT;

REPLACE CNV_NAME BY "SWEDEN";
RESULT := CNV_VALIDATENAME(CNV_NAME);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
CLOSE(OUT,LOCK);
END.
```

#### Output

```
RESULT = 1
```

In this call, the parameters have the following meanings:

`CNV_NAME` is an EBCDIC array passed to the procedure. It contains the name of the convention to be checked. If this parameter contains all blanks or nulls, the `RESULT` parameter returns a value of 0 (zero) or `FALSE`. Refer to the *MLS Guide* for the list of convention names and the explanation of the hierarchy.

`RESULT` is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

Value	Condition-Name	Meaning
0	CS_DATAOKV	The convention name is valid.
1	CS_FALSEV	The convention name is not valid.

## COMPARE\_TEXT\_USING\_ORDER\_INFO

This procedure compares two strings using the ordering information returned by VSNORDERING\_INFO. A starting position can be given for each piece of text, along with the compare relationship to be checked. One of the following methods of comparison can be chosen:

- Equivalent comparison, which is based on the ordering sequence values of characters
- Logical comparison, which is based on the ordering sequence values and the priority sequence values of characters.

### Example

This example compares two strings using the CanadaEBCDIC ccsversion. The compare relation is CS\_CMPEQLV(=) to determine if one string is equal to another, using a logical comparison. The ORDER\_ARY is obtained by calling the VSNORDERING\_INFO procedure. This call obtains the ORDER\_ARY for the CanadaEBCDIC ccsversion. The *MLS Guide* can be used to determine that the ccsversion number for CanadaEBCDIC is 74. This number can also be retrieved by calling VALIDATE\_NAME\_RETURN\_NUM with the name CanadaEBCDIC.

```
BEGIN

$ INCLUDE INTL="SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,FILEUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/COMP_TEXT_ORD_INF.");
EBCDIC ARRAY TEXT1[0:4]
           ,TEXT2[0:4];
REAL ARRAY ORDER_ARY[0:255];
POINTER P_TEXT1
        ,P_TEXT2;
INTEGER COMPARE_LEN
        ,VSN_NUM
        ,RESULT;

VSN_NUM := 74;                                % Canada EBCDIC
RESULT := VSNORDERING_INFO(VSN_NUM, ORDER_ARY);
IF RESULT EQL CS_DATAOKV THEN
  BEGIN
    COMPARE_LEN := MIN(SIZE(TEXT1), SIZE(TEXT2));
    P_TEXT1 := TEXT1[0];
    P_TEXT2 := TEXT2[0];
    REPLACE TEXT1 BY "hotel";
    REPLACE TEXT2 BY "hôte1";

    RESULT := COMPARE_TEXT_USING_ORDER_INFO(P_TEXT1, P_TEXT2,
      COMPARE_LEN, CS_CMPEQLV, CS_LOGICALV, ORDER_ARY);
    WRITE(OUT,<"RESULT = ",J4>,RESULT);
  END;
CLOSE(OUT,LOCK);
```

END.

### Output

RESULT = 0 % The strings are not equal

In this call, the parameters have the following meanings:

P\_TEXT1 is a POINTER array passed to the procedure. It contains the first string to be compared.

P\_TEXT2 is a POINTER array passed to the procedure. It contains the other string to be compared.

COMPARE\_LEN is an integer passed to the procedure. It designates the number of characters to be compared. If COMPARE\_LEN is larger than the number of characters in the strings, then the procedure might be comparing invalid data. The value of COMPARE\_LEN should not exceed the bounds of either the PTEXT1 array or the PTEXT2 array. The strings should be of equal size or padded with blanks up to COMPARE\_LEN. If all pairs of characters compare equally through the last pair, the strings are considered equal. The first pair of unequal characters to be encountered is compared to determine their relative ordering. The string that contains the character with the higher ordering (higher OSV and PSV) is considered to be the greater string. If, because of substitution, the strings become of unequal size, the comparison proceeds as if the shorter string had been expanded by blanks on the right to make it equal in size to the longer string.

CS\_CMPEQLV represents an integer that compares TEXT1 to TEXT2. This is one of 6 compare relation options:

Parameter Value	Value Name	What the Comparison Is to Determine
0	CS_CMPLSSV	TEXT1 is less than TEXT2.
1	CS_CMPLEQV	TEXT1 is less than or equal to TEXT2.
2	CS_CMPEQLV	TEXT1 is equal to TEXT2.
3	CS_CMPGTRV	TEXT1 is greater than TEXT2.
4	CS_CMPGEQV	TEXT1 is greater than or equal to TEXT2.
5	CS_CMPNEQV	TEXT1 is not equal to TEXT2.

CS\_LOGICALV represents an integer that specifies a logical comparison. It is one of two options:

Value	Value Name	Description
1	CS_EQUIVALENTV	Perform an equivalent comparison.
2	CS_LOGICALV	Perform a logical comparison.

ORDER\_ARY is a REAL array passed to the procedure. It contains the ordering information to be used to compare the strings. Ordering information can be obtained using the VSNORDERING\_INFO procedure. Unisys recommends that

the size of this array be 256 words. The layout of ORDER\_ARRAY can be found in the VSNORDERING\_INFO procedure later in this section.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_BAD_ARRAY_DESCRIPTIONV (3000)	CS_BAD_DATA_LEN (3002)
CS_BAD_TYPE_CODEV (3006)	CS_DATAOKV (1)
CS_FALSEV (0)	CS_FAULTV (1001)
CS_SOFTERRV (1002)	

## GET\_CS\_MSG

This procedure returns error message text specified by the error number in NUM and in the language designated in LANG\_NAME. The desired length of the return message can be specified in the MSG\_LEN parameter. If the returned text is shorter than the length specified, the procedure pads the remaining portion of the record with blanks.

An entire message consists of the following three parts:

- The header, which comprises the first 80 characters of the message returned in the MSG parameter. The text in the header provides the error number and a concise text description.
- The short description, which comprises the second 80 characters of the message returned in the MSG parameter. If space is a consideration, the description of the error can be limited to the header and short description.
- The long description, which comprises the remaining characters of the message returned in the MSG parameter. The long description provides a complete explanation of the error that was returned.

Part or all of the message text can be returned. Note that the header part starts at MSG[0], the short description at MSG[80], and the long description at MSG[160]. For example, if MSG\_LEN is specified to be equal to 200 characters, then MSG would contain the header message padded with blanks to 80, if necessary, followed by the short description padded with blanks to 160, if necessary, followed by 40 characters of the long description.

The requested message length should be at least 80 characters, equal to one line of text. Anything less results in an incomplete message. Unisys recommends using either a length of 80, 160, or 999. The value of 999 causes the entire message to be returned.

This procedure might be used to retrieve the text of an error message so that it can be displayed by a program.

### Example

This example illustrates how to get the message text associated with a CENTRALSUPPORT error message. Assume that the sample call to VALIDATE\_NAME\_RETURN\_NUM returns error number 3004 (CS\_NO\_NUM\_FOUNDV). When an error is returned this example gets the first 160 characters (2 lines) of the message text for that error.

```
BEGIN

$ INCLUDE INTL="SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,FILEUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/GET_CS_MSG.");

EBCDIC ARRAY CCSVSNAME[0:17]
            ,LANG[0:17]
            ,MSG[0:159];

INTEGER MSG_LEN
        ,NUM
        ,RESULT1
        ,RESULT2;

REPLACE CCSVSNAME[0] BY "BADNAME" FOR 7;
RESULT1:= VALIDATE_NAME_RETURN_NUM(CS_CHARACTER_SETV,CCSVSNAME, NUM);
WRITE(OUT,<"RESULT FROM VALIDATE_NAME_RETURN_NUM = ",J4>,RESULT1);
IF RESULT1 NEQ CS_DATAOKV THEN
    BEGIN
        MSG_LEN := 160;
        RESULT2 := GET_CS_MSG(RESULT1, LANG, MSG, MSG_LEN);
        WRITE(OUT,<"RESULT FROM GETCSMSG = ",J4>,RESULT2);
        WRITE(OUT,<"MSG = ">);
        WRITE(OUT,<A80>,MSG[0]);
        WRITE(OUT,<A80>,MSG[80]);
        END;
    CLOSE(OUT,LOCK);
END.
```

### Output

```
RESULT FROM VALIDATE_NAME_RETURN_NUM = 3004
RESULT FROM GETCSMSG = 1
MSG =
>>> CENTRALSUPPORT INTERFACE ERROR (#3004) <<<
INVALID CHARACTER SET OR CCSVERSION NAME
```

In this call, the parameters have the following meanings:

RESULT1 is an integer passed by reference to the procedure. It specifies an error that was returned by a library procedure. The error numbers and their meanings are listed at the end of this section.

LANG is an EBCDIC array passed to the procedure. It specifies the language to be used for the message text. If this parameter contains all blanks or zeros, the procedure uses the default language hierarchy to determine the language to be used. Refer to the *MLS Guide* for details about determining the valid language names on the system and for the explanation of the hierarchy.

MSG is an EBCDIC array returned by the procedure. It contains the message text associated with the error number specified.

MSG\_LEN is an integer passed to the procedure. For input, it specifies the maximum length of the message to be returned. It also contains an update value as an output parameter. If MSG\_LEN is equal to 0 (zero), one line of text (80 characters) is returned. If MSG\_LEN is between 1 and 79, then only a partial message is returned. MSG\_LEN should not be greater than the size of the MSG array. Recommended values for MSG\_LEN are 80, 160, or a large number, such as 999, that returns all of the message. For output, MSG\_LEN specifies the actual length of the message returned by the procedure.

RESULT2 is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_BAD_DATA_LEN (3002)	CS_DATAOKV (1)
CS_FAULTV (1001)	CS_INCOMPLETE_DATAV (2004)
CS_NO_NUM_FOUNDV (3003)	CS_SOFTERRV (1002)

## MCP\_BOUND\_LANGUAGES

This procedure returns the names of the languages that are currently bound to the MCP. For information about binding a language to the operating system, see the *MLS Guide*.

### Example

This example returns the languages bound by the operating system. Assume for this example that the bound languages are English and German.

```
BEGIN

$ INCLUDE INTL="SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,FILEUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/MCP_BOUND_LANG.");
EBCDIC ARRAY LANGUAGES_ARY[0:84];
ARRAY LINEOUT[0:14];
INTEGER TOTAL
    ,I
    ,RESULT;
```

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---

```
RESULT := MCP_BOUND_LANGUAGES(TOTAL, LANGUAGES_ARY);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
  BEGIN
    REPLACE LINEOUT BY " " FOR 80;
    WRITE(OUT,80,LINEOUT);
    WRITE(OUT,<"LANGUAGES">);
    WRITE(OUT,<"-----">);
    FOR I := 0 STEP 1 UNTIL TOTAL-1 DO
      WRITE(OUT,17,LANGUAGES_ARY[I*17]);
    END;
  CLOSE(OUT,LOCK);
END.
```

### Output

```
RESULT = 1

LANGUAGES
-----
ENGLISH
GERMAN
```

In this call, the parameters have the following meanings:

**TOTAL** is an integer returned by the procedure. It contains the total number of languages bound to the MCP.

**LANGUAGES\_ARY** is an EBCDIC array returned by the procedure. It contains the names of the languages bound to the MCP. The maximum length of each name is 17 characters, and the names are left justified. For any name that is less than 17 characters, the field is filled on the right with blanks. Unisys recommends that the size of the array be 84 characters; an array of that size holds 5 names.

**RESULT** is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_DATAOKV (1)	CS_FAULTV (1001)
CS_SOFTERRV (1002)	

## VALIDATE\_NAME\_RETURN\_NUM

This procedure checks a coded character set or ccsversion name to determine if it resides in the SYSTEM/CCSFILE file. A coded character set or ccsversion in CCSVSN\_TYPE is designated to be checked, and a name is supplied in NAME\_ARY. The procedure returns the number of the given character set or ccsversion in NUM.

This procedure might be used to obtain the ccsversion number needed as a parameter in other CENTRALSUPPORT library procedures.

**Example**

This example checks to see if a ccsversion named CanadaGP is valid. Assume for this example that CanadaGP is valid and its associated number is 75.

```

BEGIN

$ INCLUDE INTL="SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,FILEUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/VAL_NAME_RET_NUM.");
EBCDIC ARRAY NAME_ARY[0:17];
INTEGER NUM
        ,RESULT;

REPLACE NAME_ARY[0] BY "CANADAGP";
RESULT := VALIDATE_NAME_RETURN_NUM(CS_CCVERSIONV, NAME_ARY, NUM);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
    WRITE(OUT,<"NUM    = ",J4>,NUM);
CLOSE(OUT,LOCK);
END.
    
```

**Output**

```

RESULT = 1
NUM     = 75
    
```

In this call, the parameters have the following meanings:

CS\_CCVERSIONV represents an integer that requests a ccsversion number be returned. It is one of two options:

Value	Value Name	Meaning
0	CS_CHARACTER_SETV	Return a coded character set number.
1	CS_CCVERSIONV	Return a ccsversion number.

NAME\_ARY is an EBCDIC array passed to the procedure. It contains the coded character set or ccsversion name for which a number is being requested. The name can be up to 17 characters long. If this parameter contains zeros or blanks and the first parameter is CS\_CCVERSIONV, the procedure validates the system defined ccsversion. If there is no system default, the procedure returns an error in RESULT.

NUM is an integer returned by the procedure. It contains the specified coded character set or ccsversion number.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result



values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_BAD_ARRAY_DESCRIPTIONV (3000)	CS_BAD_DATA_LEN (3002)
CS_BAD_TYPE_CODEV (3006)	CS_DATAOKV (1)
CS_FAULTV (1001)	CS_NO_NAME_FOUNDV (3004)
CS_SOFTERRV (1002)	

### VALIDATE\_NUM\_RETURN\_NAME

This procedure checks the number of the coded character set or ccsversion to determine if it resides in the SYSTEM/CCSFILE file. A coded character set or ccsversion is designated to be checked and a number in NUM is supplied. The procedure returns the name of the given coded character set or ccsversion number. Refer to the *MLS Guide* for the list of numbers for coded character sets and ccsversions.

This procedure might be used to display to the application user the name of the coded character set or the ccsversion being used.

#### Example

This example checks to see if a ccsversion number 75 is valid. Assume for this example that 75 is valid and its associated name is CanadaGP.

```
BEGIN

$ INCLUDE INTL="SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,FILEUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/VAL_NUM_RET_NAME.");
EBCDIC ARRAY NAME_ARY[0:17];
INTEGER NUM
        ,RESULT;

NUM := 75;
RESULT := VALIDATE_NUM_RETURN_NAME(CS_CCVERSIONV, NUM, NAME_ARY);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
    WRITE(OUT,<"NAME   = ",A18>,NAME_ARY);
CLOSE(OUT,LOCK);
END.
```

#### Output

```
RESULT = 1
NAME   = CANADAGP
```

In this call, the parameters have the following meanings:

CS\_CCSVERSIONV represents an integer that requests the ccsversion number be returned. It is one of two options:

Value	Value Name	Meaning
0	CS_CHARACTER_SETV	Return a coded character set name.
1	CS_CCSVERSIONV	Return a ccsversion name.

NUM is an integer passed to the procedure. It contains the number for the coded character set or ccsversion for which the name is being requested. The value -2 indicates that the system default ccsversion is being validated. Refer to the *MLS Guide* for more information about the hierarchy.

NAME\_ARY is an EBCDIC array returned by the procedure. It contains the coded character set or ccsversion name. The maximum length of the name is 17 characters.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_BAD_TYPE_CODEV (3006)	CS_DATAOKV (1)
CS_FAULTV (1001)	CS_NO_NUM_FOUNDV (3003)
CS_SOFTERRV (1002)	

## VSNCOMPARE\_TEXT

This procedure compares two strings, TEXT1 and TEXT2, using a binary, equivalent or logical comparison, specified in ORD\_TYPE. The starting position for the comparison is specified for each record, along with the compare relationship to be checked.

A binary comparison is based on the hexadecimal code values of the characters. An equivalent comparison is based on the ordering sequence values (OSVs) of the characters. A logical comparison is based on the OSVs plus the priority sequence values (PSVs). These OSVs and PSVs are retrieved from the SYSTEM/CCSFILE based on the ccsversion.

### Example

This example compares two strings using the CanadaEBCDIC ccsversion. The compare relation is CS\_CMPEQLV(=) to determine if one string is equal to another, using a logical comparison. The *MLS Guide* can be used to determine that the ccsversion number for CanadaEBCDIC is 74. This number can also be retrieved by calling VALIDATE\_NAME\_RETURN\_NUM with the name CanadaEBCDIC.

```
BEGIN
```

```
  $ INCLUDE INTL="SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999
```

```
DEFINE TEXT1_START = 0 #
      ,TEXT2_START = 0 #;

FILE OUT(KIND=DISK,UNITS=CHARACTERS,FILEUSE=IO,FILETYPE=0,NEWFILE,
      MAXRECSIZE=80,TITLE="OUT/ALGOL/VSNCOMPARE_TEXT.");
EBCDIC ARRAY TEXT1[0:4]
      ,TEXT2[0:4];
INTEGER COMPARE_LEN
      ,VSN_NUM
      ,RESULT;

VSN_NUM := 74;
COMPARE_LEN := MIN(SIZE(TEXT1), SIZE(TEXT2));
REPLACE TEXT1 BY "hotel";
REPLACE TEXT2 BY "hôte1";
RESULT := VSNCOMPARE_TEXT(VSN_NUM, TEXT1, TEXT1_START, TEXT2,
      TEXT2_START, COMPARE_LEN, CS_CMPEQLV, CS_LOGICALV);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
CLOSE(OUT,LOCK);
END.
```

### Output

```
RESULT = 0
```

In this call, the parameters have the following meanings:

VSN\_NUM is an integer passed to the procedure. It contains the number of the ccsversion that is used to compare TEXT1 and TEXT2. The number can be obtained by referring to the *MLS Guide*. The following shows the valid values:

- If the number is greater than or equal to 0 (zero), then the number designates a ccsversion
- If the number is -2, the procedure uses the system default ccsversion. If the system default ccsversion is not available, the procedure returns an error in RESULT.

TEXT1 is an EBCDIC array passed to the procedure. It contains the first text to be compared.

TEXT1\_START is an integer passed to the procedure. It contains the byte offset (0 relative) of TEXT1 where the comparison starts.

TEXT2 is a record passed to the procedure. It contains the last text to be compared.

TEXT2\_START is an integer passed to the procedure. It contains the byte offset (0 relative) of TEXT2 where the comparison starts.

COMPARE\_LEN is an integer passed to the procedure. It designates the number of characters to be compared. If COMPARE\_LEN is larger than the number of characters in the strings, then the procedure might be comparing invalid data. The value of COMPARE\_LEN should not exceed the bounds of either the TEXT1 array

or the TEXT2 array. The strings should be of equal size or padded with blanks up to COMPARE\_LEN. If all pairs of characters compare equally through the last pair, the strings are considered equal. The first pair of unequal characters to be encountered is compared to determine their relative ordering. The string that contains the character with the higher ordering (higher OSV and PSV) is considered to be the greater string. If because of substitution the strings become of unequal size, the comparison proceeds as if the shorter string had been expanded by blanks on the right to make it equal in size to the longer string.

CS\_CMPEQLV represents an integer that indicates that TEXT1 is equal to TEXT2. It is one of six comparison options:

Value	Value Name	Meaning
0	CS_CMLSSV	TEXT1 is less than TEXT2.
1	CS_CMPEQV	TEXT1 is less than or equal to TEXT2.
2	CS_CMPEQLV	TEXT1 is equal to TEXT2.
3	CS_CMPGTRV	TEXT1 is greater than TEXT2.
4	CS_CMPGEQV	TEXT1 is greater than or equal to TEXT2.
5	CS_CMPNEQV	TEXT1 is not equal to TEXT2.

CS\_LOGICALV represents an integer that indicates that a logical comparison is to be done. It is one of two options:

Value	Value Name	Meaning
1	CS_EQUIVALENTV	Perform an equivalent comparison.
2	CS_LOGICALV	Perform a logical comparison.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_BAD_TYPE_CODEV (3006)	CS_DATAOKV (1)
CS_FALSEV (0)	CS_FAULTV (1001)
CS_FILE_ACCESS_ERRORV (1000)	CS_NO_NUM_FOUNDV (3003)
CS_SOFTERRV (1002)	

## VSNESCAPEMENT

This procedure takes the input text and rearranges it according to the escapement rules of the ccversion. Both the character advance direction and the character escapement direction are used. If the character advance direction is positive, then the starting position for the text is the leftmost position in the DEST parameter. If the character advance direction is negative, then the starting position for the text is the rightmost position in the DEST parameter. From that point on, the character advance direction

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value and the character escapement direction values, in combination, control where each character should be placed in relation to the previous character.

### Example

This example takes the string ABCDEFG and rearranges it according to the escapement rules of the ccsversion. Assume for this example a ccsversion number of 999 with a character advance direction (CAD) of plus (+, left to right) and with the following character escapements:

Character	Escapement	Meaning
A	+	Left to right
B	-	Right to left
C	-	Right to left
D	-	Right to left
E	+	Left to right
F	+	Left to right
G	blank	Use CAD value

BEGIN

```
$ INCLUDE INTL="SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

DEFINE SOURCE_START = 0 #
      ,DEST_START = 0 #;

FILE OUT(KIND=DISK,UNITS=CHARACTERS,FILEUSE=IO,FILETYPE=0,NEWFILE,
      MAXRECSIZE=80,TITLE="OUT/ALGOL/VSNESCAPEMENT.");
EBCDIC ARRAY SOURCE[0:6]
      ,DEST[0:6];
INTEGER VSN_NUM
      ,TRANS_LEN
      ,RESULT;

VSN_NUM := 999;
REPLACE SOURCE[0] BY "ABCDEFG" FOR 7;
TRANS_LEN := 7;
RESULT := VSNESCAPEMENT(VSN_NUM, SOURCE, SOURCE_START, DEST,
      TRANS_LEN);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
      WRITE(OUT,<"DEST = ",A7>,DEST);
CLOSE(OUT,LOCK);

END.
```

**Output**

```
RESULT = 1
DEST   = ADCBEFG
```

In this call, the parameters have the following meanings:

VSN\_NUM is an integer passed by reference to the procedure. It specifies the ccsversion to be used. The ccsversion contains the escapement rules. The following are the values allowed for VSN\_NUM:

Value	Meaning
Greater than or equal to 0	Specifies a ccsversion. The numbers of the ccsversions are listed in the <i>MLS Guide</i> .
-2	Specifies the system default ccsversion. If the system default ccsversion is not available, an error is returned.

SOURCE is an EBCDIC array passed to the procedure. It contains the text to be arranged according to the escapement rules.

SOURCE\_START is an integer passed to the procedure. It specifies the starting position in SOURCE (0 relative) for the arranging of text by escapement rules to begin.

DEST is an EBCDIC array returned by the procedure. It contains the resulting text after the escapement rules have been applied.

TRANS\_LEN is an integer passed to the procedure. It specifies the number of characters to arrange according to the escapement rules.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_BAD_ARRAY_DESCRIPTIONV (3000)	CS_BAD_DATA_LEN (3002)
CS_DATAOKV (1)	CS_FAULTV (1001)
CS_FILE_ACCESS_ERRORV (1000)	CS_NO_NUM_FOUNDV (3003)
CS_SOFTERRV (1002)	

## VSNGETORDERINGFOR\_ONE\_TEXT

This procedure returns the ordering information for the input text. The ordering information determines how the input text is collated. It includes the ordering and priority sequence values of the characters and any substitution of characters to be made when the input text is sorted. One of the following types of ordering information can be chosen:

- Equivalent ordering information, which comprises only the ordering sequence values (OSVs)
- Logical ordering information, which comprises the OSVs followed by the priority sequence values (PSVs)

### Example

This example obtains the ordering sequence values and priority sequence values for an input text string. The `ccsversion` is `CanadaEBCDIC`. The *MLS Guide* can be used to determine that the `ccsversion` number for `CanadaEBCDIC` is 74. This number can also be retrieved by calling `VALIDATE_NAME_RETURN_NUM` with the name `CanadaEBCDIC`. This example requests logical ordering information, so that both the OSVs and PSVs are returned. This example allows for maximum substitution, so the parameter `MAX_OSVS` is equal to  $(\text{ITEXT\_LEN} * 3)$  and `TOTAL_STORAGE` is equal to  $\text{INTEGER}(\text{MAX\_OSV}/2)$ .

```
BEGIN

$ INCLUDE INTL="SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

DEFINE SOURCE_START = 0 #
    ,DEST_START = 0 #;

FILE OUT(KIND=DISK,UNITS=CHARACTERS,FILEUSE=IO,FILETYPE=0,NEWFILE,
    MAXRECSIZE=80,TITLE="OUT/ALGOL/VSNGETORD_ONE_TEX.");
EBCDIC ARRAY SOURCE[0:25]
    ,DEST[0:25];
INTEGER VSN_NUM
    ,ITEXT_LEN
    ,MAX_OSVS
    ,TOTAL_STORAGE
    ,RESULT;

VSN_NUM := 74;
ITEXT_LEN := 5;
MAX_OSVS := ITEXT_LEN * 3;
TOTAL_STORAGE := MAX_OSVS + INTEGER(MAX_OSVS/2);
REPLACE SOURCE[0] BY "ABCæÆ";
RESULT := VSNGETORDERINGFOR_ONE_TEXT(VSN_NUM, SOURCE, SOURCE_START,
    ITEXT_LEN, DEST, DEST_START, MAX_OSVS, TOTAL_STORAGE,
    CS_LOGICALV);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
```

```

        WRITE(OUT, <"DEST  = ", A25>, DEST);
    CLOSE(OUT, LOCK);
END.

```

**Output**

```

RESULT = 1
DEST = 414243414541 450000000000 000000111221 100000000000

```

VSN\_NUM is an integer passed to the procedure. It contains the number of the ccsversion that is used.

SOURCE is an array passed to the procedure. It contains the text for which the ordering information is requested.

SOURCE\_START is an integer passed to the procedure. It contains the offset of the location where the source text is to begin.

ITEXT\_LEN is an integer passed to the procedure. It contains the length of the source text.

DEST is a result returned by the procedure. It contains the ordering information for the source text.

DEST\_START is an integer returned by the procedure. It designates the starting offset at which the result values are placed.

MAX\_OSVS is an integer passed to the procedure. It designates the maximum number of bytes to be used to store the ordering sequence values.

The value of MAX\_OSVS should be at least the length of the input text, but it might need to be greater to allow for substitution. The maximum substitution length is 3 bytes; therefore, to allow for substitution for every character, the value of MAX\_OSVS is as follows:

$$\langle \text{length of source text in bytes} \rangle * 3$$

If the number of ordering sequence values returned is less than MAX\_OSVS, then the array row is padded with the ordering sequence value for blank.

TOTAL\_STORAGE is an integer passed by the procedure. It defines the maximum number of bytes needed to store the complete ordering information for the text. If equivalent ordering information is requested, TOTAL\_STORAGE is equal to MAX\_OSVS. If logical ordering information is requested, space must be provided for the four-bit priority values in addition to the space allowed for the OSVs. Each OSV has one PSV, and one byte can hold two PSVs. Therefore, the space allowed for PSVs is MAXOSVS/2, and the value of TOTAL\_STORAGE is as follows:

$$\text{MAXOSVS} + (\text{MAXOSVS}/2)$$

When the ordering information is returned by the procedure, all the OSVs are listed first, followed by all the PSVs.



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CS\_LOGICALV represents an integer that requests logical ordering information. It is one of two options:

Parameter Value	Value Name	Type of Information Returned
1	CS_EQUIVALENTV	Ordering sequence values only
2	CS_LOGICALV	Priority sequence values only

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_BAD_DATA_LEN (3002)	CS_BAD_TEXT_PARAMV (3008)
CS_BAD_TYPE_CODEV (3006)	CS_DATAOKV (1)
CS_FALSEV (0)	CS_FAULTV (1001)
CS_FILE_ACCESS_ERRORV (1000)	CS_NO_NUM_FOUNDV (3003)
CS_SOFTERRV (1002)	

## VSNINFO

This procedure returns the following information for a designated ccsversion:

- The number of the base coded character set to which the ccsversion applies
- The escapement information
- The space characters used for the ccsversion
- The array sizes required by the ccsversion translate tables and sets

### Example

This example calls the procedure VSNINFO to get information about the system default ccsversion. For this example assume the system default ccsversion in Norway (71).

```
BEGIN

$ INCLUDE INTL="SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,FILEUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/VSNINFO.");

ARRAY VSN_ARY[0:7]
      ,LINEOUT[0:14];
INTEGER VSN_NUM
      ,I
      ,RESULT;
FORMAT FORM1(A31,T41,A10,T55,J2)
```

```

,FORM2("    SPACE CHARACTER[" ,I1,"] (HEX)",T41,A5,J2,A3,T55,H2);

VSN_NUM := CS_VSN_NOT_SPECIFIEDV;
RESULT := VSNINFO(VSN_NUM, VSN_ARY);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
  BEGIN
    REPLACE LINEOUT BY " " FOR 80;
    WRITE(OUT,80,LINEOUT);
    WRITE(OUT,<"VSN ARRAY">);
    WRITE(OUT,<"FIELD MEANING",T40,"LOCATION",T53,"VALUE">);
    WRITE(OUT,<"-----",T40,"-----",T53,"-----">);
    WRITE(OUT, FORM1, "BASE CHARACTER SET NUMBER    ",
           "[0]      ", VSN_ARY[0]);
    WRITE(OUT, FORM1, "TEXT LINE ORIENTATION      ",
           "[1]      ", VSN_ARY[1]);
    WRITE(OUT, FORM1, "LINE ADVANCE DIRECTION     ",
           "[2]      ", VSN_ARY[2]);
    WRITE(OUT, FORM1, "CHARACTER ADVANCE DIRECTION ",
           "[3]      ", VSN_ARY[3]);
    WRITE(OUT, FORM1, "NUMBER OF SPACES CHARACTERS ",
           "[4].[47:8] ", VSN_ARY[4].[47:8]);
    FOR I := 1 STEP 1 UNTIL VSN_ARY[4].[47:8] DO
      WRITE(OUT, FORM2, I,"[4].[",47-I*8,":8]",VSN_ARY[4].[47-I*8:8]);
    WRITE(OUT, FORM1, "SIZE OF SPACES IN TRUTHSET  ",
           "[5].[47:8] ", VSN_ARY[5].[47:8]);
    WRITE(OUT, FORM1, "SIZE OF ALPHA TRUTHSET     ",
           "[5].[39:8] ", VSN_ARY[5].[39:8]);
    WRITE(OUT, FORM1, "SIZE OF NUMERIC TRUTHSET   ",
           "[5].[31:8] ", VSN_ARY[5].[31:8]);
    WRITE(OUT, FORM1, "SIZE OF PRESENTATION TRUTHSET ",
           "[5].[23:8] ", VSN_ARY[5].[23:8]);
    WRITE(OUT, FORM1, "SIZE OF LOWER TRUTHSET     ",
           "[5].[15:8] ", VSN_ARY[5].[15:8]);
    WRITE(OUT, FORM1, "SIZE OF UPPER TRUTHSET     ",
           "[5].[7:8]  ", VSN_ARY[5].[7:8]);
    WRITE(OUT, FORM1, "UNUSED                      ",
           "[6].[47:8] ", VSN_ARY[6].[47:8]);
    WRITE(OUT, FORM1, "SIZE OF ESCAPEMENT TRANS TABLE ",
           "[6].[39:8] ", VSN_ARY[6].[39:8]);
    WRITE(OUT, FORM1, "SIZE OF LOWTOUP TRANS TABLE  ",
           "[6].[31:8] ", VSN_ARY[6].[31:8]);
    WRITE(OUT, FORM1, "SIZE OF UPTOLOW TRANS TABLE  ",
           "[6].[23:8] ", VSN_ARY[6].[23:8]);
    WRITE(OUT, FORM1, "SIZE OF NUMTOALTDIG TRANS TABLE",
           "[6].[15:8] ", VSN_ARY[6].[15:8]);
    WRITE(OUT, FORM1, "SIZE OF ALTDIGTONUM TRANS TABLE",
           "[6].[7:8]  ", VSN_ARY[6].[7:8]);
    WRITE(OUT, FORM1, "SIZE OF OSV TRANS TABLE     ",
           "[7].[47:8] ", VSN_ARY[7].[47:8]);
    WRITE(OUT, FORM1, "SIZE OF PSV TRANS TABLE     ",
           "[7].[39:8] ", VSN_ARY[7].[39:8]);
  
```

## Internationalization

---

```
WRITE(OUT, FORM1, "SIZE OF SUBSTCHAR TRANS TABLE ",
      "[7].[31:8]", VSN_ARY[7].[31:8]);
WRITE(OUT, FORM1, "SIZE OF SUBSTSEQ TRANS TABLE ",
      "[7].[23:8]", VSN_ARY[7].[23:8]);
WRITE(OUT, FORM1, "SIZE OF SUBSTOSV TRANS TABLE ",
      "[7].[15:8]", VSN_ARY[7].[15:8]);
WRITE(OUT, FORM1, "SIZE OF SUBSTPSV TRANS TABLE ",
      "[7].[7:8] ", VSN_ARY[7].[7:8]);
END;
CLOSE(OUT, LOCK);
END.
```

### Output

RESULT = 1

VSN ARRAY FIELD MEANING	LOCATION	VALUE
-----	-----	-----
BASE CHARACTER SET NUMBER	[0]	4
TEXT LINE ORIENTATION	[1]	0
LINE ADVANCE DIRECTION	[2]	0
CHARACTER ADVANCE DIRECTION	[3]	0
NUMBER OF SPACES CHARACTERS	[4].[47:8]	1
SPACE CHARACTER[1] (HEX)	[4].[39:8]	40
SIZE OF SPACES IN TRUTHSET	[5].[47:8]	8
SIZE OF ALPHA TRUTHSET	[5].[39:8]	8
SIZE OF NUMERIC TRUTHSET	[5].[31:8]	8
SIZE OF PRESENTATION TRUTHSET	[5].[23:8]	8
SIZE OF LOWER TRUTHSET	[5].[15:8]	8
SIZE OF UPPER TRUTHSET	[5].[7:8]	8
UNUSED	[6].[47:8]	0
SIZE OF ESCAPEMENT TRANS TABLE	[6].[39:8]	64
SIZE OF LOWTOUP TRANS TABLE	[6].[31:8]	64
SIZE OF UPTOLOW TRANS TABLE	[6].[23:8]	64
SIZE OF NUMTOALTDIG TRANS TABLE	[6].[15:8]	0
SIZE OF ALTDIGTONUM TRANS TABLE	[6].[7:8]	0
SIZE OF OSV TRANS TABLE	[7].[47:8]	64
SIZE OF PSV TRANS TABLE	[7].[39:8]	64
SIZE OF SUBSTCHAR TRANS TABLE	[7].[31:8]	0
SIZE OF SUBSTSEQ TRANS TABLE	[7].[23:8]	0
SIZE OF SUBSTOSV TRANS TABLE	[7].[15:8]	0
SIZE OF SUBSTPSV TRANS TABLE	[7].[7:8]	0

In this call, the parameters have the following meanings:

**VSN\_NUM** is an integer passed to the procedure. It contains the ccsversion number for which information is requested.

**VSN\_ARY** is an array returned by the procedure. It contains the ccsversion information, as follows:

<b>Location</b>	<b>Information Contained</b>
WORD 0	Base coded character set number.
WORD 1	Text line orientation.
WORD 2	Line advance direction.
WORD 3	Character advance direction.
WORD 4	Space characters. The first byte is the number of space characters; the actual characters follow.
WORD 5.[47:08]	Size of SPACES truth set.
WORD 5.[39:08]	Size of ALPHA truth set.
WORD 5.[31:08]	Size of NUMERIC truth set.
WORD 5.[23:08]	Size of PRESENTATION truth set.
WORD 5.[15:08]	Size of LOWER truth set.
WORD 5.[07:08]	Size of UPPER truth set.
WORD 6.[47:08]	This location is unused.
WORD 6.[39:08]	Size of ESCAPEMENT translation table.
WORD 6.[31:08]	Size of LOWTOUP translation table.
WORD 6.[23:08]	Size of UPTOLOW translation table.
WORD 6.[15:08]	Size of NUMTOALTDIG translation table.
WORD 6.[07:08]	Size of ALTDIGTONUM translation table.
WORD 7.[47:08]	Size of OSV translation table.
WORD 7.[39:08]	Size of PSV translation table.
WORD 7.[31:08]	Size of SUBSTCHAR translation table.
WORD 7.[23:08]	Size of SUBSTSEQ translation table.
WORD 7.[15:08]	Size of SUBSTOSV translation table.
WORD 7.[07:08]	Size of SUBSTPSV translation table.

Unisys recommends that the size of VSN\_ARRAY be 8 words.

**RESULT** is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_DATAOKV (1)	CS_FAULTV (1001)
CS_FILE_ACCESS_ERRORV (1000)	CS_NO_NUM_FOUNDV (3003)
CS_SOFTERRV (1002)	

### VSNINSPECT\_TEXT

This procedure searches specified text for characters that are present or not present in a requested truth set. The SCANNED\_CHARS parameter is an integer that represents the number of characters that were searched when the criteria specified in the FLAG parameter were met. If SCANNED\_CHARS is equal to INSPECT\_LEN, then all the characters were searched, but none met the criteria. Otherwise, adding the TEXT\_START value to the SCANNED\_CHARS value gives the location of the character, from the start of the array, that met the search criteria.

#### Example

This example examines a record that contains two fields, a name and a phone number. The name is verified to contain only alphabetic characters as defined by the France ccsversion. The *MLS Guide* can be used to determine that the ccsversion number for France is 35. This number can also be retrieved by calling VALIDATE\_NAME\_RETURN\_NUM with the name France.

```
BEGIN

$ INCLUDE INTL="SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

DEFINE IDNUMLEN = 10 #
      ,NAMELEN = 30 #
      ,TEXT_START = 0 #
      ,INSPECT_LEN = IDNUMLEN #;

FILE OUT(KIND=DISK,UNITS=CHARACTERS,FILEUSE=IO,FILETYPE=0,NEWFILE,
      MAXRECSIZE=80,TITLE="OUT/ALGOL/VSNINSPECT_TEXT.");
EBCDIC ARRAY TEXT[0:NAMELEN+IDNUMLEN];
INTEGER SCANNED_CHARS
      ,RESULT
      ,VSN_NUM;

REPLACE TEXT[0] BY "7775961089John Alan Smith";
VSN_NUM := 35;
RESULT := VSNINSPECT_TEXT(VSN_NUM, TEXT, TEXT_START, INSPECT_LEN,
      CS_NUMERICSV, CS_NOTINTSETV, SCANNED_CHARS);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
  BEGIN
    WRITE(OUT,<"SCANNED CHARACTERS = ",J4>,SCANNED_CHARS);
    IF SCANNED_CHARS NEQ IDNUMLEN THEN
      WRITE(OUT,<"ERROR - INVALID ID, BAD CHARACTER FOUND">);
    END;
  CLOSE(OUT,LOCK);
END.
```

**Output**

```
RESULT = 1
SCANNED CHARACTERS = 10
```

In this call, the parameters have the following meanings:

VSN\_NUM is an integer passed to the procedure. It specifies the ccsversion to be used. The ccsversion contains the rules for applying a truth set. The following are the values allowed for VSN\_NUM:

Value	Meaning
Greater than or equal to 0	Specifies a ccsversion. The numbers of the ccsversions are listed in the <i>MLS Guide</i> .
-2	Specifies the system default ccsversion. If the system default ccsversion is not available, an error is returned.

TEXT is an EBCDIC array passed to the procedure. The array is then searched using the requested truth set.

TEXT\_START is an integer passed to the procedure. It contains the byte offset (0 relative) in TEXT where the search starts.

INSPECT\_LEN is an integer passed to the procedure. It specifies the number of characters to be searched beginning at TEXT\_START. In other words, it specifies that maximum length of the search.

CS\_NUMERICSV represents an integer that indicates that a numeric truth set be used for the search. It is one of six options:

Value	Sample Data Name	Meaning
12	CS_ALPHAV	Alphabetic truth set. It identifies the characters defined as alphabetic in the specified ccsversion.
13	CS_NUMERICSV	Numeric truth set. It identifies the characters defined as numeric in the specified ccsversion.
14	CS_PRESENTATIONV	Presentation truth set. It identifies the characters in the ccsversion that can be represented on a presentation device, for example a printer.
15	CS_SPACESV	Spaces truth set. It identifies the characters defined as space in the specified ccsversion.
16	CS_LOWERCASEV	Lowercase truth set. It identifies the characters defined as lowercase alphabetic in the ccsversion.
17	CS_UPPERCASEV	Uppercase truth set. It identifies the characters defined as uppercase alphabetic in the ccsversion.

A ccsversion is not required to have a definition for each of these truth sets. Some of the truth sets are optional. Options 16 and 17 are not required. A result of CS\_DATA\_NOT\_FOUNDV (4002) might be returned if the truth set has not been defined for the ccsversion. The input text remains unchanged.

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---

CS\_NOTINTSETV represents an integer that indicates the type of search to be performed. It is one of two options:

Value	Sample Data Name	Meaning
0	CS_NOTINTSETV	Search TEXT until a character is found that is not in the requested truth set.
1	CS_INTSETV	Search TEXT until a character is found that is in the requested truth set.

SCANNED\_CHARS is an integer returned by the procedure. It contains the number of characters that were scanned when the search criteria were met.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_BAD_FLAGV (3007)	CS_BAD_TYPE_CODEV (3006)
CS_DATA_NOT_FOUNDV (4002)	CS_DATAOKV (1)
CS_FAULTV (1001)	CS_FILE_ACCESS_ERRORV (1000)
CS_NO_NUM_FOUNDV (3003)	CS_SOFTERRV (1002)

## VSNORDERING\_INFO

This procedure returns the ordering information for a designated ccsversion. The ordering information determines the way in which data is collated for the ccsversion. It includes the ordering and priority sequence values of the characters and any substitution of characters to be made when the designated ccsversion ordering is applied to a string of text.

The table obtained with this procedure might be used with the COMPARE\_TEXT\_USING\_ORDER\_INFO procedure. Because the table is stored in working memory, it does not have to be retrieved each time it is used. Using this combination of procedures in place of a general call to the VSNCOMPARE\_TEXT procedure can improve the performance of an application program that performs a high volume of translations.

### Example

This example gets the ordering information for the CanadaEBCDIC ccsversion. The ordering information is returned in ORDER\_ARY. The *MLS Guide* can be used to determine that the ccsversion number for CanadaEBCDIC is 74. This number can also be retrieved by calling VALIDATE\_NAME\_RETURN\_NUM with the name CanadaEBCDIC.

```
BEGIN
```

```
  $ INCLUDE INTL="SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999
```

```

FILE OUT(KIND=DISK,UNITS=CHARACTERS,FILEUSE=IO,FILETYPE=Ø,NEWFILE,
        MAXRECSIZE=8Ø,TITLE="OUT/ALGOL/VSNORDERING_INFO.");
ARRAY ORDER_ARY[Ø:255];
INTEGER VSN_NUM
        ,RESULT;

VSN_NUM := 74;
RESULT := VSNORDERING_INFO(VSN_NUM, ORDER_ARY);
WRITE(OUT,<"RESULT = ",J4>, RESULT);
CLOSE(OUT,LOCK);
END.

```

**Output**

RESULT = 1

In this call, the parameters have the following meanings:

VSN\_NUM is an integer passed to the procedure. It contains the number of the ccsversion for which ordering information is requested.

ORDER\_ARY is an array returned from the procedure. It contains the ordering information for the ccsversion. The first two words of the array are size words. Word 1 is not used at this time. Word 0 contains the following information:

Word	Offset	Information Contained
Word 0	[47:08]	Size of ordering ttable in words (always 64)
Word 0	[39:08]	Size of priority ttable in words (always 64)
Word 0	[31:08]	Size of substitution characters truth set in words (may be greater than or equal to 0 words)
Word 0	[23:08]	Size of substitution sequences array in words (may be greater than or equal to 0 words)
Word 0	[15:08]	Size of substitution ordering array in words (may be greater than or equal to 0 words)
Word 0	[07:08]	Size of substitution priority array in words (may be greater than or equal to 0 words)

ORDER\_ARY also contains the following components in order:

1. Ordering translate table
 

64-word ALGOL translate table. Translates each character to its ordering sequence value.
2. Priority translate table
 

64-word ALGOL translate table. Translates each character to its priority sequence value.
3. Substitution characters truth set



An ALGOL truth set that contains all the characters that are part of any substitution sequence, many to one or one to many.

#### 4. Substitution sequences array

A real array. Each word contains one of the substitution sequences, right justified. For example, if *ch* is a substitution sequence, then it is stored as 0000008388.

#### 5. Substitution ordering array

A real array, parallel to substitution sequences array. For each substitution sequence, the ordering sequence values for that sequence are stored in the corresponding word along with the length (left-justified). The format of the word is [47:08] number of ordering sequence values. This must be greater than or equal to 1, or less than or equal to 3. The next [47:08] bytes contain the OSVs left-justified. For example, suppose *a with e* is substituted by the OSVs 129 and 133. The substitution ordering word will appear as 028185000000. The elements of the substitution ordering word have the following meanings:

02	Two OSVs
81	The OSV 129
85	The OSV 133

#### 6. Substitution priority array

A real array. Each word contains the priority sequence values corresponding to the substitution ordering array. The word format of this array is exactly the same as the word format of the substitution ordering array.

Unisys recommends that the size of this array be 256 words.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_DATAOKV (1)	CS_FAULTV (1001)
CS_FILE_ACCESS_ERRORV (1000)	CS_NO_NUM_FOUNDV (3003)
CS_SOFTERRV (1002)	

## VSNTRANSTABLE

This procedure returns a translation table for a designated ccsversion. The type of translation table requested depends on the task to be performed.

Translation tables can be used to perform the following tasks:

- Translate lowercase letters to uppercase letters.
- Translate uppercase letters to lowercase letters.

- Translate any digits 0 through 9 to any alternative digits (that is, one-to-one mapping of 0 through 9 to another representation for those digits).
- Translate alternative digits to 0 through 9.
- Determine the escapement direction for each character.

The translation table from VSNTRANSTABLE can be retained in working memory. This translation table can then be used with the REPLACE syntax. This improves performance over a call to VSNTRANS\_TEXT. This process can improve performance of an application program that performs a high volume of translations. Because the table is stored in working memory, it does not have to be retrieved each time it is to be used.

### Example

This example gets the uppercase to lowercase translate table for the CanadaEBCDIC ccsversion. The translate table is returned in the TTABLE\_ARY. The *MLS Guide* can be used to determine that the ccsversion number for CanadaEBCDIC is 74. This number can also be retrieved by calling VALIDATE\_NAME\_RETURN\_NUM with the name CanadaEBCDIC.

```
BEGIN

$ INCLUDE INTL="SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,FILEUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/VSNTRANS_TABLE.");
ARRAY TTABLE_ARY[0:63];
INTEGER VSN_NUM
        ,RESULT;

VSN_NUM := 74;
RESULT := VSNTRANSTABLE(VSN_NUM, CS_UPTOLOWCASEV, TTABLE_ARY);
WRITE(OUT,<"RESULT = ",J4>, RESULT);
CLOSE(OUT,LOCK);
END.
```

### Output

```
RESULT = 1
```

In this call, the parameters have the following meanings:

VSN\_NUM is an integer passed to the procedure. It designates the number of the ccsversion from which the translation table is to be retrieved.

CS\_UPTOLOWCASEV represents an integer that requests the translation of uppercase characters to lowercase. It is one of five options:

Parameter Value	Value Name	Translation Task
5	CS_NUMTOALTDIGV	Numeric characters to alternative digits
6	CS_ALTDIGTONUMV	Alternative digits to numeric characters
7	CS_LOWTOUPCASEV	Lowercase characters to uppercase characters
8	CS_UPTOLOWCASEV	Uppercase characters to lowercase characters
9	CS_ESCMENTPERCHARV	Escapement direction for each character

A `ccsersion` is not required to have a definition for each of these tables. Some of the tables are optional. Options 5, 6, 7, and 8 are not required. A result of `CS_DATA_NOT_FOUNDV` (4002) might be returned if the table has not been defined for the `ccsersion`.

`TTABLE_ARRAY` is an array returned from the procedure. It contains the translate table. The size of this array must be at least 64 words.

`RESULT` is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

<code>CS_ARRAY_TOO_SMALLV</code> (3001)	<code>CS_BAD_ARRAY_DESCRIPTIONV</code> (3000)
<code>CS_BAD_TYPE_CODEV</code> (3006)	<code>CS_DATAOKV</code> (1)
<code>CS_DATA_NOT_FOUNDV</code> (4002)	<code>CS_FAULTV</code> (1001)
<code>CS_FILE_ACCESS_ERRORV</code> (1000)	<code>CS_NO_NUM_FOUNDV</code> (3003)
<code>CS_SOFTERRV</code> (1002)	

## VSNTRANS\_TEXT

This procedure applies a translate table, specified by `TTABLE_TYPE`, to the source text and places the result into `DEST`. The same array can be used for both the source and destination text.

There are five translate table types available. These types include the following:

- Numeric to alternate digits
- Alternate digits to numeric
- Lowercase to uppercase
- Uppercase to lowercase
- Escapement direction for each character

**Example**

This example translates a string in lowercase letters to uppercase letters using the CanadaEBCDIC ccsversion. The *MLS Guide* can be used to determine that the ccsversion number for CanadaEBCDIC is 74. This number can also be retrieved by calling `VALIDATE_NAME_RETURN_NUM` with the name CanadaEBCDIC.

```
BEGIN

$ INCLUDE INTL="SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

DEFINE SOURCE_START = 0 #
      ,DEST_START = 0 #;

FILE OUT(KIND=DISK,UNITS=CHARACTERS,FILEUSE=IO,FILETYPE=0,NEWFILE,
      MAXRECSIZE=80,TITLE="OUT/ALGOL/VSNTRANS_TEXT.");
EBCDIC ARRAY SOURCE[0:6]
      ,DEST[0:6];
INTEGER VSN_NUM
      ,TRANS_LEN
      ,RESULT;

REPLACE SOURCE BY "pæan";
VSN_NUM := 74;
TRANS_LEN := 4;
RESULT := VSNTRANS_TEXT(VSN_NUM, SOURCE, SOURCE_START, DEST,
      DEST_START, TRANS_LEN, CS_LOWTUOUPCASEV);
WRITE(OUT,<"RESULT = ",J4>,RESULT);
IF RESULT EQL CS_DATAOKV THEN
      WRITE(OUT,<"DEST = ",A7>,DEST);
CLOSE(OUT,LOCK);
END.
```

**Output**

```
RESULT = 1
DEST = PÆAN
```

In this call, the parameters have the following meanings:

`VSN_NUM` is an integer passed to the procedure. It contains the number of the ccsversion to be used. The ccsversion contains the rules for translation of text. Refer to the *MLS Guide* for a list of the ccsversion numbers. The values allowed for `VSN_NUM` and the meanings of the values are as follows:

Value	Meaning
Greater than or equal to 0	Use the specified ccsversion number.
-2	Use the system default ccsversion. If the system default ccsversion is not available, an error is returned.

`SOURCE` is an EBCDIC array passed to the procedure. It contains the data to translate.

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---

**SOURCE\_START** is an integer passed to the procedure. It contains the byte offset (0 relative) of **SOURCE** where translation starts.

**DEST** is an EBCDIC array returned by the procedure. It contains the translated text. **DEST** must be at least as large as **DEST\_START** and **TRANS\_LEN**.

**DEST\_START** is an integer returned by the procedure. It indicates the starting offset location where translated text should be placed.

**TRANS\_LEN** is an integer passed to the procedure. It contains the number of characters to translate, beginning at **SOURCE\_START**.

**CS\_LOWTOUPCASEV** represents an integer that requests the translation of all lowercase characters to uppercase. It is one of five options:

Value	Sample Data Name	Meaning
5	CS_NUMTOALTDIGV	Translate numbers 0 through 9 to alternate digits specified in the <b>ccsversion</b> .
6	CS_ALTDIGTONUMV	Translate alternate digits to numbers 0 through 9.
7	CS_LOWTOUPCASEV	Translate all characters from lowercase to uppercase.
8	CS_UPTOLOWCASEV	Translate all characters from uppercase to lowercase.
9	CS_ESCMENTPERCHARV	Translate a character to its escapement value.

A **ccsversion** is not required to have a definition for each of these tables. Some of the tables are optional. Options 5, 6, 7, and 8 are not required. A result of **CS\_DATA\_NOT\_FOUNDV** (4002) might be returned if the table has not been defined for the **ccsversion**. The input text remains the unchanged.

**RESULT** is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_BAD_DATA_LEN (3002)	CS_BAD_TYPE_CODEV (3006)
CS_DATA_NOT_FOUNDV (4002)	CS_DATAOKV (1)
CS_FAULTV (1001)	CS_FILE_ACCESS_ERRORV (1000)
CS_NO_NUM_FOUNDV (3003)	CS_SOFTERRV (1002)

## VSNTRUTHSET

This procedure returns a truth set for the designated **ccsversion**. The truth set contains the characters in a given data class for the **ccsversion**. Truth sets are available for the following data classes:

- Alphabetic
- Numeric
- Space
- Presentation (The characters that can be displayed or printed on a presentation device)

The truth set from VSNTRUTHSET can be retained in working memory. This truth set can then be used with the SCAN statement. This improves performance over a call to VSNINSPECT\_TEXT. Because the table is stored in working memory, it does not have to be retrieved each time it is to be used. This process can improve performance of an application program that performs a high volume of translations.

### Example

This example gets the numeric data class truth set for the CanadaEBCDIC ccsversion. The truth set is returned in the TSET\_ARY. The *MLS Guide* can be used to determine that the ccsversion number for CanadaEBCDIC is 74. This number can also be retrieved by calling VALIDATE\_NAME\_RETURN\_NUM with the name CanadaEBCDIC.

```
BEGIN

$ INCLUDE INTL="SYMBOL/INTL/ALGOL/PROPERTIES." 10000000 - 49999999

FILE OUT(KIND=DISK,UNITS=CHARACTERS,FILEUSE=IO,FILETYPE=0,NEWFILE,
        MAXRECSIZE=80,TITLE="OUT/ALGOL/VSNTRUTH_SET.");
ARRAY TSET_ARY[0:7];
INTEGER VSN_NUM
        ,RESULT;

VSN_NUM := 74;
RESULT := VSNTRUTHSET(VSN_NUM, CS_NUMERICSV, TSET_ARY);
WRITE(OUT,<"RESULT = ",J4>, RESULT);
CLOSE(OUT,LOCK);
END.
```

### Output

```
RESULT = 1
```

In this call, the parameters have the following meanings:

VSN\_NUM is an integer passed to the procedure. It contains the number of the ccsversion from which the truth set is to be retrieved. The ccsversion contains the rules for translation of text. Refer to the *MLS Guide* for a list of ccsversion numbers. The values allowed for VSN\_NUM and the meanings of the values are as follows:

Value	Meaning
Greater than or equal to 0	Use the specified ccsversion number.
-2	Use the system default ccsversion. If the system default ccsversion is not available, an error is returned.

CS\_NUMERICSV represents an integer that indicates the type of truth set to be returned. It is one of six options:

Parameter Value	Value Name	Truth Set Returned
12	CS_ALPHAV	Alphabetic characters
13	CS_NUMERICSV	Numeric characters
14	CS_DISPLAYV	Displayable characters
15	CS_SPACESV	Space characters
16	CS_LOWERCASEV	Lowercase characters
17	CS_UPPERCASEV	Uppercase characters

A ccsversion is not required to have a definition for each of these truth sets. Some of the truth sets are optional. Options 16 and 17 are not required. A result of CS\_DATA\_NOT\_FOUNDV (4002) might be returned if the truth set has not been defined for the ccsversion.

TSET\_ARY is an array returned from the procedure. It contains the truth set table. Unisys recommends that the size of this array be 8 words.

RESULT is an integer returned by the procedure. It indicates whether or not an error occurred during the execution of the procedure. An explanation of the error result values and messages can be found at the end of this section. Possible values returned by this procedure are:

CS_ARRAY_TOO_SMALLV (3001)	CS_BAD_ARRAY_DESCRIPTIONV (3000)
CS_BAD_TYPE_CODEV (3006)	CS_DATA_NOT_FOUNDV (4002)
CS_DATAOKV (1)	CS_FAULTV (1001)
CS_FILE_ACCESS_ERRORV (1000)	CS_NO_NUM_FOUNDV (3003)
CS_SOFTERRV (1002)	

## Explanation of Error Values

All of the procedures in the CENTRALSUPPORT library return integer results to indicate the success or failure of the procedure.

The range 1 through 999 indicates that the procedure call completed successfully.

The range 1000 through 1999 consists of error messages caused by a Unisys software error.

Values from 2000 through 2999 contain error messages in which the caller passed invalid data to a procedure, but the CENTRALSUPPORT library was able to return some valid data.

Values from 3000 through 3999 contain error messages in which the caller passed invalid data to a CENTRALSUPPORT procedure, and the CENTRALSUPPORT library was unable to return any valid data.

Values from 4000 through 4999 contain error messages in which the caller passed data for which the CENTRALSUPPORT library could find no return information. The CENTRALSUPPORT library completed the request, but no data was returned.

Table 9-2 lists the possible error results, their values, and the specific description part of the message. For a list of the complete error messages and for information about corrective action to be taken if an error occurs, see the *MLS Guide*.

**Table 9–2. Error Results for Internationalization**

Result	Value	Specific Description
CS_ARRAY_TOO_SMALLV	3001	The output array size is smaller than the length of the data it is supposed to contain.
CS_BAD_ALT_FRAC_DIGITSV	3017	The international-fractional-digits value is either missing or out of range.
CS_BAD_ARRAY_DESCRIPTIONV	3000	A parameter was incorrectly specified as less than or equal to 0 (zero).
CS_BAD_CPLV	3028	The characters-per-line value is either missing or it is out of range.
CS_BAD_DATA_LEN	3002	At least one array length is invalid or the offset + length is greater than the size of the array.
CS_BADDATEINPUTV	3012	Date component specifies a value out of range.
CS_BAD_FLAGV	3007	The flag specified is out of acceptable range.
CS_BAD_FRACDIGITSV	3016	The fractional digits value is either missing or out of range.
CS_BAD_HEXCODEV	3042	An invalid character was encountered in a hex value representing a symbol in a monetary or numeric template.
CS_BAD_INPUTVALV	3035	The input value did not contain digits or an expected symbol was missing.
CS_BAD_LDATETEMPV	3018	The long date template is either missing or contains invalid information.

continued



Table 9–2. Error Results for Internationalization (cont.)

Result	Value	Specific Description
CS_BAD_LPPV	3027	The lines-per-page value is either missing or it is out of range.
CS_BAD_LTIMETEMPV	3021	The long time template is either missing or it contains invalid information.
CS_BAD_MAXDIGITSV	3015	The maximum digits value is either missing or out of range.
CS_BAD_MINDIGITSV	3032	The mindigits field in a "t" control character in a monetary or numeric template is out of range.
CS_BAD_MONTEMPV	3023	The monetary template is either missing or it contains invalid information.
CS_BAD_NDATETEMPV	3020	The numeric date template is either missing or contains invalid information.
CS_BAD_NTIMETEMPV	3022	The numeric time template is either missing or contains invalid information.
CS_BAD_NUMTEMPV	3024	The numeric template is either missing or it contains invalid information.
CS_BAD_PRECISIONV	3038	The "PRECISION" parameter value is out of range.
CS_BAD_SDATETEMPV	3019	The short date template is either missing or it contains invalid information.
CS_BAD_TEMPCHARV	3011	An invalid control character was detected in the template.
CS_BAD_TEMPLNV	3030	An invalid template length value was encountered.
CS_BAD_TEXT_PARAMV	3008	The space for OSVs or total storage allocated in OUTPUT is not big enough for OSVs and/or PSVs.
CS_BADTIMEINPUTV	3013	TIME component specifies a value out of range.
CS_BAD_TYPE_CODEV	3006	The type code specified is out of the acceptable range.
CS_CNV_EXISTS_ERRV	3014	An attempt was made to add a new convention with the name of an existing convention.
CS_CNVFILE_NOTPRESENTV	3037	A standard convention definition cannot be added, modified, or deleted.

continued

Table 9–2. Error Results for Internationalization (cont.)

Result	Value	Specific Description
CS_CNV_NOTAVAILV	3036	Specified convention does not exist and cannot be retrieved, modified or deleted.
CS_CONVENTION_NOT_FOUNDV	2002	The data is not in the requested convention; it is in MYSELF.CONVENTION or the SYSTEM CONVENTION.
CS_DATA_NOT_FOUNDV	4002	The requested data was not found.
CS_DATAOKV	1	Your request has been processed.
CS_DEL_PERMANENT_CNV_ERRV	3040	The named convention is a standard convention and cannot be modified or deleted.
CS_FALSEV	0	Your request has been processed.
CS_FAULTV	1001	An unexpected fault occurred in CENTRALSUPPORT. Your request cannot be processed at this time.
CS_FIELD_TRUNCATEDV	2003	The date or time component was too long and was truncated.
CS_FILE_ACCESS_ERRORV	1000	An error occurred while accessing the SYSTEM/CCSFILE or the SYSTEM/CONVENTIONS file.
CS_INCOMPLETE_DATAV	2004	Only partial data is being returned. There was insufficient space in the output array.
CS_LANGUAGE_NOT_FOUNDV	2001	The data is not in the requested language. It is in MYSELF.LANGUAGE or the SYSTEM LANGUAGE or the first available LANGUAGE.
CS_MISSING_RBRACKETV	3033	A right bracket "]" is required to terminate a "t" control character symbol definition list.
CS_MISSING_TCCOLONV	3034	An expected colon ":" is missing from the "t" control character in a monetary or numeric template.
CS_MUTUAL_EXCLUSIVEV	3031	A mutually exclusive combination of control characters has been encountered in a monetary or numeric template.

continued

**Table 9–2. Error Results for Internationalization (cont.)**

<b>Result</b>	<b>Value</b>	<b>Specific Description</b>
CS_NO_ALTCURR_DELIMV	3043	The international currency notation is missing a required terminating delimiter.
CS_NO_CNVCNAMEV	3039	A required convention name was not provided.
CS_NO_HEXCODE_DELIMV	3041	A hexadecimal value representing a symbol in a monetary or numeric template is missing a required delimiter.
CS_NO_MSGNUM_FOUNDV	3005	The requested number was not found.
CS_NO_NAME_FOUNDV	3004	The requested name was not found.
CS_NO_NUM_FOUNDV	3003	The requested number was not found.
CS_REQSYMBOLV	3029	A required symbol in either the monetary or the numeric template is missing.
CS_SOFTERRV	1002	A CENTRALSUPPORT software error was detected. Your request cannot be processed at this time.

# Appendix A

## Run-Time Format-Error Messages

### Free-field Input

The meanings of the format-error numbers pertaining to free-field input are given in the following table.

Number	Error Message
400	An error occurred on free-field input.
416	Evaluation of a list element caused an I/O action on the current file.
420	Input from the <core-to-core file part> required more records than allowed by the <core-to-core blocking part>.
442	The input data corresponding to a single-precision list element consisted of a hexadecimal string of more than 12 significant digits.
443	The input data contained a hexadecimal string containing nonhexadecimal characters.
444	The input data corresponding to a double-precision list element consisted of a hexadecimal string of more than 24 significant digits.
462	The next list element was a pointer, and the corresponding input data consisted of a quoted string that had been only partially assigned.
467	The input data contained a value greater than the maximum value allowed for the corresponding list element.
473	The input data contained a string with no trailing quotation mark character.
484	An expression was used as a list element on input.

### Formatted Output

The meanings of the format-error numbers pertaining to formatted output are given in the following table.

Number	Error Message
100	An error occurred on formatted output.
102	The editing phrase letter was V, and the data specified by the list element did not produce an A, C, D, E, F, G, H, I, J, K, L, O, P, R, S, T, U, X, or Z in the appropriate character position.
103	The editing phrase was of the form rV, and the resulting specifier required a <field width>.

*continued*

## Run-Time Format-Error Messages

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*continued*

<b>Number</b>	<b>Error Message</b>
104	The editing phrase was of the form rV, and the resulting specifier required a <field width> and <decimal places>.
105	The editing phrase was of the form Fw.d, and d was less than zero.
106	The editing phrase used was Fw.d, and d was less than zero.
107	The editing phrase used was Ew.d or Dw.d, and d was less than zero.
109	The editing phrase used was Zw, and the corresponding list element was not of type INTEGER or BOOLEAN.
110	The type of the input data was not compatible with the type of the corresponding list element.
111	The editing phrase was of the form Zw.d. The phrase chosen to edit the output was Ew.d, but d was less than zero.
113	The editing phrase used was Ew.d or Dw.d, and w was less than or equal to d.
114	The value of a dynamic w or d part was greater than the maximum allowable integer (549,755,813,887).
116	Evaluation of a list element caused an I/O action on the current file (recursive I/O).
117	An attempt was made to write a number of characters greater than the record size.
120	Output to the <core-to-core file part> required more records than allowed by the <core-to-core blocking part>.
131	The value of a dynamic r part was greater than the maximum allowable real value (4.31359146673 * 10**68).
132	The value of a dynamic w part was greater than the maximum allowable integer (549,755,813,887).
133	The value of a dynamic d part was greater than the maximum allowable integer (549,755,813,887).
163	The record size was not large enough to allow the free-field write specified.

## Formatted Input

The meanings of the format-error numbers pertaining to formatted input are given in the following table.

<b>Number</b>	<b>Error Message</b>
200	An error occurred on formatted input.
202	The editing phrase letter was V, and the data specified by the list element did not produce an A, C, D, E, F, G, H, I, J, K, L, O, P, R, S, T, U, X, or Z in the appropriate character position.

*continued*

*continued*

<b>Number</b>	<b>Error Message</b>
203	The editing phrase was of the form rV, and the resulting specifier required a <field width>.
204	The editing phrase was of the form rV, and the resulting specifier required a <field width> and <decimal places>.
205	The editing phrase was of the form rVw, and the resulting specifier required <decimal places>.
206	The editing phrase used was Fw.d, and d was less than zero.
207	The editing phrase used was Ew.d or Dw.d, and d was less than zero.
209	The editing phrase used was Zw, and the corresponding list element was not of type INTEGER or BOOLEAN.
210	The type of a list element was incompatible with the corresponding editing phrase.
213	The editing phrase used was Ew.d or Dw.d, and w was less than or equal to d.
214	The value of a dynamic w or d part was greater than the maximum allowable integer (549,755,813,887).
216	Evaluation of a list element caused an I/O action on the current file (recursive I/O).
217	An attempt was made to read a number of characters greater than the record size.
218	The editing phrase letter was H or K, but the input data contained nonblank, nonhexadecimal characters or nonblank, nonoctal characters, respectively.
220	Input from the <core-to-core file part> required more records than allowed by the <core-to-core blocking part>.
231	The value of a dynamic r part was greater than the maximum allowable real value (4.31359146673 * 10**68).
232	The value of a dynamic w part was greater than the maximum allowable integer (549,755,813,887).
233	The value of a dynamic d part was greater than the maximum allowable integer (549,755,813,887).
250	Input was attempted using a U editing phrase.
271	Input was attempted using a \$ or P format modifier.
281	The input data was invalid for an I editing phrase.
284	An expression was used as a list element on input.
285	The list element was of type REAL, but the corresponding input data contained a value greater than the maximum allowable real value (4.31359146673 * 10**68).

*continued*

## Run-Time Format-Error Messages

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*continued*

<b>Number</b>	<b>Error Message</b>
286	The list element was of type INTEGER or BOOLEAN, but the input data contained a value greater than the maximum allowable integer (549,755,813,887).
291	The input data corresponding to a numeric editing phrase contained a nondigit character in the exponent part following at least one valid digit.
292	The input data corresponding to a numeric editing phrase contained more than one sign in the exponent part.
293	The input data corresponding to a numeric editing phrase contained an invalid character after the exponent sign and before the exponent value.
294	The input data corresponding to a numeric editing phrase contained an invalid character after the decimal point.
295	The input data corresponding to a numeric editing phrase contained more than one sign in the mantissa.

# Appendix B

## Reserved Words

A reserved word in Extended ALGOL has the same syntax as an identifier. The reserved words are divided into three types.

A reserved word of type 1 can never be declared as an identifier; that is, it has a predefined meaning that cannot be changed. For example, because LIST is a type 1 reserved word, the following declaration is flagged with a syntax error:

```
ARRAY LIST[0:999]
```

A reserved word of type 2 can be redeclared as an identifier; it then loses its predefined meaning in the scope of that declaration. For example, because IN is a type 2 reserved word, the following declaration is legal:

```
FILE IN(KIND = READER)
```

However, in the scope of the declaration, the following statement is flagged with a syntax error on the word *IN*:

```
SCAN P WHILE IN ALPHA
```

If a type 2 reserved word is used as a variable in a program but it is not declared as a variable, then the error message that results is not the expected *UNDECLARED IDENTIFIER*. Instead, it might be *NO STATEMENT CAN START WITH THIS*.

A reserved word of type 3 is context-sensitive. It can be redeclared as an identifier, and if it is used where the syntax calls for that reserved word, it carries the predefined meaning; otherwise, it carries the user-declared meaning. The different meanings for the type 3 reserved word STATUS are illustrated in the following example.

```
BEGIN
  TASK T;
  REAL STATUS;
  % IN THE NEXT STATEMENT, "STATUS" IS A REAL VARIABLE
  STATUS := 4.5;
  % IN THE NEXT STATEMENT, "STATUS" IS A TASK ATTRIBUTE
  IF T.STATUS = VALUE(TERMINATED) THEN
    % IN THE NEXT STATEMENT, "STATUS" IS A REAL VARIABLE
    STATUS := 10.0;
END.
```



## Reserved Words

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Type 3 reserved words include the following:

- File attribute names
- Task attribute names
- Library attribute names
- Direct array attribute names
- Mnemonics for attribute values

All file attributes, direct array attributes, and mnemonics described in the *A Series File Attributes Programming Reference Manual* are type 3 reserved words in ALGOL.

## Reserved Words List

The following is an alphabetical list of reserved words for Extended ALGOL. The number in parentheses following each word indicates the type of the reserved word. For example, *FOR (1)* indicates that FOR is a type 1 reserved word.

ABORTTRANSACTION (2)	ABS(2)	ACCEPT(2)
ACTUALNAME(3)	AFTER(2)	ALL (2)
ALPHA(1)	ALPHA6(3)	ALPHA7(3)
ALPHA8(3)	AND(2)	ANYFAULT(3)
APPLYINSERT (2)	APPLYMODIFY (2)	ARCCOS (2)
ARCSIN (2)	ARCTAN (2)	ARCTAN2 (2)
ARRAY(1)	ARRAYS(3)	ARRAYSEARCH (2)
AS(3)	ASCII (2)	ASCIITOBCL(3)
ASCIITOEBCDIC(3)	ASCIITHEX(3)	ATANH (2)
ATTACH (2)	AVAILABLE (2)	BACKUPPREFIX (3)
BASE (3)	BCL (2)	BCLTOASCII (3)
BCLTOEBCDIC (3)	BCLTOHEX (3)	BEFORE(2)
BEGIN(1)	BOOLEAN(1)	BY (2)
BYFUNCTION(3)	BYTITLE(3)	CABS (2)
CALL (2)	CALLING (2)	CANCEL (2)
CANCELTRPOINT (2)	CASE (2)	CAT (2)
CAUSE (2)	CAUSEANDRESET (2)	CCOS (2)
CEXP (2)	CHANGEFILE (2)	CHARGECODE (3)
CLASS (3)	CHECKPOINT (2)	CHECKSUM (2)
CLN (2)	CLOSE (2)	CODE(3)
COMMENT(1)	COMPILETIME (2)	COMPILETYPE (3)
COMPLEX (2)	CONJUGATE (2)	CONTROL (3)
CONTINUE(1)	COREESTIMATE (3)	COS (2)

*continued*

*continued*

COSH (2)	COTAN (2)	CRUNCH(3)
CSIN (2)	CSQRT (2)	CURRENT (2)
DABS (2)	DALPHA (2)	DAND (2)
DARCCOS (2)	DARCSIN (2)	DARCTAN (2)
DARCTAN2 (2)	DBS(3)	DCOS (2)
DCOSH (2)	DEALLOCATE (2)	DECIMAL (2)
DECIMALPOINTISCOMMA(3)	DECLAREDRIORITY(3)	DEFINE (2)
DELINKLIBRARY (2)	DELTA (2)	DEQV (2)
DERF (2)	DERFC (2)	DETACH (2)
DEXP (2)	DGAMMA (2)	DICTIONARY (2)
DIGITS (2)	DIMP (2)	DINTEGER (2)
DIRECT(1)	DISABLE (2)	DISCARD(3)
DISK(3)	DISKPACK(3)	DISPLAY (2)
DIV (2)	DLGAMMA (2)	DLN (2)
DLOG (2)	DONTWAIT (2)	DMABS (2)
DMAVG (2)	DMAX (2)	DMCHR (2)
DMCONTAINS (2)	DMCOUNT (2)	DMEQUIV (2)
DMEXCEPTIONINFO (2)	DMEXCEPTIONMSG (2)	DMEXCLUDES (2)
DMEXITS (2)	DMEXT (2)	DMFUNCTION (2)
DMIN (2)	DMISA (2)	DMLENGTH (2)
DMMATCH (2)	DMMAX (2)	DMMIN (2)
DMNEXTEXCEPTION (2)	DMPOS (2)	DMPRED (2)
DMRECORD(2)	DMROUND (2)	DMRPT (2)
DMSQRT (2)	DMSUCC (2)	DMSUM (2)
DMTRUNC (2)	DMUPDATECOUNT (2)	DNABS (2)
DNORMALIZE (2)	DNOT (2)	DO(1)
DOR (2)	DOUBLE(1)	DROP (2)
DSCALELEFT (2)	DSCALERIGHT (2)	DSCALERIGHTT (2)
DSIN (2)	DSINH (2)	DSQRT (2)
DTAN (2)	DTANH (2)	DUMP (2)
EBCDIC (2)	EBCDICTOASCII (3)	EBCDICTOBCL (3)
EBCDICTOHEX (3)	EGI(2)	ELAPSEDTIME(3)
ELSE(1)	EMI(2)	EMPTY (2)
EMPTY4 (2)	EMPTY7 (2)	EMPTY8 (2)

*continued*

## Reserved Words

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*continued*

ENABLE (2)	END(1)	ENTIER (2)
ENTITY (2)	EQL (2)	EQV(2)
ERF (2)	ERFC (2)	ESI(2)
EVENT(1)	EXCEPTIONEVENT(3)	EXCEPTIONTASK(3)
EXCHANGE (2)	EXCLUDE (2)	EXITS (2)
EXP (2)	EXPONENTOVERFLOW(3)	EXPONENTUNDERFLOW(3)
EXPORT (2)	EXTERNAL (2)	FALSE(1)
FAMILY(3)	FILE(1)	FILECARDS(3)
FILES(3)	FILL (2)	FIRST (2)
FIRSTONE(2)	FIRSTWORD (2)	FIX (2)
FOR(1)	FORMAL (2)	FORMAT(1)
FORWARD (2)	FUNCTIONNAME(3)	FREE (2)
FREEZE (2)	GAMMA (2)	GEQ (2)
GO(1)	GTR (2)	HAPPENED (2)
HEAD (2)	HEX (2)	HEXTOASCII (3)
HEXTOBCL (3)	HEXTOEBCDIC (3)	HISTORY(3)
IF(1)	IMAG (2)	IMP (2)
IN (2)	INCLUDE (2)	INITIATOR(3)
INPUTHEADER(2)	INTEGER(1)	INTEGEROVERFLOW(3)
INTEGERT (2)	INTERRUPT (2)	INTNAME(3)
INVALIDADDRESS(3)	INVALIDINDEX(3)	INVALIDOP(3)
INVALIDPROGRAMWORD(3)	IS (2)	ISNT (2)
INVERSE (2)	ISYS (2)	JOBNUMBER(3)
LABEL(1)	LB (2)	LENGTH (2)
LEQ (2)	LIBACCESS(3)	LIBERATE (2)
LIBPARAMETER(3)	LIBRARIES(3)	LIBRARY (2)
LINE (2)	LINENUMBER (2)	LINKLIBRARY (2)
LIST(1)	LISTLOOKUP (2)	LN (2)
LNGAMMA (2)	LOCK (2)	LOCKED (3)
LOG (2)	LONG(1)	LOOP(3)
LSS (2)	MASKSEARCH (2)	MAX (2)
MAXCARDS (3)	MAXIOTIME (3)	MAXLINES (3)
MAXPROCTIME (3)	MEMORYPARITY(3)	MEMORYPROTECT(3)
MERGE (2)	MESSAGECOUNT(2)	MESSAGESEARCHER (2)

*continued*

*continued*

MIN (2)	MLSACCEPT(2)	MLSDISPLAY(2)
MOD (2)	MODIFY (2)	MONITOR (2)
MUX (2)	MYJOB (2)	MYSELF (2)
NABS (2)	NAME (3)	NEQ (2)
NO (2)	NOCR(2)	NOLF(2)
NONE (2)	NORMALIZE (2)	NOT (2)
NULL(3)	NUMERIC (2)	OF (2)
OFFER(3)	OFFSET (2)	ON (2)
ONES (2)	OPEN (2)	OPTION (3)
OR (2)	ORDER (2)	ORGUNIT (3)
OUT(3)	OUTPUTHEADER(2)	OUTPUTMESSAGE (2)
OWN(1)	PACK(3)	PAGED(3)
PARTNER(3)	PERMANENT(3)	PICTURE (2)
POINTER(1)	POTC (2)	POTH (2)
POTL (2)	PRIVATELIBRARIES(3)	PROCEDURE(1)
PROCESS (2)	PROCESSID (2)	PROCESSIONTIME (3)
PROCESSTIME (3)	PROCURE (2)	PROGRAMDUMP (2)
PROGRAMMEDOPERATOR(3)	PURGE (2)	QUERY (2)
RANDOM (2)	RB (2)	READ (2)
READLOCK (2)	REAL(1)	RECEIVE(2)
RECORD(2)	REEL(3)	REFERENCE(1)
REMAININGCHARS (2)	REMOVEFILE (2)	REPEAT (2)
REPLACE (2)	RESET (2)	RESIZE (2)
RESTART (3)	RETAIN(3)	RETRIEVE (2)
REWIND (2)	RUN (2)	SAVETRPOINT (2)
SCALELEFT (2)	SCALERIGHT (2)	SCALERIGHTF (2)
SCALERIGHTT (2)	SCAN (2)	SCANPARITY(3)
SDIGITS (2)	SECONDWORD (2)	SEEK (2)
SELECT (2)	SEND(2)	SET (2)
SETACTUALNAME(2)	SETTOCHILD (2)	SETTOPARENT (2)
SIBS(3)	SIGN (2)	SIN (2)
SINGLE (2)	SINH (2)	SIZE (2)
SKIP (2)	SOME (2)	SORT (2)
SPACE (2)	SQRT (2)	STACKER (2)

*continued*

## Reserved Words

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*continued*

STACKNO (3)	STACKSIZE (3)	STARTINSERT (2)
STARTMODIFY (2)	STARTTIME (3)	STATION (2)
STATUS (3)	STEP(1)	STOP (2)
STOPPOINT (3)	STRING (2)	STRINGPROTECT(3)
STRING4 (2)	STRING7 (2)	STRING8 (2)
SUBFILE (2)	SUBROLE (2)	SWITCH(1)
SYNCHRONIZE(3)	TADS(3)	TAIL (2)
TAKE (2)	TAN (2)	TANH (2)
TARGETTIME (3)	TASK(1)	TASKATTERR (3)
TASKFILE(3)	TASKVALUE (3)	TERMINAL(2)
THEN(1)	THRU (2)	TIME (2)
TIMELIMIT (2)	TIMES (2)	TITLE(3)
TO (2)	TRANSITIVE (2)	TRANSLATE (2)
TRANSLATETABLE(1)	TRUE(1)	TRUTHSET(1)
URGENT(3)	USERCODE(3)	WAIT (2)
WAITANDRESET (2)	WHEN (2)	WITH (2)
WORDS (2)	WRITE (2)	TYPE (2)
UNTIL(1)	USING (2)	VALUE(1)
WHERE (2)	WHILE(1)	ZERODIVIDE(3)
ZIP(1)		

## Reserved Words by Type

### Type 1 Reserved Words

ALPHA	ARRAY	BEGIN
BOOLEAN	COMMENT	CONTINUE
DIRECT	DO	DOUBLE
ELSE	END	EVENT
FALSE	FILE	FOR
FORMAT	GO	IF
INTEGER	LABEL	LIST
LONG	OWN	POINTER
PROCEDURE	REAL	REFERENCE
STEP	SWITCH	TASK

*continued*

*continued*

THEN	TRANSLATETABLE	TRUE
TRUTHSET	UNTIL	VALUE
WHILE	ZIP	

**Type 2 Reserved Words**

ABORTTRANSACTION	ABS	ACCEPT
AFTER	ALL	AND
APPLYINSERT	APPLYMODIFY	ARCCOS
ARCSIN	ARCTAN	ARCTAN2
ARRAYSEARCH	ASCII	ATANH
ATTACH	AVAILABLE	BCL
BEFORE	BY	CABS
CALL	CALLING	CANCEL
CANCELTRPOINT	CASE	CAT
CAUSE	CAUSEANDRESET	CCOS
CEXP	CHANGEFILE	CHECKPOINT
CHECKSUM	CLN	CLOSE
COMPILETIME	COMPLEX	CONJUGATE
COS	COSH	COTAN
CSIN	CSQRT	CURRENT
DABS	DALPHA	DAND
DARCCOS	DARCSIN	DARCTAN
DARCTAN2	DCOS	DCOSH
DEALLOCATE	DECIMAL	DEFINE
DELINKLIBRARY	DELTA	DEQV
DERF	DERFC	DETACH
DEXP	DGAMMA	DICTIONARY
DIGITS	DIMP	DINTEGER
DISABLE	DISCARD	DISPLAY
DIV	DLGAMMA	DLN
DLOG	DMABS	DMAVG
DMAX	DMCHR	DMCONTAINS
DMCOUNT	DMEQUIV	DMEXCEPTIONINFO
DMEXCEPTIONMSG	DMEXCLUDES	DMEXITS
DMEXT	DMFUNCTION	DMIN

*continued*

## Reserved Words

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*continued*

DMISA	DMLENGTH	DMMATCH
DMMAX	DMMIN	DMNEXTEXCEPTION
DMPOS	DMPRED	DMRECORD
DMROUND	DMRPT	DMSQRT
DMSUCC	DMSUM	DMTRUNC
DMUPDATECOUNT	DNABS	DNORMALIZE
DNOT	DONTWAIT	DOR
DROP	DSCALELEFT	DSCALERIGHT
DSCALERIGHTT	DSIN	DSINH
DSQRT	DTAN	DTANH
DUMP	EBCDIC	EGI
EMI	EMPTY	EMPTY4
EMPTY7	EMPTY8	ENABLE
ENTIER	ENTITY	EQL
ERF	ERFC	ESI
EXCLUDE	EXITS	EXCHANGE
EXP	EQV	EXPORT
EXTERNAL	FILL	FIRST
FIRSTONE	FIRSTWORD	FIX
FORMAL	FORWARD	FREE
FREEZE	GAMMA	GEQ
GTR	HAPPENED	HEAD
HEX	IMAG	IMP
IN	INCLUDE	INPUTHEADER
INTEGERT	INTERRUPT	INVERSE
IS	ISNT	ISYS
LB	LENGTH	LEQ
LIBERATE	LIBRARY	LINE
LINENUMBER	LINKLIBRARY	LISTLOOKUP
LN	LNGAMMA	LOCK
LOG	LSS	MASKSEARCH
MAX	MERGE	MESSAGECOUNT
MESSAGESEARCHER	MIN	MLSACCEPT
MLSDISPLAY	MOD	MODIFY
MONITOR	MUX	MYJOB

*continued*

*continued*

MYSELF	NABS	NEQ
NO	NOCR	NOLF
NONE	NORMALIZE	NOT
NUMERIC	OF	OFFSET
ON	ONES	OPEN
OR	ORDER	OUTPUTHEADER
OUTPUTMESSAGE	PICTURE	POTC
POTH	POTL	PROCESS
PROCESSID	PROCURE	PROGRAMDUMP
PURGE	QUERY	RANDOM
RB	READ	READLOCK
RECEIVE	RECORD	REMAININGCHARS
REMOVEFILE	REPEAT	REPLACE
RESET	RESIZE	REWIND
RUN	RETRIEVE	SAVETRPOINT
SELECT	SEND	SETTOCHILD
SETTOPARENT	SOME	STARTINSERT
STARTMODIFY	SUBROLE	TERMINAL
TRANSITIVE	TYPE	USING
WHERE	SCALELEFT	SCALERIGHT
SCALERIGHTF	SCALERIGHTT	SCAN
SDIGITS	SECONDWORD	SEEK
SET	SETACTUALNAME	SIGN
SIN	SINGLE	SINH
SIZE	SKIP	SORT
SPACE	SQRT	STACKER
STATION	STOP	STRING
STRING4	STRING7	STRING8
SUBFILE	TAIL	TAKE
TAN	TANH	THRU
TIME	TIMELIMIT	TIMES
TO	TRANSLATE	WAIT
WAITANDRESET	WHEN	WITH
WORDS	WRITE	



## Reserved Words

---

### Type 3 Reserved Words

ACTUALNAME	ALPHA6	ALPHA7
ALPHA8	ANYFAULT	ARRAYS
AS	ASCIITOBCL	ASCIITOEBCDIC
ASCIITOHX	BACKUPPREFIX	BASE
BCLTOASCII	BCLTOEBCDIC	BCLTOHEX
BYTITLE	BYFUNCTION	CHARGECODE
CLASS	CODE	COMPILETYPE
CONTROL	COREESTIMATE	CRUNCH
DBS	DECIMALPOINTISCOMMA	DECLAREDPRORITY
DISK	DISKPACK	EBCDICTOASCII
EBCDICTOBCL	EBCDICTOHX	ELAPSEDTIME
EXCEPTIONEVENT	EXCEPTIONTASK	EXPONENTOVERFLOW
EXPONENTUNDERFLOW	FAMILY	FILECARDS
FILES	FUNCTIONNAME	HEXTOASCII
HEXTOBCL	HEXTOEBCDIC	HISTORY
INITIATOR	INTEGEROVERFLOW	INTNAME
INVALIDADDRESS	INVALIDINDEX	INVALIDOP
INVALIDPROGRAMWORD	JOBNUMBER	LIBACCESS
LIBPARAMETER	LIBRARIES	LOCKED
LOOP	MEMORYPARITY	MEMORYPROTECT
MAXCARDS	MAXIOTIME	MAXLINES
MAXPROCTIME	NAME	NULL
OFFER	OPTION	ORGUNIT
OUT	PACK	PAGED
PARTNER	PERMANENT	PRIVATELIBRARIES
PROCESSIONTIME	PROCESSTIME	PROGRAMMEDOPERATOR
REEL	RESTART	RETAIN
SCANPARITY	SIBS	STACKNO
STACKSIZE	STARTTIME	STATUS
STOPPOINT	STRINGPROTECT	SUBSPACES
SYNCHRONIZE	TADS	TARGETTIME
TASKATTERR	TASKFILE	TASKVALUE
TEMPORARY	TITLE	TYPE
URGENT	USERCODE	ZERODIVIDE

# Appendix C

## Data Representation

### Field Notation

The notation  $[m:n]$  is used in this manual to describe fields within data words. The 48 accessible bits of a data word are considered to be numbered, with the leftmost bit numbered as bit 47 and the rightmost bit numbered as bit 0. In the notation  $[m:n]$ ,  $m$  denotes the number of the leftmost bit of the field being described, and  $n$  denotes the number of bits in the field. For example, the field indicated by the shaded area in Figure C-1 (bits 28 through 24) is described as  $[28:5]$ .

47	43	39	35	31	27	23	19	15	11	7	3
46	42	38	34	30	26	22	18	14	10	6	2
45	41	37	33	29	25	21	17	13	9	5	1
44	40	36	32	28	24	20	16	12	8	4	0

Figure C-1. Field Notation,  $[28:5]$

All data words have a field associated with them that is called the tag of the word. The tag identifies the type of the data word; that is, whether the word is an operand, descriptor, and so on. The tag is not accessible to ALGOL programs.

Hexadecimal format is used extensively in this manual to indicate word contents. This format is particularly suited to describe the value of a data word, because each hexadecimal digit indicates the contents of a 4-bit field. Such fields can be visualized as the columns in Figure C-1.

### Character Representation

Characters are stored in fields of one, two, three, four, six, or eight bits. In the table below, the Character Type column lists the valid ALGOL character types. The Field Size and Bits Used columns show the field size in bits and the number of bits within that field, respectively, that are used for storing each type of character. The Valid Constructs column shows the character-oriented ALGOL constructs that are used to manipulate each character type.

## Data Representation

---

Character Type	Field Size	Bits Used	Valid Constructs
EBCDIC	8	8	Pointer, character array, string, string literal
ASCII	8	7	Pointer, character array, string, string literal
BCL	6	6	Pointer, character array, string literal
Hexadecimal (HEX)	4	4	Pointer, character array, string, string literal
Octal	3	3	String literal
Quaternary	2	2	String literal
Binary	1	1	String literal

Figures C-2 through C-5 illustrate how the various character types are stored within a data word.

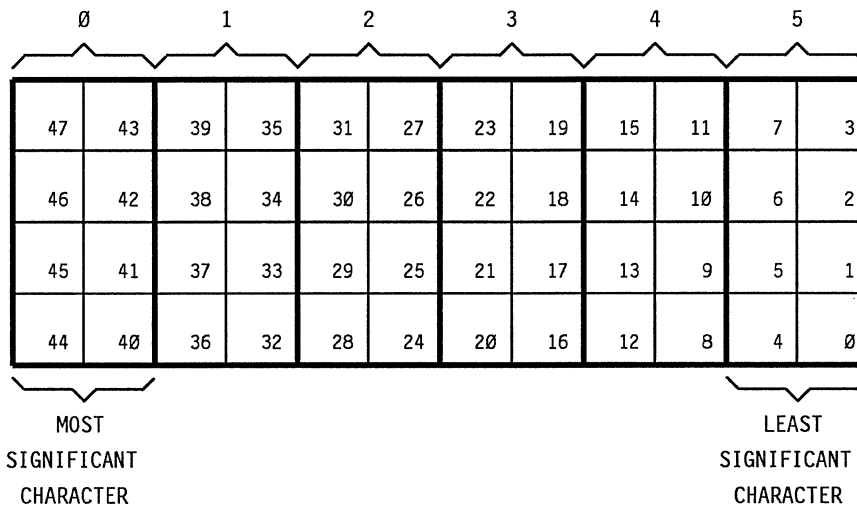


Figure C-2. EBCDIC Characters (8-bit Fields)

Figure C-3 shows that ASCII characters, which are 7-bit characters, are stored in 8-bit fields (as are EBCDIC characters). The zeros shown for bits 7, 15, 23, 31, 39, and 47 indicate that these bits are 0 when ASCII characters are stored.

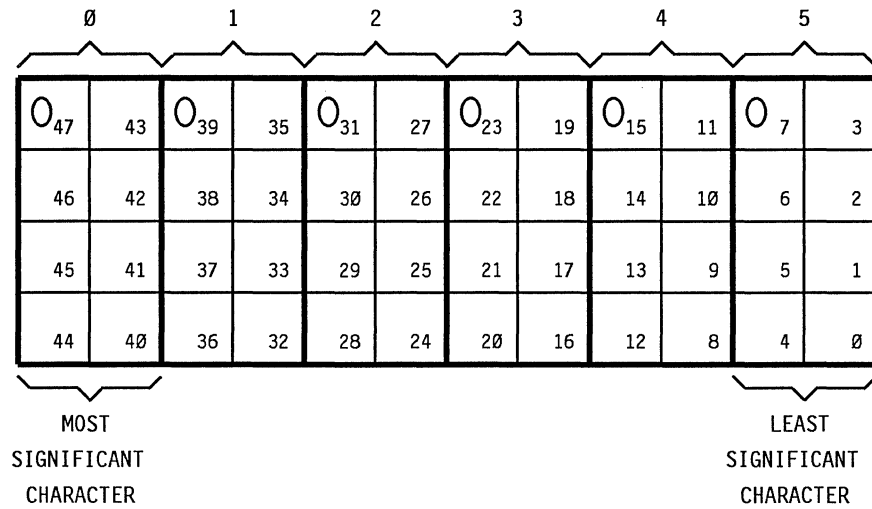


Figure C-3. ASCII Characters (8-bit Fields)

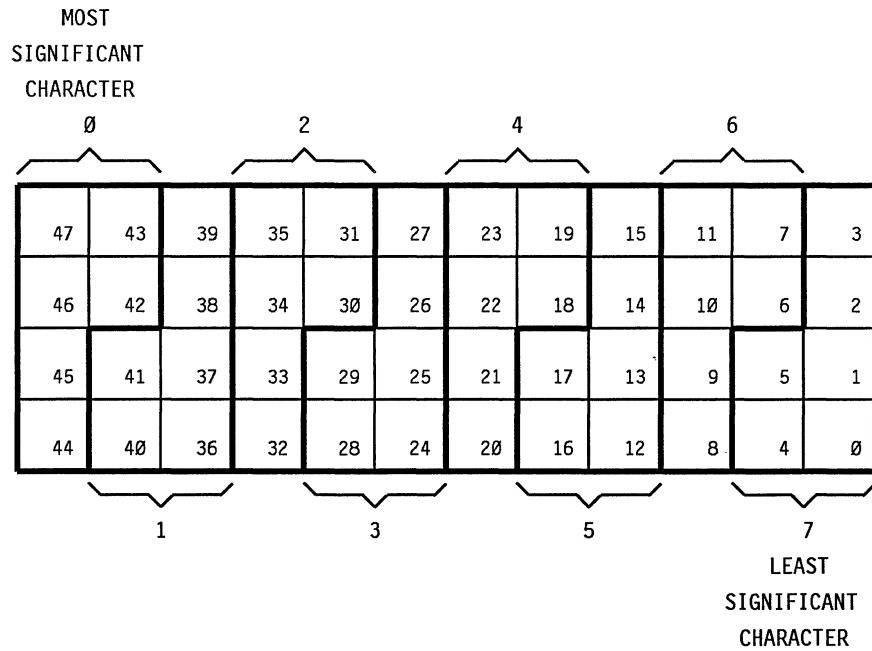


Figure C-4. BCL Characters (6-bit Fields)

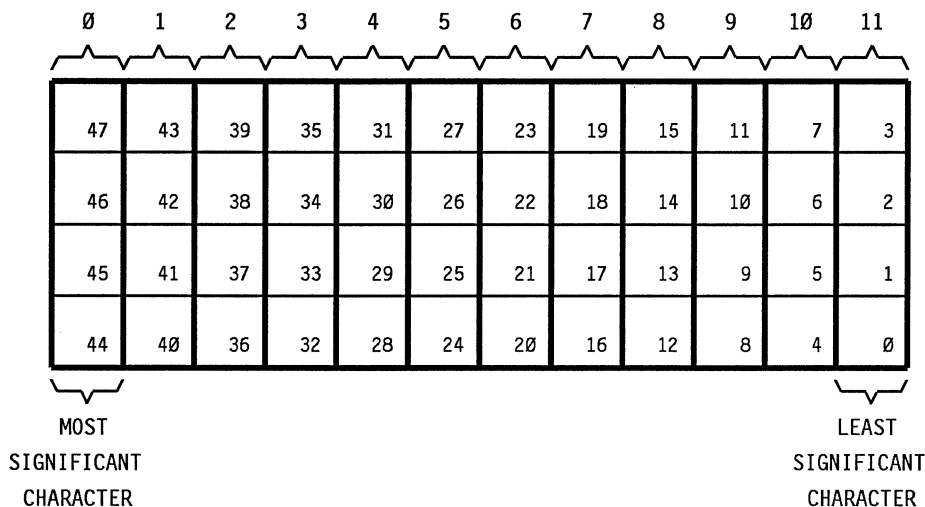


Figure C-5. Hexadecimal Characters (4-bit Fields)

## Character Values and Graphics

The following is a list of the 256 EBCDIC values represented in binary, octal, decimal, and hexadecimal formats. The corresponding BCL, ASCII, and EBCDIC graphics (as they appear when printed using an EBCDIC96 print train) are also shown. In the EBCDIC column, corresponding standard mnemonics appear for some nonprintable EBCDIC values.

Binary	Octal	Decimal	Hexadecimal	BCL	ASCII	EBCDIC
00000000	000	0	00	0	NUL	NUL
00000001	001	1	01	1	SOH	SOH
00000010	002	2	02	2	STX	STX
00000011	003	3	03	3	ETX	ETX
00000100	004	4	04	4	EOT	
00000101	005	5	05	5	ENQ	HT
00000110	006	6	06	6	ACK	
00000111	007	7	07	7	BEL	DEL
00001000	010	8	08	8	BS	
00001001	011	9	09	9	HT	
00001010	012	10	0A	;	LF	
00001011	013	11	0B	@	VT	VT
00001100	014	12	0C	?	FF	FF
00001101	015	13	0D	:	CR	CR

*continued*

## Data Representation

*continued*

Binary	Octal	Decimal	Hexadecimal	BCL	ASCII	EBCDIC
00001110	016	14	0E	>	SO	SO
00001111	017	15	0F	'	SI	SI
00010000	020	16	10	+	DLE	DLE
00010001	021	17	11	A	DC1	DC1
00010010	022	18	12	B	DC2	DC2
00010011	023	19	13	C	DC3	DC3
00010100	024	20	14	D	DC4	
00010101	025	21	15	E	NAK	NL
00010110	026	22	16	F	SYN	BS
00010111	027	23	17	G	ETB	
00011000	030	24	18	H	CAN	CAN
00011001	031	25	19	I	EM	EM
00011010	032	26	1A	.	SUB	
00011011	033	27	1B	[	ESC	
00011100	034	28	1C	&	FS	FS
00011101	035	29	1D	(	GS	GS
00011110	036	30	1E	<	RS	RS
00011111	037	31	1F	!	US	US
00100000	040	32	20	}	SP	
00100001	041	33	21	J	!	
00100010	042	34	22	K	"	
00100011	043	35	23	L	;	
00100100	044	36	24	M	\$	
00100101	045	37	25	N	%	LF
00100110	046	38	26	O	&	ETB
00100111	047	39	27	P	'	ESC
00101000	050	40	28	Q	(	
00101001	051	41	29	R	)	
00101010	052	42	2A	\$	*	
00101011	053	43	2B	*	+	
00101100	054	44	2C	-	,	
00101101	055	45	2D	)	-	ENQ
00101110	056	46	2E	;	.	ACK

*continued*

## Data Representation

---

*continued*

Binary	Octal	Decimal	Hexadecimal	BCL	ASCII	EBCDIC
00101111	057	47	2F	^	/	BEL
00110000	060	48	30		0	
00110001	061	49	31	/	1	
00110010	062	50	32	S	2	SYN
00110011	063	51	33	T	3	
00110100	064	52	34	U	4	
00110101	065	53	35	V	5	
00110110	066	54	36	W	6	
00110111	067	55	37	X	7	EOT
00111000	070	56	38	Y	8	
00111001	071	57	39	Z	9	
00111010	072	58	3A	,	:	
00111011	073	59	3B	%	;	
00111100	074	60	3C	_	<	DC4
00111101	075	61	3D	=	=	NAK
00111110	076	62	3E	]	>	
00111111	077	63	3F	"	?	SUB
01000000	100	64	40		@	SP (blank)
01000001	101	65	41		A	
01000010	102	66	42		B	
01000011	103	67	43		C	
01000100	104	68	44		D	
01000101	105	69	45		E	
01000110	106	70	46		F	
01000111	107	71	47		G	
01001000	110	72	48		H	
01001001	111	73	49		I	
01001010	112	74	4A		J	[
01001011	113	75	4B		K	.
01001100	114	76	4C		L	<
01001101	115	77	4D		M	(
01001110	116	78	4E		N	+
01001111	117	79	4F		O	!

*continued*

## Data Representation

*continued*

Binary	Octal	Decimal	Hexadecimal	BCL	ASCII	EBCDIC
01010000	120	80	50		P	&
01010001	121	81	51		Q	
01010010	122	82	52		R	
01010011	123	83	53		S	
01010100	124	84	54		T	
01010101	125	85	55		U	
01010110	126	86	56		V	
01010111	127	87	57		W	
01011000	130	88	58		X	
01011001	131	89	59		Y	
01011010	132	90	5A		Z	]
01011011	133	91	5B		[	\$
01011100	134	92	5C		\	*
01011101	135	93	5D		]	)
01011110	136	94	5E		^	;
01011111	137	95	5F		_	^
01100000	140	96	60		'	-
01100001	141	97	61		a	/
01100010	142	98	62		b	
01100011	143	99	63		c	
01100100	144	100	64		d	
01100101	145	101	65		e	
01100110	146	102	66		f	
01100111	147	103	67		g	
01101000	150	104	68		h	
01101001	151	105	69		i	
01101010	152	106	6A		j	
01101011	153	107	6B		k	,
01101100	154	108	6C		l	%
01101101	155	109	6D		m	_
01101110	156	110	6E		n	>
01101111	157	111	6F		o	?

*continued*



## Data Representation

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*continued*

Binary	Octal	Decimal	Hexadecimal	BCL	ASCII	EBCDIC
01110000	160	112	70		p	
01110001	161	113	71		q	
01110010	162	114	72		r	
01110011	163	115	73		s	
01110100	164	116	74		t	
01110101	165	117	75		u	
01110110	166	118	76		v	
01110111	167	119	77		w	
01111000	170	120	78		x	
01111001	171	121	79		y	'
01111010	172	122	7A		z	:
01111011	173	123	7B		{	;
01111100	174	124	7C			@
01111101	175	125	7D		}	'
01111110	176	126	7E		~	=
01111111	177	127	7F		DEL	"
10000000	200	128	80			
10000001	201	129	81			a
10000010	202	130	82			b
10000011	203	131	83			c
10000100	204	132	84			d
10000101	205	133	85			e
10000110	206	134	86			f
10000111	207	135	87			g
10001000	210	136	88			h
10001001	211	137	89			i
10001010	212	138	8A			
10001011	213	139	8B			
10001100	214	140	8C			
10001101	215	141	8D			
10001110	216	142	8E			
10001111	217	143	8F			
10010000	220	144	90			

*continued*

*continued*

Binary	Octal	Decimal	Hexadecimal	BCL	ASCII	EBCDIC
10010001	221	145	91			j
10010010	222	146	92			k
10010011	223	147	93			l
10010100	224	148	94			m
10010101	225	149	95			n
10010110	226	150	96			o
10010111	227	151	97			p
10011000	230	152	98			q
10011001	231	153	99			r
10011010	232	154	9A			
10011011	233	155	9B			
10011100	234	156	9C			
10011101	235	157	9D			
10011110	236	158	9E			
10011111	237	159	9F			
10100000	240	160	A0			
10100001	241	161	A1			~
10100010	242	162	A2			s
10100011	243	163	A3			t
10100100	244	164	A4			u
10100101	245	165	A5			v
10100110	246	166	A6			w
10100111	247	167	A7			x
10101000	250	168	A8			y
10101001	251	169	A9			z
10101010	252	170	AA			
10101011	253	171	AB			
10101100	254	172	AC			
10101101	255	173	AD			
10101110	256	174	AE			
10101111	257	175	AF			
10110000	260	176	B0			
10110001	261	177	B1			

*continued*

## Data Representation

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*continued*

Binary	Octal	Decimal	Hexadecimal	BCL	ASCII	EBCDIC
10110010	262	178	B2			
10110011	263	179	B3			
10110100	264	180	B4			
10110101	265	181	B5			
10110110	266	182	B6			
10110111	267	183	B7			
10111000	270	184	B8			
10111001	271	185	B9			
10111010	272	186	BA			
10111011	273	187	BB			
10111100	274	188	BC			
10111101	275	189	BD			
10111110	276	190	BE			
10111111	277	191	BF			
11000000	300	192	C0			{
11000001	301	193	C1			A
11000010	302	194	C2			B
11000011	303	195	C3			C
11000100	304	196	C4			D
11000101	305	197	C5			E
11000110	306	198	C6			F
11000111	307	199	C7			G
11001000	310	200	C8			H
11001001	311	201	C9			I
11001010	312	202	CA			
11001011	313	203	CB			
11001100	314	204	CC			
11001101	315	205	CD			
11001110	316	206	CE			
11001111	317	207	CF			
11010000	320	208	D0			}
11010001	321	209	D1			J
11010010	322	210	D2			K

*continued*

## Data Representation

---

*continued*

Binary	Octal	Decimal	Hexadecimal	BCL	ASCII	EBCDIC
11010011	323	211	D3			L
11010100	324	212	D4			M
11010101	325	213	D5			N
11010110	326	214	D6			O
11010111	327	215	D7			P
11011000	330	216	D8			Q
11011001	331	217	D9			R
11011010	332	218	DA			
11011011	333	219	DB			
11011100	334	220	DC			
11011101	335	221	DD			
11011110	336	222	DE			
11011111	337	223	DF			
11100000	340	224	E0			\
11100001	341	225	E1			
11100010	342	226	E2			S
11100011	343	227	E3			T
11100100	344	228	E4			U
11100101	345	229	E5			V
11100110	346	230	E6			W
11100111	347	231	E7			X
11101000	350	232	E8			Y
11101001	351	233	E9			Z
11101010	352	234	EA			
11101011	353	235	EB			
11101100	354	236	EC			
11101101	355	237	ED			
11101110	356	238	EE			
11101111	357	239	EF			
11110000	360	240	F0			0
11110001	361	241	F1			1
11110010	362	242	F2			2
11110011	363	243	F3			3

*continued*

## Data Representation

---

*continued*

Binary	Octal	Decimal	Hexadecimal	BCL	ASCII	EBCDIC
11110100	364	244	F4			4
11110101	365	245	F5			5
11110110	366	246	F6			6
11110111	367	247	F7			7
11111000	370	248	F8			8
11111001	371	249	F9			9
11111010	372	250	FA			
11111011	373	251	FB			
11111100	374	252	FC			
11111101	375	253	FD			
11111110	376	254	FE			
11111111	377	255	FF			

## Default Character Type

The default character type is the character type assumed by pointers, string variables, string literals, and so on when a character type is not explicitly specified. The default character type is also used as the default value of the INTMODE file attribute. For more information on INTMODE, refer to the *A Series File Attributes Programming Reference Manual*.

Two compiler control options affect the default character type: the ASCII option and the BCL option. For more information, refer to “ASCII Option” and “BCL Option” in Section 6 “Compiling Programs.” If the ASCII option is TRUE, the default character type is ASCII. If the BCL option is TRUE, the default character type is BCL. If neither the ASCII option nor the BCL option is TRUE, the default character type is EBCDIC.

Free-field and formatted I/O generate either EBCDIC or BCL data depending on the default character type. If the default character type is BCL, BCL data is generated. If the default character type is EBCDIC or ASCII, EBCDIC data is generated.

The example programs below demonstrate the effects of different default character types.

**Examples**

```

%%% PROGRAM 1 %%%
BEGIN
% OPTION RECORD
  FILE F(KIND=DISK,NEWFILE=TRUE);
  ARRAY A[0:9];
  POINTER P;
  STRING S;          % DECLARATION OF S
  OPEN(F);
  P := POINTER(A);
  S := "ABC";        % STRING ASSIGNMENT
END.

```

If this example is compiled and executed as is, the default character type is EBCDIC. Thus, the INTMODE attribute of file F is EBCDIC, the character size of pointer P is eight bits, the string type of string S is EBCDIC, and, after the string assignment is executed, S contains the EBCDIC string *ABC*.

If *% OPTION RECORD* on the third line is replaced by the compiler control record *\$ SET ASCII*, and the program is compiled and executed, the default character type is ASCII. Thus, the INTMODE of file F is ASCII, the character size of pointer P is eight bits, the string type of string S is ASCII, and, after the string assignment is executed, S contains the ASCII string *ABC*.

If program 1 is compiled after *% OPTION RECORD* is replaced by the compiler control record *\$ SET BCL*, the default character type is BCL and the program is flagged with two syntax errors: one on the declaration of string S and one on the string assignment, because string variables cannot be of type BCL.

```

%%% PROGRAM 2 %%%
BEGIN
$ SET BCL
  FILE F(KIND=DISK,NEWFILE=TRUE);
  ARRAY A[0:9];
  POINTER P;
  OPEN(F);
  P := POINTER(A);
  REPLACE P BY "ABC";  % REPLACE STATEMENT
END.

```

Program 2 contains the compiler control record *\$ SET BCL* and has no string constructs. It compiles without error. If program 2 is compiled and executed, the default character type is BCL. Thus, the INTMODE of file F is BCL, the character size of pointer P is six bits, and, after the REPLACE statement is executed, P references the BCL characters ABC stored in array A.

Program 2 is flagged with a warning message when it is compiled, because the BCL character type is not supported on all A Series systems.

## Signs of Numeric Fields

Certain operations in ALGOL require an indication of a numeric sign in character data. The sign of a numeric field is represented as follows:

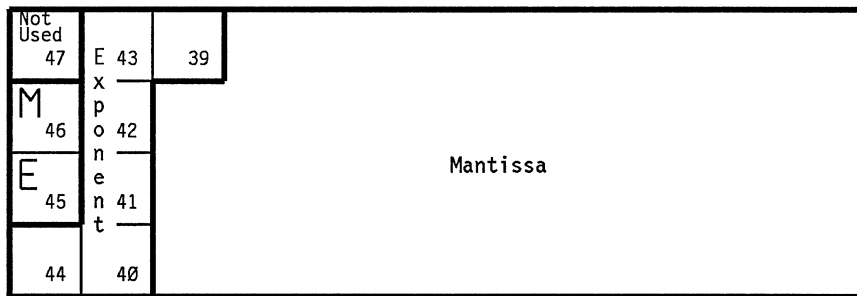
8-bit characters	The sign is in the zone field of the least significant character (field [7:4] of the character). A bit configuration of 1"1101" (4"D") indicates a negative number; any other bit configuration indicates a positive number.
6-bit characters	The sign is in the zone field of the least significant character (field [5:2] of the character). A bit configuration of 1"10" indicates a negative number; any other bit configuration indicates a positive number.
4-bit digits	The sign is carried as a separate digit, and it is the most significant digit of the field. A bit configuration of 1"1101" (4"D") indicates a negative number; any other bit configuration indicates a positive number.

## One-Word Operand

Real, integer, and Boolean operands each require one word of storage.

## Real Operand

The internal structure of a real operand is illustrated in Figure C-6.



LEGEND

<u>Field</u>	<u>Use</u>
Tag	C
[47:1]	Not used
[46:1]	Sign of mantissa: 1 = negative Ø = positive
[45:1]	Sign of exponent: 1 = negative Ø = positive
[44:6]	Exponent
[38:39]	Mantissa

Figure C-6. Real Operand

Real (single-precision, floating-point) values are represented internally in signed-magnitude, mantissa-and-exponent notation. The sign of the mantissa is contained in bit 46, and the sign of the exponent is contained in bit 45. A minus sign is denoted by a 1 in the appropriate sign bit. The magnitude of the exponent is contained in field [44:6]; hence, the maximum absolute value of an exponent in a real operand is  $2^{*}6-1 = 63$ . The magnitude of the mantissa is contained in field [38:39]; hence, the maximum absolute value of a mantissa in a real operand is  $2^{*}39-1$ . There is an implied radix point to the right of bit zero.

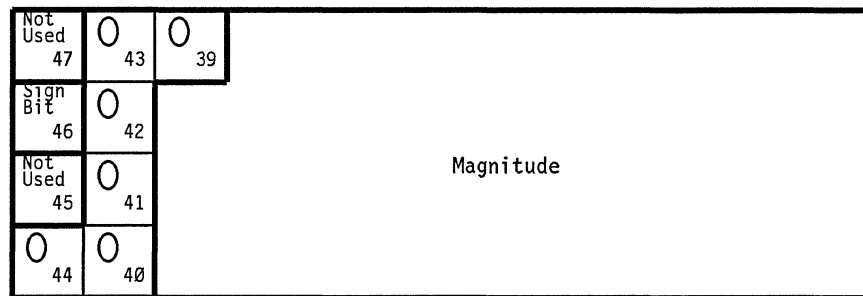
The value represented by a real operand can be obtained by the following formula:

$$(\text{mantissa}) * 8^{**}(\text{exponent})$$

Certain operations, such as the NORMALIZE function, return a normalized real operand as their result. A normalized real operand is a real operand in which the leftmost octade (3-bit field) of the mantissa is nonzero. For example, the real value 0.5, in normalized form, is represented internally as 4"26C000000000". In this example, the mantissa is  $4 * 8^{*}20$  and the exponent is -13.

### Integer Operand

The internal structure of an integer operand is illustrated in Figure C-7.



LEGEND

<u>Field</u>	<u>Use</u>
Tag	0
[47:1]	Not used
[46:1]	Sign: 1 = negative 0 = positive
[45:1]	Not used
[44:6]	0
[38:39]	Magnitude

Figure C-7. Integer Operand

Integer values are represented internally in signed-magnitude notation. The sign of the value is denoted by bit 46 of the data word. A minus sign is denoted by a 1 in bit 46. The



## Data Representation

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magnitude of the value is stored in field [38:39]. The maximum absolute value of an integer operand is  $2^{39}-1$ . There is an implied radix point to the right of bit zero.

For example, the internal representation of the integer 10 is

4"000000000000A"

The internal representation of -10 is

4"400000000000A"

The internal representation of 99,999,999,999 is

4"00174876E7FF"

The following internal representation represents the decimal value 549,755,813,887 (the maximum value an integer operand can contain). A larger value would have to be stored in a real operand or a double-precision operand.

4"007FFFFFFFFF"

Note that the internal format of an integer operand is the same as the internal format of a real operand with an exponent of zero.

## Boolean Operand

The internal structure of a Boolean operand is illustrated in Figure C-8.

∇ <sub>47</sub>	∇ <sub>43</sub>	∇ <sub>39</sub>	∇ <sub>35</sub>	∇ <sub>31</sub>	∇ <sub>27</sub>	∇ <sub>23</sub>	∇ <sub>19</sub>	∇ <sub>15</sub>	∇ <sub>11</sub>	∇ <sub>7</sub>	∇ <sub>3</sub>
∇ <sub>46</sub>	∇ <sub>42</sub>	∇ <sub>38</sub>	∇ <sub>34</sub>	∇ <sub>30</sub>	∇ <sub>26</sub>	∇ <sub>22</sub>	∇ <sub>18</sub>	∇ <sub>14</sub>	∇ <sub>10</sub>	∇ <sub>6</sub>	∇ <sub>2</sub>
∇ <sub>45</sub>	∇ <sub>41</sub>	∇ <sub>37</sub>	∇ <sub>33</sub>	∇ <sub>29</sub>	∇ <sub>25</sub>	∇ <sub>21</sub>	∇ <sub>17</sub>	∇ <sub>13</sub>	∇ <sub>9</sub>	∇ <sub>5</sub>	∇ <sub>1</sub>
∇ <sub>44</sub>	∇ <sub>40</sub>	∇ <sub>36</sub>	∇ <sub>32</sub>	∇ <sub>28</sub>	∇ <sub>24</sub>	∇ <sub>20</sub>	∇ <sub>16</sub>	∇ <sub>12</sub>	∇ <sub>8</sub>	∇ <sub>4</sub>	∇ <sub>0</sub>

### LEGEND

<u>Field</u>	<u>Use</u>
Tag	0
[47:47]	Any bit or field within this field can be referenced as a Boolean value using the <partial word part> or <concatenation> constructs.
[0:1]	The Boolean value of the operand as a whole.

Figure C-8. Boolean Operand

Boolean operations are performed on a bit-by-bit basis on all 48 bits of a Boolean operand. The one exception is the NOT operation performed on an arithmetic relation, where NOT is performed on the low-order bit (bit zero), but not necessarily on the other 47 bits. However, when a Boolean operand is referenced as a whole, only the low-order bit (bit zero) is significant (0 is FALSE, 1 is TRUE).

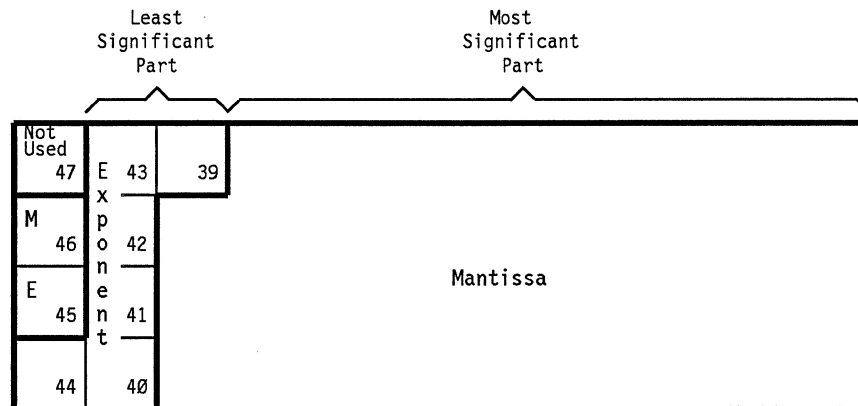
In Figure C-8, the shaded V's indicate that each bit of the entire 48-bit Boolean operand can be used to store an individual Boolean value. The individual bits can be referenced by using the <partial word part> and <concatenation> constructs.

## Two-Word Operand

Double-precision and complex operands each require two words of storage.

## Double-Precision Operand

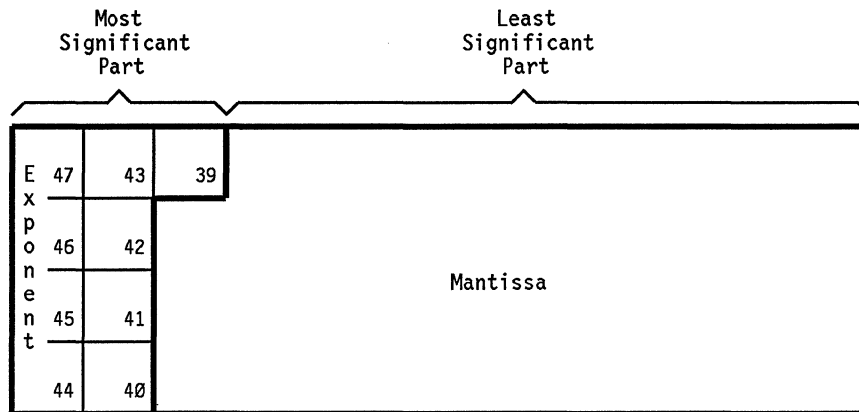
The internal structure of a double-precision operand is illustrated in Figures C-9 and C-10.



LEGEND

Field	Use
Tag	2
[47:1]	Not used
[46:1]	Sign of mantissa: 1 = negative 0 = positive
[45:1]	Sign of exponent: 1 = negative 0 = positive
[44:6]	Least significant portion of the exponent
[38:39]	Most significant portion of the mantissa

Figure C-9. First Word, Double Precision Operand



LEGEND

Field	Use
Tag	2
[47:9]	Most significant portion of the exponent
[39:39]	Least significant portion of the mantissa

**Figure C-10. Second Word, Double Precision Operand**

Double-precision values are represented internally in signed-magnitude, mantissa-and-exponent notation. The sign of the mantissa is contained in bit 46 of the first data word, and the sign of the exponent is contained in bit 45 of the first data word. A minus sign is denoted by a 1 in the appropriate sign bit.

The magnitude of the exponent of a double-precision operand is contained in a total of 15 bits. The most significant nine of these 15 bits are contained in field [47:9] of the second data word. The least significant six of these 15 bits are contained in field [44:6] of the first data word.

The magnitude of the mantissa of a double-precision operand is represented by a total of 78 bits. The most significant 39 bits are contained in field [38:39] of the first data word. The least significant 39 bits are contained in field [38:39] of the second data word. There is an implied radix point to the right of bit zero of the first data word; that is, between the most significant and least significant parts of the mantissa.

The value represented by a double-precision operand can be obtained by the following formula:

$$(MM + LM * 8^{(-13)}) * 8^{(ME * 2^{*6} + LE)}$$

where

- MM is the most significant part of the mantissa.
- LM is the least significant part of the mantissa.

- ME is the most significant part of the exponent.
- LE is the least significant part of the exponent.

Some operations return a normalized double-precision operand as their result. A normalized double-precision operand is a double-precision operand in which the leftmost octade (3-bit field) of the full 78-bit mantissa is nonzero. For example, the double-precision value 1@@0, in normalized form, is represented internally as

4"261000000000", 4"000000000000"

In this example, the mantissa is  $1 * 8^*$

and the exponent is  $-12$ .

## Complex Operand

A complex operand requires two words of storage. The first word contains the real part of the complex value; the second word contains the imaginary part. The internal structure of both the real and imaginary parts of the complex value is identical to the internal structure of a real operand. For more information, refer to "Real Operand" earlier in this appendix.

## Type Coercion of One-Word and Two-Word Operands

Because the internal representation of Boolean, complex, double precision, integer, and both normalized and nonnormalized real variables are all different, coercing a variable from one type to another must be done with care. Certain system software, such as intrinsics and operating system procedures, expect input parameters to be in a particular format, and if the expected bit pattern of a variable has been altered through type coercion, this software will not work correctly.

Type coercion can be effected through the following:

- Address equation between Boolean, integer, and real variables.
- Using a type transfer variable on the left side of an arithmetic or Boolean assignment.
- Using a type-transfer function such as the INTEGER function.
- Using a call-by-name parameter (for example, by passing a real variable to a call-by-name integer parameter).

The following is an example of address equation:

## Data Representation

---

```
BEGIN
  BOOLEAN B;
  INTEGER I = B;
  REAL    R = B;
  B := TRUE;      % B = TRUE,    I = 1, R = 1.0
  B := NOT TRUE; % B = FALSE,   I = Invalid or 0,
                    %              R = (-7.0064 E-46)

  I := 3;        % B = TRUE,    I = 3, R = 3.0
  R := 3;        % B = TRUE,    I = 3, R = 3.0
  R := 3.0;     % B = FALSE,   I = Invalid, 2 E37, or 3, R = 3.0
  I := 4/3;     % B = TRUE,    I = 1, R = 1.0
END.
```

## Data Descriptors and Pointer

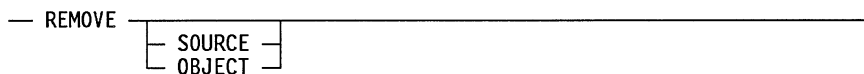
An unindexed data descriptor is the mechanism used on A Series systems to represent the contents of an array. An indexed data descriptor is used to reference one element of a word array. A pointer references one character within a word or character array. For more information on the structures of descriptors and pointers, see the *A Series System Architecture Reference Manual, Volume 2*.

# Appendix D

## Understanding Railroad Diagrams

### What Are Railroad Diagrams?

Railroad diagrams are diagrams that show you the rules for putting words and symbols together into commands and statements that the computer can understand. These diagrams consist of a series of paths that show the allowable structure, constants, and variables for a command or a statement. Paths show the order in which the command or statement is constructed. Paths are represented by horizontal and vertical lines. Many railroad diagrams have a number of different paths you can take to get to the end of the diagram. For example:



If you follow this railroad diagram from left to right, you will discover three acceptable commands. These commands are

- REMOVE
- REMOVE SOURCE
- REMOVE OBJECT

If all railroad diagrams were this simple, this explanation could end here. However, because the allowed ways of communicating with the computer can be complex, railroad diagrams sometimes must also be complex.

Regardless of the level of complexity, all railroad diagrams are visual representations of commands and statements. Railroad diagrams are intended to

- Show the mandatory items.
- Show the user-selected items.
- Present the order in which the items must appear.
- Show the number of times an item can be repeated.
- Show the necessary punctuation.

To familiarize you with railroad diagrams, this explanation describes the elements of the diagrams and provides examples.

Some of the actual railroad diagrams you will encounter might be more complex. However, all railroad diagrams, simple or complex, follow the same basic rules. They

## Understanding Railroad Diagrams

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all consist of paths that represent the allowable structure, constants, and variables for commands and statements.

By following railroad diagrams, you can easily understand the correct syntax for commands and statements. Once you become proficient in the use of railroad notation, the diagrams serve as quick references to the commands and statements.

### Constants and Variables

A constant is an item that cannot be altered. You must enter the constant as it appears in the diagram, either in full or as an allowable abbreviation. If a constant is partially underlined, you can abbreviate the constant by entering only the underlined letters. In addition to the underlined letters, any of the remaining letters can be entered. If no part of the constant is underlined, the constant cannot be abbreviated. Constants can be recognized by the fact that they are never enclosed in angle brackets (< >) and are in uppercase letters.

A variable is an item that represents data. You can replace the variable with data that meets the requirements of the particular command or statement. When replacing a variable with data, you must follow the rules defined for the particular command or statement. Variables appear in railroad diagrams enclosed in angle brackets.

In the following example, BEGIN and END are constants while <statement list> is a variable. The constant BEGIN can be abbreviated since it is partially underlined. Valid abbreviations for BEGIN are BE, BEG, and BEGI.

— BEGIN —<statement list>— END —————|

### Constraints

Constraints are used in a railroad diagram to control progression through the diagram. Constraints consist of symbols and unique railroad diagram line paths. They include

- Vertical bars
- Percent signs
- Right arrows
- Required items
- User-selected items
- Loops
- Bridges

A description of each item follows.

#### Vertical Bar

The vertical bar symbol (|) represents the end of a railroad diagram and indicates the command or statement can be followed by another command or statement.

— SECONDWORD — ( —<arithmetic expression>— ) —————|

### Percent Sign

The percent sign (%) represents the end of a railroad diagram and indicates the command or statement must be on a line by itself.

— STOP —————|%

### Right Arrow

The right arrow symbol (>) is used when the railroad diagram is too long to fit on one line and must continue on the next. A right arrow appears at the end of the first line, and another right arrow appears at the beginning of the next line.

— SCALERIGHT — ( —<arithmetic expression>— , —————→  
→<arithmetic expression>— ) —————|

### Required Items

A required item can be either a constant, a variable, or punctuation. A required item appears as a single entry, by itself or with other items, on a horizontal line. Required items can also exist on horizontal lines within alternate paths or nested (lower-level) diagrams. If the path you are following contains a required item, you must enter the item in the command or statement; the required item cannot be omitted.

In the following example, the word EVENT is a required constant and <identifier> is a required variable:

— EVENT —<identifier>—————|

### User-Selected Items

User-selected items appear one below the other in a vertical list. You can choose any one of the items from the list. If the list also contains an empty path (solid line), none of the choices are required. A user-selected item can be either a constant, a variable, or punctuation. In the following railroad diagram, either the plus sign (+) or the minus sign (-) can be entered before the required variable <arithmetic expression>, or the symbols can be disregarded because the diagram also contains an empty path.

— [ + ]  
[ - ] —<arithmetic expression>—————|



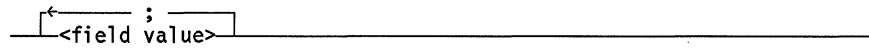
## Understanding Railroad Diagrams

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### Loop

A loop represents an item or group of items that you can repeat. A loop can span all or part of a railroad diagram. It always consists of at least two horizontal lines, one below the other, connected on both sides by vertical lines. The top line is a right-to-left path that contains information about repeating the loop.

Some loops include a return character. A return character is a character—often a comma (,) or semicolon (;)—required before each repetition of a loop. If there is no return character, the items must be separated by one or more blank spaces.

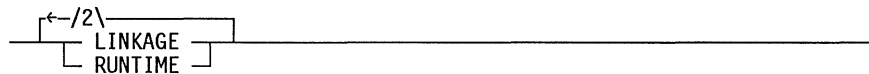
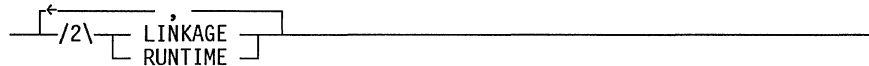


### Bridge

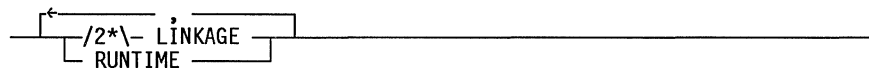
Sometimes a loop also includes a bridge, which is used to show the maximum number of times the loop can be repeated. The bridge can precede the contents of the loop, or it can precede the return character (if any) on the upper line of the loop.

The bridge determines the number of times you can cross that point in the diagram. The bridge is an integer enclosed in sloping lines (/ \). Not all loops have bridges. Those that do not can be repeated any number of times until all valid entries have been used.

In the first bridge example, you can enter LINKAGE or RUNTIME no more than two times. In the second bridge example, you can enter LINKAGE or RUNTIME no more than three times.



In some bridges an asterisk (\*) follows the number. The asterisk means that you must cross that point in the diagram at least once. The maximum number of times that you can cross that point is indicated by the number in the bridge.



In the previous bridge example, you must enter LINKAGE at least once but no more than twice, and you can enter RUNTIME any number of times.

The following figure shows the types of constraints used in railroad diagrams.

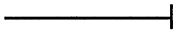
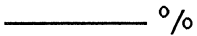
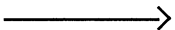

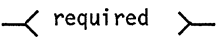
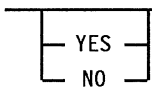
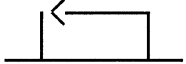
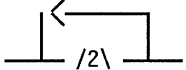
SYMBOL/PATH	EXPLANATION
	Vertical bar. Indicates that the command or statement can be followed by another command or statement.
	Percent sign. Indicates that the command or statement must be on a line by itself.
 	Right arrow. Indicates that the diagram occupies more than one line.
	Required items. Indicates the constants, variables, and punctuation that must be entered in a command or statement.
	User-selected items. Indicates the items that appear one below the other in a vertical list. You select which item or items to include.
	A loop. Indicates an item or group of items that can be repeated.
	A bridge. Indicates the maximum number of times a loop can be repeated.

Figure D-1. Railroad Constraints

## Following the Paths of a Railroad Diagram

The paths of a railroad diagram lead you through the command or statement from beginning to end. Some railroad diagrams have only one path, while others have several alternate paths. The following railroad diagram indicates there is only one path that requires the constant LINKAGE and the variable <linkage mnemonic> :

— LINKAGE —<linkage mnemonic>—————|

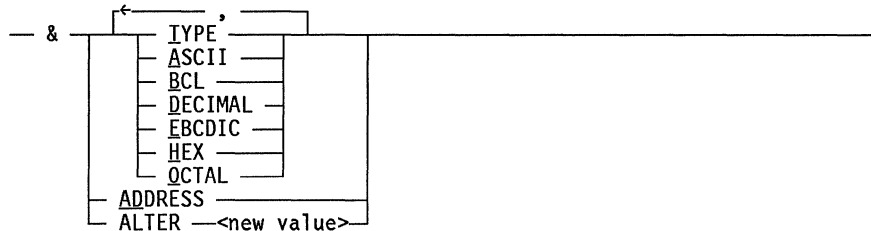
Alternate paths provide choices in the construction of commands and statements. Alternate paths are provided by loops, user-selected items, or a combination of both. More complex railroad diagrams can consist of many alternate paths, or nested (lower-level) diagrams, that show a further level of detail.

For example, the following railroad diagram consists of a top path and two alternate paths. The top path includes an ampersand (&) and the constants (that are

## Understanding Railroad Diagrams

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user-selected items) in the vertical list. These constants are within a loop that can be repeated any number of times until all options have been selected. The first alternate path requires the ampersand and the required constant ADDRESS. The second alternate path requires the ampersand followed by the required constant ALTER and the required variable <new value>.



## Railroad Diagram Examples with Sample Input

The following examples show five railroad diagrams and possible command and statement constructions based on the paths of these diagrams.

### Example 1

<lock statement>



#### Sample Input

LOCK (FILE4)

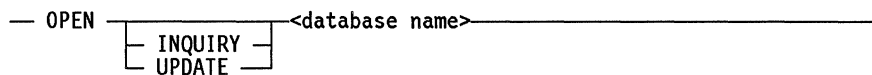
#### Explanation

LOCK is a constant and cannot be altered. Because no part of the word is underlined, the entire word must be entered.

The parentheses are required punctuation, and FILE4 is a sample file identifier.

### Example 2

<open statement>



#### Sample Input

OPEN DATABASE1

#### Explanation

The constant OPEN is followed by the variable DATABASE1, which is a database name.

The railroad diagram shows two user-selected items, INQUIRY and UPDATE. However, because there is an empty path (solid line), these entries are not required.

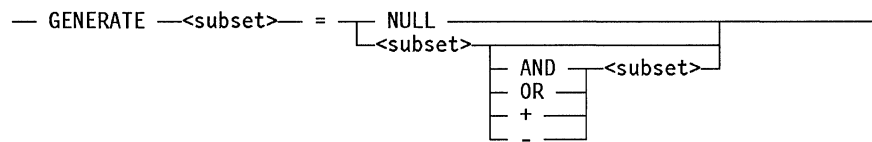
*continued*

*continued*

Sample Input	Explanation
OPEN INQUIRY DATABASE1	The constant OPEN is followed by the user-selected constant INQUIRY and the variable DATABASE1.
OPEN UPDATE DATABASE1	The constant OPEN is followed by the user-selected constant UPDATE and the variable DATABASE1.

### Example 3

<generate statement>

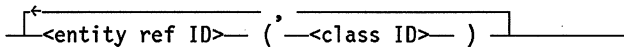


Sample Input	Explanation
GENERATE Z = NULL	The GENERATE constant is followed by the variable Z, an equal sign (=), and the user-selected constant NULL.
GENERATE Z = X	The GENERATE constant is followed by the variable Z, an equal sign, and the user-selected variable X.
GENERATE Z = X AND B	The GENERATE constant is followed by the variable Z, an equal sign, the user-selected variable X, the AND command (from the list of user-selected items in the nested path), and a third variable, B.
GENERATE Z = X + B	The GENERATE constant is followed by the variable Z, an equal sign, the user-selected variable X, the plus sign (from the list of user-selected items in the nested path), and a third variable, B.

# Understanding Railroad Diagrams

## Example 4

<entity reference declaration>

— ENTITY REFERENCE — 

### Sample Input

ENTITY REFERENCE ADVISOR1 (INSTRUCTOR)

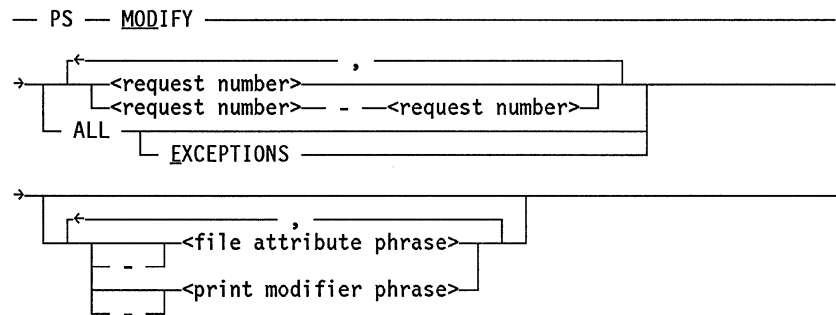
### Explanation

The required item ENTITY REFERENCE is followed by the variable ADVISOR1 and the variable INSTRUCTOR. The parentheses are required.

ENTITY REFERENCE ADVISOR1 (INSTRUCTOR),  
ADVISOR2 (ASST\_INSTRUCTOR)

Because the diagram contains a loop, the pair of variables can be repeated any number of times.

## Example 5

— PS — MODIFY — 

### Sample Input

PS MODIFY 11159

### Explanation

The constants PS and MODIFY are followed by the variable 11159, which is a request number.

PS MODIFY 11159,11160,11163

Because the diagram contains a loop, the variable 11159 can be followed by a comma, the variable 11160, another comma, and the final variable 11163.

PS MOD 11159–11161 DESTINATION =  
"LP7"

The constants PS and MODIFY are followed by the user-selected variables 11159–11161, which are request numbers, and the user-selected variable DESTINATION = "LP7", which is a file attribute phrase. Note that the constant MODIFY has been abbreviated to its minimum allowable form.

PS MOD ALL EXCEPTIONS

The constants PS and MODIFY are followed by the user-selected constants ALL and EXCEPTIONS.

# Glossary

## A

### **accidental entry**

*See* thunk.

### **actual segment descriptor (ASD)**

A pointer to the location of a data or code item in memory or on a disk.

### **address couple**

A representation of the address of an item in a program. An address couple consists of two numbers: the first number is a lexical level, and the second number is a displacement (offset) within that lexical level.

### **address equation**

The process of declaring an identifier to have the same address as a previously declared identifier.

### **array**

An ordered collection of a fixed number of common elements under one name, each element having the same data type. Access for each element is through an index to the common name.

### **ASCII**

American Standard Code for Information Interchange. A standard 7-bit or 8-bit information code used to represent alphanumeric characters, control characters, and graphic characters on a computer system.

### **ASD**

*See* actual segment descriptor.

### **asynchronous process**

A process that executes in parallel with its initiator.

## B

### **bad GO TO**

In ALGOL and NEWP, a GO TO statement in an inner block that transfers control to a label that is global to that block. The block in which a bad GO TO occurs is exited abruptly and local variables are deallocated immediately.

### **BCL**

*See* Burroughs Common Language.

### **Burroughs Common Language (BCL)**

An obsolete code using 6-bit character representation.

## Glossary

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### **by name**

Pertaining to one method of passing a parameter to a procedure. The system substitutes the actual parameter wherever the formal parameter is mentioned in the procedure body. Any assignments to the actual parameter immediately change the value of the formal parameter, and vice versa. *Synonym for call-by-name.*

### **by reference**

Pertaining to one method of passing a parameter to a procedure. The system evaluates the location of the actual parameter and replaces the formal parameter with a reference to that location. Any change made to the formal parameter affects the actual parameter, and vice versa. *Synonym for call-by-reference.*

### **by value**

Pertaining to one method of passing a parameter to a procedure. A copy of the value of the actual parameter is assigned to the formal parameter, which is thereafter handled as a variable that is local to the procedure body. Any change made to the value of a by-value formal parameter has no effect outside the procedure body. *Synonym for call-by-value.*

## C

### **call-by-name**

Pertaining to one method of passing a parameter to a procedure. The system substitutes the actual parameter wherever the formal parameter is mentioned in the procedure body. Any assignments to the actual parameter immediately change the value of the formal parameter, and vice versa. *Synonym for by name.*

### **call-by-reference**

Pertaining to one method of passing a parameter to a procedure. The system evaluates the location of the actual parameter and replaces the formal parameter with a reference to that location. Any change made to the formal parameter affects the actual parameter, and vice versa. *Synonym for by reference.*

### **call-by-value**

Pertaining to one method of passing a parameter to a procedure. A copy of the value of the actual parameter is assigned to the formal parameter, which is thereafter handled as a variable that is local to the procedure body. Any change made to the value of a call-by-value formal parameter has no effect outside the procedure body. *Synonym for by value.*

### **CANDE**

*See* Command and Edit.

### **ccsversion**

The instructions for the application of a coded character set, including information about the way in which data is presented, collated, and cased.

### **character array**

In ALGOL, an array whose elements are ASCII, EBCDIC, or hexadecimal characters. *Contrast with* word array.

**code segment descriptor**

A descriptor that references a code segment. An operating system uses code segment descriptors to obtain segments of an object code file as needed during execution of a program.

**code segment dictionary**

A memory structure that is associated with a process and that indexes the memory addresses of the various segments of program code used by that process. The same code segment dictionary can be shared by more than one process, provided that each process is an instance of the same procedure. A code segment dictionary is also referred to as the D1 stack.

**coded character set**

A character set in which each character is assigned a code value.

**collating sequence**

A set of rules establishing the order in which items will be arranged in a set. Common collating sequences are alphabetical order and numerical order with, often, additional rules for dealing with symbols, punctuation, and spaces.

**Command and Edit (CANDE)**

A time-sharing message control system (MCS) that enables a user to create and edit files, and develop, test, and execute programs interactively.

**control variable**

The variable that controls the repetitive execution of instructions in a loop.

**copy descriptor**

A duplicate of a mom descriptor except the copy bit is set to 1. A copy descriptor is derived from a mom descriptor, and multiple copy descriptors can reference the same data segment.

**coroutine**

One of a group of processes that exist simultaneously, but take turns executing, so that only one of the processes is executing at any given time. The coroutine that is currently executing is called the active coroutine and the others are called continuable coroutines.

**critical block**

For a dependent process, the block of the highest lexical level that includes the declaration of any critical objects used by the dependent process. The process that is executing the critical block is called the parent of the dependent process. If the parent exits the critical block while the dependent process is in use, the parent is discontinued, and the dependent process also is discontinued.

**D**

**Data Management System II (DMSII)**

A specialized system software package used to describe a database and maintain the relationships among the data elements in the database.



## Glossary

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### **descriptor**

A computer word of a particular format that is used to reference data segments and code segments in memory or on a disk.

### **DMSII**

*See* Data Management System II.

### **D1 stack**

*See* code segment dictionary.

### **D2 stack (D[2] stack)**

(1) A stack initiated for each executing program that is used for storage of items allocated at lexical level 2. The D2 stack is also referred to as the working stack.

(2) In the transaction processing system (TPS), data and procedures that are global to a particular transaction base reside in the D2 stack of the transaction library, which is also referred to as the *<transaction base name>/CODE/HOSTLIB stack*.

## E

### **EBCDIC**

Extended Binary Coded Decimal Interchange Code. An 8-bit code representing 256 graphic and control characters that are the native character set of most mainframe systems.

### **entry point**

A procedure or function that is a library object.

### **equivalent array**

In ALGOL, an array that is declared to refer to the same data as another array.

### **escapement**

The direction in which the active position is to advance after a character is displayed or printed.

### **external sign flip-flop (EXTF)**

A flip-flop that is assigned values by, and affects the actions of, certain hardware operators. The state of EXTF reflects information about the signs of numeric quantities.

### **EXTF**

*See* external sign flip-flop.

## F

### **fault**

An error encountered by a hardware operator.

### **FIB**

*See* file information block.

**file equation**

A mechanism for specifying the values of file attributes when a program is compiled or executed. A file equation implicitly assigns a value to the FILECARDS task attribute.

**file information block (FIB)**

A data structure in an object code file that contains information describing a file.

**float flip-flop (FLTF)**

A flip-flop that is assigned values by, and affects the actions of, certain hardware operators. The state of FLTF reflects information about the insertion of floating characters into character strings.

**FLTF**

See float flip-flop.

**fully specified formal procedure**

In ALGOL, a procedure parameter (formal procedure) whose declaration includes the word FORMAL. With such procedures, the compiler checks the parameters of the actual procedure passed to it at compilation time.

**G****global identifier**

Within a given block of an ALGOL, NEWP, or Pascal program, an identifier that is declared in an outer block. A global identifier retains its values and characteristics as the blocks to which it is global are entered and exited.

**H****halt/load**

A system-initialization procedure that temporarily halts the system and loads the operating system from a disk to main memory.

**host program**

A program to which separately compiled procedures can be bound by the Binder program or by using the SEPCOMP facility.

**I****International Standards Organization (ISO)**

A division of the United Nations under which the Consultative Committee on International Telegraphy and Telephony (CCITT) operates. The ISO was established in 1947 to promote the development of standards to facilitate international trade, and to develop mutual cooperation in areas of intellectual, scientific, technological, and economic activity.

**internationalization**

The software, firmware, and hardware features that enable users to customize products or accommodate the needs of a specific language, culture, or line of business.

## Glossary

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### **I/O control word (IOCW)**

The area in the I/O control block (IOCB) where information about the I/O operation to be performed resides.

### **IOCW**

See I/O control word.

### **ISO**

See International Standards Organization.

## **L**

### **lex level**

See lexical level.

### **lexical level (lex level)**

(1) A number that indicates the relative level of an addressing space within the stack of an executing program. Lexical levels range from 0 through either 15 or 31, depending on the computer family. A lower lexical level indicates a more global addressing space. (2) A measure of how many other blocks a block is nested within. The outer block of a program has a lex level of 2 or 3, depending on whether the program has a procedure heading. Each block has a lex level one higher than the block it is nested within.

### **library**

(1) A collection of one or more named routines or entry points that are stored in a file and can be called by other programs. (2) A program that exports objects for use by user programs.

### **library object**

An object that is shared by a library and one or more user programs.

### **local identifier**

An identifier that is declared within a given block of a program. The value or values associated with that identifier inside the block are not associated with that identifier outside the block.

### **localization**

The act of adapting a system or product so that it complies with the standards and functional requirements of a particular locality of line of business.

### **logical comparison**

A comparison of two character strings based on the ordering sequence values and the priority sequence values of the characters.

### **logical ordering**

The sorting of character strings based on the ordering sequence values and the priority sequence values of the characters.

## M

**Master Control Program (MCP)**

An operating system on A Series and B 7900 systems. The MCP controls the operational environment of the system by performing job selection, memory management, peripheral management, virtual memory management, dynamic subroutine linkage, and logging of errors and system utilization.

**Master Control Program/Advanced Systems (MCP/AS)**

An operating system on A Series and B 7900 systems that supports Actual Segment Descriptor (ASD) memory architecture. The MCP/AS controls the operational environment of the system by performing job selection, memory management, peripheral management, virtual memory management, dynamic subroutine linkage, and logging of errors and system utilization.

**MCP**

*See* Master Control Program.

**MCP/AS**

*See* Master Control Program/Advanced Systems.

**MLS**

*See* MultiLingual System.

**mom descriptor**

The original descriptor for a data segment. For a given data segment in memory, there is one mom descriptor and there can be many copy descriptors. A mom descriptor is a data descriptor that has 0 (zero) in the copy bit.

**MultiLingual system (MLS)**

A system for developing and accessing output messages, online help text, and menu screens in different natural languages, such as English, French, and Spanish.

## N

**natural language**

A language written or spoken by humans.

**NDLII**

*See* Network Definition Language II.

**Network Definition Language II (NDLII)**

The Unisys language used to describe the physical, logical, and functional characteristics of the data communications subsystem to network support processors (NSPs), line support processors (LSPs), and data communications data link processors (DCDLPs).

## O

**ODT**

*See* operator display terminal.

### **operator display terminal (ODT)**

(1) A terminal or other device that is connected to the system in such a way that it can communicate directly with the operating system. The ODT allows operations personnel to accomplish system operations functions through either of two operating modes: system command mode or data comm mode. (2) The name given to the system control terminal (SCT) when it is used as an ODT. (3) A system control terminal (SCT) configured for direct communication with the operating system. The ODT is used primarily by operations personnel for entering commands that control and direct the system and its resources. (4) *See also* system control terminal (SCT).

### **ordering sequence value (OSV)**

An integer value between 1 and 255 that is assigned to each code position in a coded character set and represents a relative ordering value. An ordering value of 0 signifies the lowest ranking in the coded character set and an ordering value that is greater than all other ordering values signifies the highest ranking. More than one code position can be assigned the same ordering value.

### **original array**

In ALGOL, an array that is declared with a bound pair list. Each original array is distinct from all other original arrays.

### **OSV**

*See* ordering sequence value.

## **P**

### **paged array**

An array that is automatically divided (*paged* or *segmented*) at run time into smaller segments.

### **PIB**

*See* program information block (PIB).

### **primary coroutine**

A program that initiates a procedure as a coroutine.

### **priority sequence value (PSV)**

An integer value between 1 and 15 that is assigned to each code position in a coded character set and represents a relative priority within an ordering sequence value (OSV). Each code position that has a unique ordering value is assigned a priority value of 1. For code positions with the same OSV, a priority value of 1 signifies the lowest ranking in the OSV, and a priority value which is greater than all other priority values signifies the highest ranking.

### **process**

(1) The execution of a program or of a procedure that was initiated. The process has its own process stack and process information block (PIB). It also has a code segment dictionary, which can be shared with other processes that are executions of the same program or procedure. (2) A software application; that is, any activity or systematic sequence of operations that produces a specified result.

**program information block (PIB)**

A memory structure that is associated with each process stack and code segment dictionary. The PIB contains control information that is visible only to the operating system. The PIB for a process stack also contains a reference to a task attribute block (TAB).

**PSV**

*See* priority sequence value.

**R****ready queue (READYQ)**

A list, maintained by the operating system, of the processes that are waiting for service from a processor.

**READYQ**

*See* ready queue.

**referred array**

In ALGOL, an array identifier that refers to data in another array through array row equivalence, array reference assignment, or array specification in a PROCEDURE declaration.

**remote job entry (RJE)**

A Unisys message control system (MCS) that allows jobs, data, and control commands to be sent to a central system from a remote card reader; RJE also allows output of data from the central system to be sent to remote peripherals.

**reserved word**

A word that has special meaning within a programming language and that generally cannot be redefined or redeclared by the programmer.

**RJE**

*See* remote job entry.

**S****save memory**

An area of memory that cannot be overlaid as long as the item with which it is associated is allocated.

**scope**

(1) Those portions of a program or programs that can contain statements that access a particular object. (2) In ALGOL or NEWP, the portion of a program in which an identifier can be used successfully to denote its corresponding values and characteristics.

**SCT**

*See* system control terminal.

## Glossary

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### **secondary coroutine**

A procedure initiated as a coroutine by a program.

### **segment dictionary**

See code segment dictionary.

### **segmented array**

See paged array.

### **separately compiled procedure (SEPCOMP)**

In ALGOL, a procedure that is compiled on its own, rather than as part of a program, so that the procedure can be bound into a host program.

### **SEPCOMP**

See separately compiled procedure.

### **stack**

A region of memory used to store data items in a particular order, usually on a last-in, first-out basis. *Synonym for* process stack.

### **subroutine**

A self-contained section of a program to which program control is transferred when the subroutine is invoked and that transfers control back to the point of invocation when it is exited.

### **substitution**

(1) A predetermined string of up to 3 characters that can be ordered as if the string were 1 character. The ordered character string is assigned a single ordering sequence value (OSV) and a single priority sequence value (PSV). For example, in Spanish the letter pair *ch* is ordered as if it were a single letter, different from either *c* or *h* and ordered between *c* and *d*. (2) A single character that can be used to generate a string of two or three OSVs and PSVs. For example, the German sharp *s* is ordered as though it were *ss*.

### **system control terminal (SCT)**

(1) A terminal or other device that is connected to the system in such a way that it can communicate directly with the maintenance processor. An SCT can operate in maintenance mode or in operator display terminal (ODT) mode. On some systems, the SCT also provides a remote support mode. (2) A terminal used to enter information. An SCT can be used three ways: as an operator display terminal (ODT) to interface with the operating system, as a maintenance display terminal (MDT) to interface with the maintenance subsystem, or as a remote display terminal (RDT) to interface with remote support. The windows providing these uses are available once the automatic initialization sequence has finished.

## **T**

### **TAB**

See task attribute block.

**task**

(1) A dependent process. (2) A single, complete unit of work performed by the system, such as compiling or executing a program or copying a file from one disk to another. Tasks are initiated by a job, by another task, or directly by a user. *See also* process.

**task attribute block (TAB)**

A memory structure that stores the values of task attributes associated with a given task variable. Prior to the Mark 3.9 system software release, this information was part of the process information block (PIB).

**TCP/IP**

*See* Transmission Control Protocol/Internet Protocol.

**thunk**

A compiler-generated procedure that calculates and returns the value of a constant or expression passed to a call-by-name formal parameter. The thunk is executed each time the formal parameter is used. A thunk is also referred to as an accidental entry.

**touched array**

An array for which memory has been allocated by the operating system.

**Transmission Control Protocol/Internet Protocol (TCP/IP)**

A family of protocols that were originally developed for use in a Department of Defense network, and which have been widely adopted as standard protocols for multivendor networks. The applications protocols typically supported by TCP/IP are File Transfer Protocol (FTP), Simple Mail Transfer Protocol (SMTP), and Telnet.

**truth set**

A declared set of characters upon which membership tests can be made.

**U****unpaged array**

An array that is not automatically divided (*paged* or *segmented*) at run time into smaller segments. Arrays smaller than 1024 words are always unpaged.

**unsegmented array**

*See* unpaged array.

**up-level event**

In ALGOL, the situation that arises when either of the following is true: (1) The block containing an event is exited before the block containing the interrupt attached to the event is exited. (2) The block containing the finished event for a direct I/O statement is exited before the block containing the direct array is exited.

**up-level pointer assignment**

In ALGOL, any construct that could result in a pointer pointing to an array declared at a higher lexical level than that at which the pointer is declared. Such a construct is disallowed by the compiler, because the array can be deallocated, leaving the pointer pointing to an invalid portion of memory.



### W

#### WFL

*See* Work Flow Language.

#### word

A unit of computer memory. On A Series and B 7900 systems, a word consists of 48 bits used for storage plus tag bits used to indicate how the word is interpreted.

#### word array

In ALGOL, an array whose elements are single- or double-precision operands. *Contrast with* character array.

#### Work Flow Language (WFL)

The Unisys language used on A Series systems for constructing jobs that compile and run programs. WFL includes variables, expressions, and flow-of-control statements that offer the programmer a wide range of capabilities with regard to task control.

#### working stack

*See* D2 stack.

### Z

#### zone field

The high order, or most significant, four bits of a byte.

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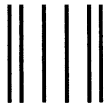
Name \_\_\_\_\_

Telephone Number \_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

Address (Street, City, State, Zip) \_\_\_\_\_



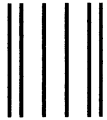
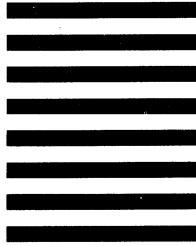
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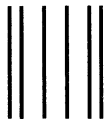
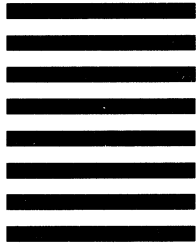
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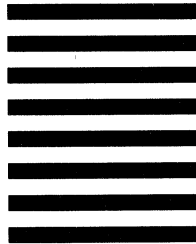
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