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IBM System/360 Operating System Introduction to Model 85 Programming Support

Preliminary Specifications

The IBM System/360 Model 85 is supported by the IBM System/360 Operating System, of which the two multiprogramming versions, MFT and MVT, have been modified to provide unique programming support. This publication briefly describes this additional support. Included are:

- Recovery Management Support programs.
- Assembler F support of Model 85 machine capabilities that are new to System/360.
- Support of the optional Model 85 operator console with CRT display.
- An Integrated Emulator program for emulation of 709/7090/7094/7094 II programs.



PREFACE

This publication provides information about IBM programming support for the IBM System/360 Model 85 that is not yet available in other Systems Reference Library publications. The information is introductory, yet sufficiently detailed for planning.

Programming support for the Model 85 that is not covered in this publication is included in the Systems Reference Library publications for the IBM System/360 Operating System, except for model-dependent support. The revisions and Technical Newsletters that are released with the Model 85 support package will document model-dependent differences.

In addition to the current library of Operating System publications (see IBM System/360 Bibliography, Form A22-6822), the following publications contain informa-

tion that should be read in conjunction with this publication:

IBM System/360 Model 85 Functional Characteristics, Form A22-6916.

IBM System/360 Principles of Operation, Form A22-6821 (editions of September, 1968, and later).

IBM System/360 Operating System Assembler Language, Form C28-6514.

For more information on the 709/7090/7094/7094 II Integrated Emulator for the Model 85 see:

IBM System/360 Operating System: 709/7090/7094/7094 II Emulator Program for IBM System/360 Model 85, Form C27-6944.

First Edition (January 1969)

Significant changes or additions to the specifications contained in this publication are continually being made. When using this publication in connection with the operation of IBM equipment, check the latest SRL Newsletter for revisions or contact the local IBM branch office.

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The IBM System/360 Model 85 offers significantly increased performance beyond that of the System/360 Models 65 and 75; it provides both power and growth for scientific and commercial users. The upward compatibility of System/360 has been maintained, so that the System/360 Operating System, together with a user's existing library of System/360 programs, can be used on the Model 85.

Figure 1 shows a typical configuration of the Model 85 CPU and various channels, control units, and I/O devices.

MACHINE CHARACTERISTICS

The Model 85 utilizes advanced design concepts and introduces certain new features, some standard and some optional, to System/360.

Standard Features

The Model 85 can have a main storage of four capacities ranging from 512K (524,288 bytes) to 4096K (4,194,304 bytes). A high-speed buffer holds duplicate data from currently used sections of main storage and is referred to by the CPU whenever possible. Thus, a great many references to main storage are eliminated. The buffer storage cycle time is one-third to one-quarter of the main storage cycle time, which is 960 or 1,040 nanoseconds, depending on the model. Buffer and main storage

references are controlled automatically; no special programming considerations are involved.

Advanced engineering features of the Model 85 also include checking and correcting errors in main storage and automatically retrying most instructions. As a result, machine-check interruptions indicate either that an error condition exists or that an error condition has been corrected.

In the Model 85, the interruption code for a machine-check interruption is not all zeros. The code specifies either a type of existing error condition ("hard" machine-check interruption) or a type of error that has been detected and corrected ("soft" machine-check interruption). With programming support from the Operating System, these machine features enhance machine reliability and provide a means for flexible handling of machine-check interruptions.

The Model 85 incorporates both read-only storage (ROS) and writable control storage (WCS). Writable control storage provides extended diagnostic capability for the IBM customer engineer. It also is used by the Machine-Check Handler program for a specific purpose (see "Recovery Management Support"), and is used by the optional Compatibility Feature for emulating 709/7090/7094/7094 II programs.

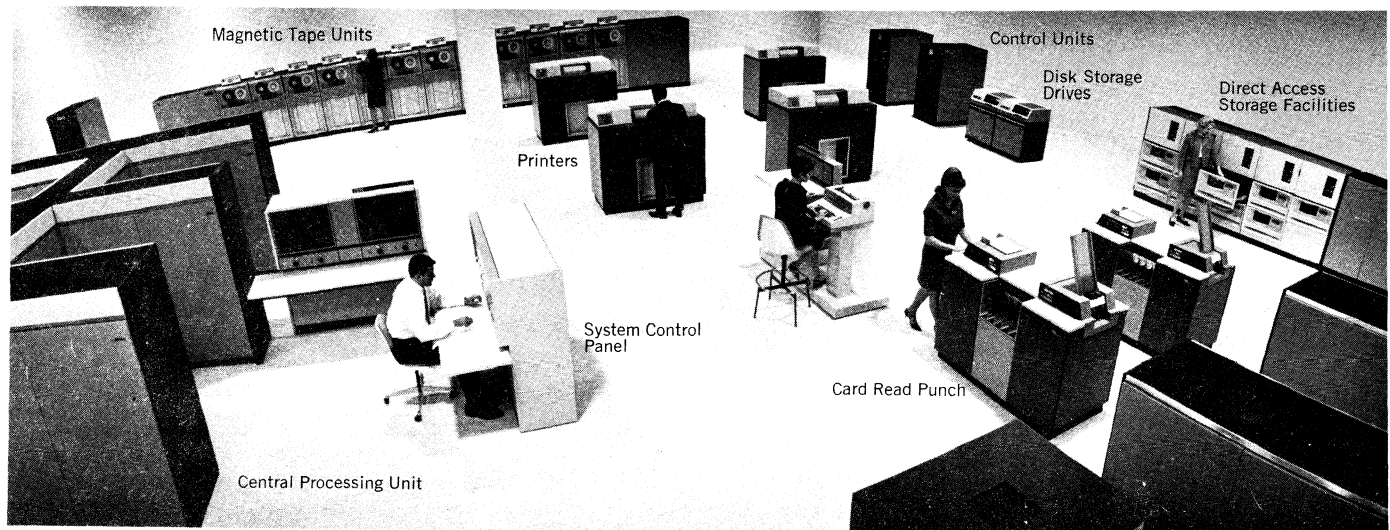


Figure 1. IBM System/360 Model 85

In addition to the universal instruction set, seven new floating-point instructions are standard on the Model 85. Five of these instructions are for performing arithmetic operations with greater precision; two are for rounding results.

The Model 85 introduces to System/360 the byte-oriented operand feature. Because of this standard feature, fixed-point, floating-point, and logical operands of the unprivileged RX- and RS-format instructions are not required to be on integral boundaries as they are for other System/360 models.

However, if a program is assembled to run on a Model 85 in such a way that the byte-oriented operand feature will be called into play, performance degradation is likely to result for the affected instructions. Instruction execution times increase, sometimes substantially, when the feature is used. Therefore, to ensure optimum performance, storage operands should be aligned on integral boundaries; use of unaligned operands should be reserved for exceptional cases.

Up to six selector channels and one multiplexor channel can be attached to the Model 85. A full range of System/360 input/output devices and control units can be used.

Optional Features

An optional feature of the Model 85 is high-speed multiply for both fixed-point and floating-point multiply instructions. There are no special programming considerations for use of this feature.

The Model 85 console may optionally be the new operator console feature that is integrated with the system control panel, or a stand-alone unit such as the IBM 1052 Printer-Keyboard Model 7 with IBM 2150 Console. The operator console feature shares the cathode-ray tube screen on the control panel (which otherwise serves solely as a customer engineer maintenance device), and includes an input keyboard and the necessary buffer storage and circuitry.

PROGRAMMING SUPPORT

It is intended that the IBM System/360 Operating System be used as the control program for the Model 85. Either Multiprogramming with a Fixed Number of Tasks (MFT) or Multiprogramming with a Variable Number of Tasks (MVT) should be the control program. The Primary Control Program (PCP) version of OS should not be used because it will not support the Recovery Management

programs for the Model 85 or the new Model 85 operator console feature.

The major items of new programming support for the Model 85 described in this publication are:

- Recovery Management Support.
- Assembler F extensions.
- Model 85 operator console with CRT display.
- Emulation.

Recovery Management Support

Recovery Management Support (RMS) programs are included with MFT or MVT when the Operating System is generated for the Model 85. Their purpose is to increase system availability beyond that which is provided by machine recovery facilities alone.

RMS has two primary functions: recovering, if possible, from hard machine-check error conditions, and formatting error records. When a hard machine-check interruption occurs, the Machine-Check Handler for the Model 85 (MCH/85) initiates recovery operations; when a channel-check condition exists, the Channel-Check Handler program initiates recovery operations. Depending on the circumstances surrounding the error, total recovery may be the result (some time loss but otherwise unaffected system operation), or system recovery with selective termination of a task may occur (probably requiring rescheduling of the job).

When recovery is not achieved and the system is halted, the error recording function makes diagnostic information available to the customer engineer for repair and system restart. MCH/85 produces an error record regardless of whether the machine-check interruption was hard or soft. CCH also produces error records. All RMS error records are written onto the SYS1.LOGREC data set. Printouts can be obtained with the aid of the Environment Record Editing and Printing program (EREP).

Assembler F Extensions

Extensions to Assembler F support the new Model 85 machine instructions. Assembler F also includes a new Assembler instruction, OPSYN, which provides a means for using source programs containing the new machine instructions on other models of System/360.

Model 85 Operator Console with CRT Display

The optional Model 85 operator console is supported by MFT and MVT. It provides a communication link between the system and the operator that is faster and more convenient for the operator than a printer-keyboard console. Messages from the system and from problem programs are displayed on the cathode-ray tube screen and retained until deleted automatically or by the operator. Input is from a keyboard located under the screen.

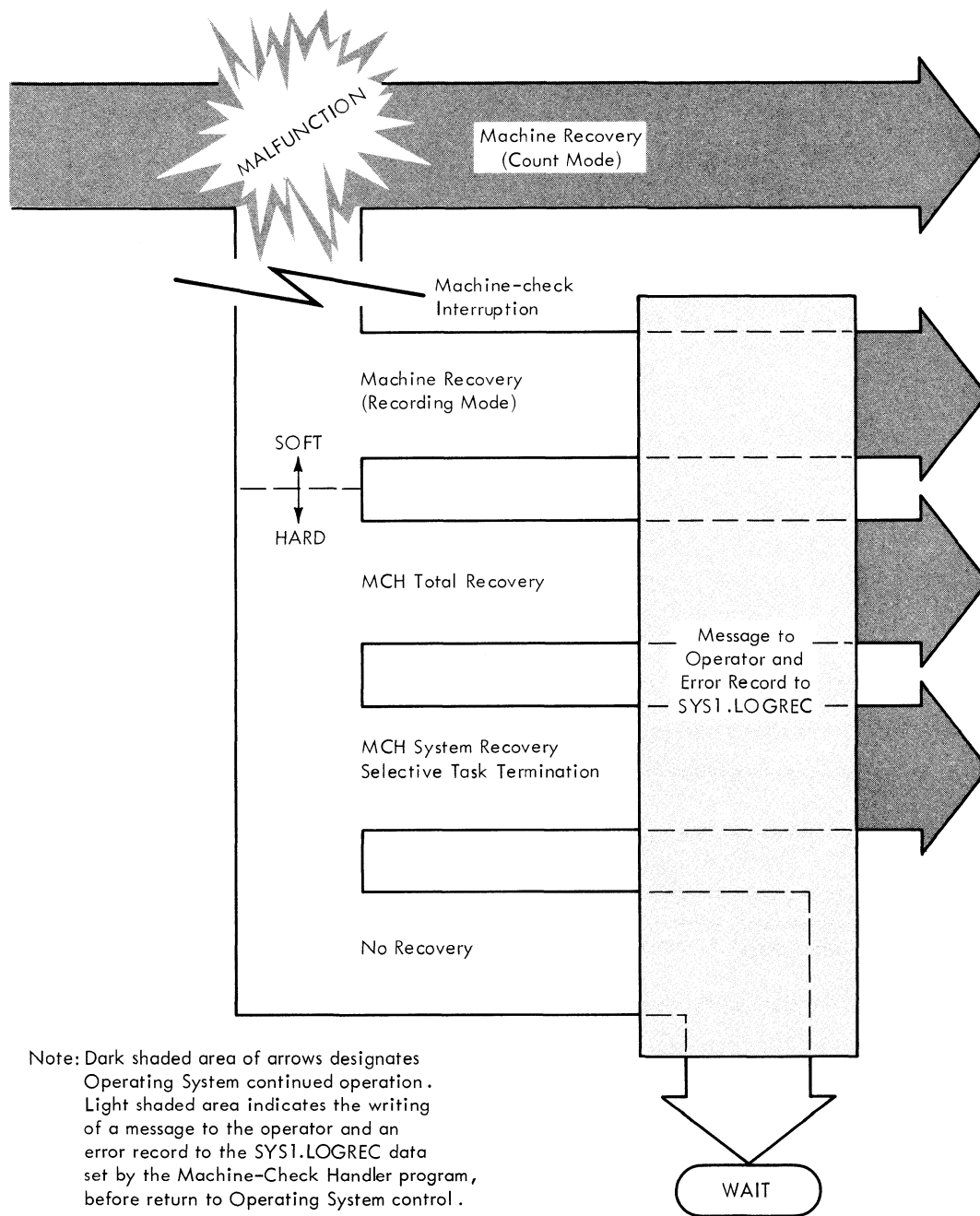
The cathode-ray tube screen is formatted to contain up to 29 messages plus lines for displaying and controlling input, for displaying instructions to the operator, and for warning the operator. A new command, CONTROL, is provided for controlling the data displayed on the screen. See the

section on the operator console later in this book for a depiction of the screen format.

The Model 85 operator console can be manually switched to maintenance mode, no longer under OS control, when the CPU has been stopped. Data that a customer engineer can inspect via rows of lights on other System/360 models can be made to appear on the screen when it is in maintenance mode.

Emulation

Emulation of 709/7090/7094/7094 II programs is provided through the combination of the 7094 Compatibility Feature and an emulator program operating under control of OS/360.



Note: Dark shaded area of arrows designates Operating System continued operation. Light shaded area indicates the writing of a message to the operator and an error record to the SYS1.LOGREC data set by the Machine-Check Handler program, before return to Operating System control.

Figure 2. Results of Machine-Check Handler Execution

The Recovery Management Support programs for the IBM System/360 Model 85 are the Machine-Check Handler for the Model 85 (MCH/85) and the Channel-Check Handler (CCH). These programs are required when generating an MFT or MVT system for the Model 85; the Recovery Management Support programs cannot be included with a PCP system.

MCH/85 and CCH will be documented in detail in IBM System/360 Operating System Program Logic Manuals.*

MACHINE-CHECK HANDLER

MCH for the Model 85 is invoked to handle both soft and hard machine-check interruptions. When a machine-check interruption occurs, the machine recovery facilities have posted the results of their processing in the interruption code of the machine-check old PSW. MCH/85 proceeds on the basis of those results, as shown in Figure 2.

A soft machine-check interruption indicates that a storage data error was corrected by the machine recovery facilities, or that an instruction retry by the machine recovery facilities has been successful. It may also indicate that an uncorrectable error in storage has occurred on a channel operation.

A hard machine-check interruption indicates one of the following:

- An uncorrectable storage error on a CPU operation was detected.
- The CPU instruction retry was unsuccessful.
- The instruction could not be retried.

Soft Machine-Check Interruption Processing

A soft machine-check interruption indicates that no corrective action by MCH/85 is required. However, if the soft machine-check interruption was caused by a corrected storage error, MCH/85 may perform

*Program Logic Manuals are intended primarily for use by IBM personnel involved in program design and maintenance. They may not be made available to others without the approval of local IBM management.

an analysis of the failing storage location to determine whether the error will recur. (This information is particularly valuable to the maintenance personnel and will be included within the appropriate error message.) Following a soft machine-check interruption, an error message is written to the operator, an error record is written onto the SYS1.LOGREC data set, and control is returned to the Operating System.

Hard Machine-Check Interruption Processing

When MCH/85 receives control upon the occurrence of a hard machine-check interruption, the error condition is analyzed to determine whether recovery is to be attempted, and if so, at what level. For example, if a storage protect key has failed, an attempt is made to restore the correct key value. Or, if a multiply instruction has failed in a machine that contains the optional high-speed multiply feature, MCH/85 loads into writable control storage a microprogram that provides an alternate algorithm for retry of the failing instruction and for use in the execution of subsequent multiply instructions.

Recovery from a storage data error may be possible by refreshing the affected load module - that is, by overlaying it with a fresh copy - if the load module was marked by the linkage editor with the refreshable attribute (REFR). Retry is then performed when possible.

When recovery from a hard machine-check interruption is successful, MCH/85 writes an appropriate message to the operator and formats an error record, which is written onto the SYS1.LOGREC data set. Control is then returned to the Operating System for resumption of normal processing.

When recovery is not successful, selective task termination is attempted. If MCH/85 can isolate program damage to a non-critical task, that task is terminated and the system continues. The operator is notified so that the affected job can be rescheduled; an error record is written onto the SYS1.LOGREC data set.

Whenever total recovery or system recovery cannot be achieved, a message is written to the operator, an error record is written onto the SYS1.LOGREC data set, and the machine enters the wait state. In order to obtain the diagnostic information on the SYS1.LOGREC data set, the operator schedules the Environment Record Editing

and Printing program (EREP) to get a printout for the customer engineer.

In some cases, it may be impossible to use EREP to obtain a printout because MCH/85 could not produce an error record for the SYS1.LOGREC data set, having encountered a catastrophic error. The message to the operator will then specify that SEREP be used to obtain a printout of machine status information. SEREP formats the LOGOUT area and produces an error record.

Mode Changing

A persistent error that is correctable by the machine recovery facilities will soon become burdensome if identical messages are issued repeatedly while MCH/85 writes record after record onto the SYS1.LOGREC data set. MCH/85 provides a means for switching from the usual "recording mode" to a "count mode" use of error recovery facilities. In count mode, errors that are corrected by the Model 85 machine recovery facilities are counted. A soft machine-check interruption does not occur until the counter overflows. A new operator command, MODE, is used to control this function.

The two separate facilities, Hardware Instruction Retry (HIR) and Error Correction Code (ECC), can be set separately into recording mode or count mode. (Recording mode, whereby all machine errors produce machine-check interruptions, is the default state for the Model 85.)

The operator can specify a count for count mode that, when reached, will cause a soft machine-check interruption to be taken and the counter to be reset. (Both counters are logged out with each machine-check interruption so the number of corrected incidents between machine-check interruptions is known.)

For each of the machine recovery facilities, the operator can specify a threshold for recording mode that, when reached, will cause MCH/85 to switch to count mode automatically and to notify the operator.

CHANNEL-CHECK HANDLER

The Channel-Check Handler, an extension to the input/output supervisor, increases the system's I/O retry capability to include the occurrence of channel control checks, channel data checks, and interface control checks. When one of these error conditions is encountered, CCH and the appropriate device-dependent I/O error recovery procedure work together to determine the feasibility of a recovery attempt and to perform the retry. An error record is formatted for subsequent writing onto the SYS1.LOGREC data set by the Statistical Data Recorder routine of the I/O subsystem.

If CCH is unable to complete its functions, MCH/85 is called upon to write the error record.

The seven new instructions offered on the System/360 Model 85 require Assembler support. Extensions to Assembler F provide this support.

NEW MACHINE INSTRUCTIONS

Assembler F will produce object code for the new Model 85 floating-point instructions, after a validity check has found the source instructions to be correctly coded.

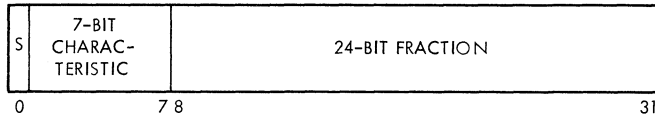
FORTRAN, PL/I, COBOL, ALGOL, and RPG do not support the seven new floating-point instructions. To take advantage of these

new instructions, programs written in those languages require appropriate subroutines in Assembler language.

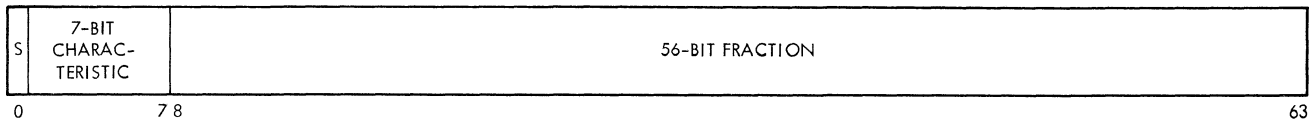
The new instructions, five extended-precision and two rounding, are summarized in Table 1. The "name" column indicates their functions.

Figure 3 shows the data format for extended operands of the AXR, SXR, MXR, and LRDR instructions, and for extended results of the AXR, SXR, MXR, MXDR, and MXD instructions. Figure 3 also shows the formats of short and long floating-point numbers.

SHORT FLOATING POINT NUMBER



LONG FLOATING POINT NUMBER



EXTENDED FLOATING POINT NUMBER

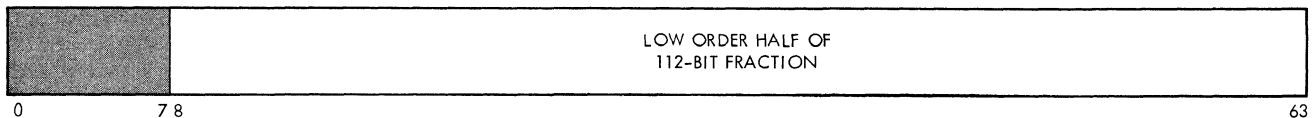
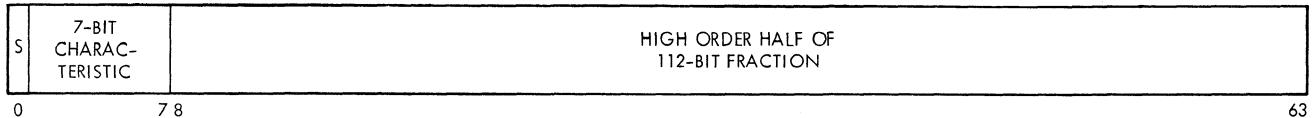


Figure 3. Floating-Point Formats

IBM System/360 Principles of Operation, Form A22-6821, contains detailed functional descriptions of the new Model 85 machine instructions.

NEW ASSEMBLER INSTRUCTION: OPSYN

A source program containing the new Model 85 floating-point instructions cannot be assembled to run successfully on another System/360 model unless some means are provided for converting those new instructions into instructions that can be executed by the other machine. The OPSYN Assembler instruction helps to provide a facility for doing this.

The format of the OPSYN statement is:

A OPSYN B

A is the name field of the statement and is a source code mnemonic; B is an existing machine instruction mnemonic, an extended mnemonic code, an operation code defined by a previous OPSYN statement, or blank. The OPSYN statement assigns to A all of the properties of B or, if B is blank, removes A from the Assembler F Operation Code Table.

If a programmer wishes to use, for example, MXR (extended multiply) on a System/360 other than a Model 85, he has at least two ways to do so:

1. The programmer can remove MXR from the Assembler F Operation Code Table and add a macro instruction named MXR as a user macro, in this manner:

```

MXR OPSYN
    MACRO
    MXR      &R1,&R2
    .
    .
    MEND

```

The first statement removes MXR as a machine instruction and allows the programmer to define MXR as a macro instruction; without the OPSYN statement, Assembler F would continue to assemble MXR as a machine instruction.

2. The programmer can approximate MXR by "equating" it to MDR (multiply long):

MXR OPSYN MDR

The MDR instruction is then assembled for each occurrence of MXR in the source program. This allows the programmer to debug his routine on a System/360 other than a Model 85. Later, if he has the opportunity, he can remove the OPSYN statement, reassemble the program, and run the program on a Model 85.

SUPPORT OF UNALIGNED DATA

The Model 85 will execute unprivileged RX- and RS-format instructions with fixed-point, floating-point, or logical operands that are not on integral boundaries. Assembly of such instructions normally produces the diagnostic message "IEU033 Alignment Error". A new PARM option in the EXEC statement for the Assembler F, ALGN or NOALGN, makes it possible to suppress the message and thereby obtain a "clean" assembly listing (a listing with no error messages). The object code is not affected.

Note that an assembled program that requires use of the Model 85 byte-oriented operand feature cannot be run on another machine, nor can it run successfully under the Operating System if it violates any alignment restrictions imposed by OS/360.

Table 1. Extended-Precision and Rounding Instructions

Name	Mnemonic	Type	Op Code
ADD NORMALIZED (extended operands, extended result)	AXR	RR	36
SUBTRACT NORMALIZED (extended operands, extended result)	SXR	RR	37
MULTIPLY (extended operands, extended result)	MXR	RR	26
MULTIPLY (long operands, extended result)	MXDR	RR	27
MULTIPLY (long operands, extended result)	MXD	RX	67
LOAD ROUNDED (extended to long)	LRDR	RR	25
LOAD ROUNDED (long to short)	LRER	RR	35

NEW TYPE L CONSTANT

Model 85 extended-precision floating-point instructions do not include corresponding load and store instructions. Two Load Longs or Store Longs can be used instead with no appreciable degradation in performance compared to what extended-precision loads or stores would have given.

A new Define Constant operand type, L, has been added to provide extended-

precision floating-point constants for the programmer. It can be used as a Define Storage operand or in a literal. Unless changed by a length modifier, the Type L constant is 16 bytes long and is aligned on a double word boundary. Its format is that of two contiguous Type D constants, as shown in Figure 3, except that it is assembled with the sign of the second double word equal to that of the first, and the characteristic of the second equal to that of the first minus 14, modulo 128.

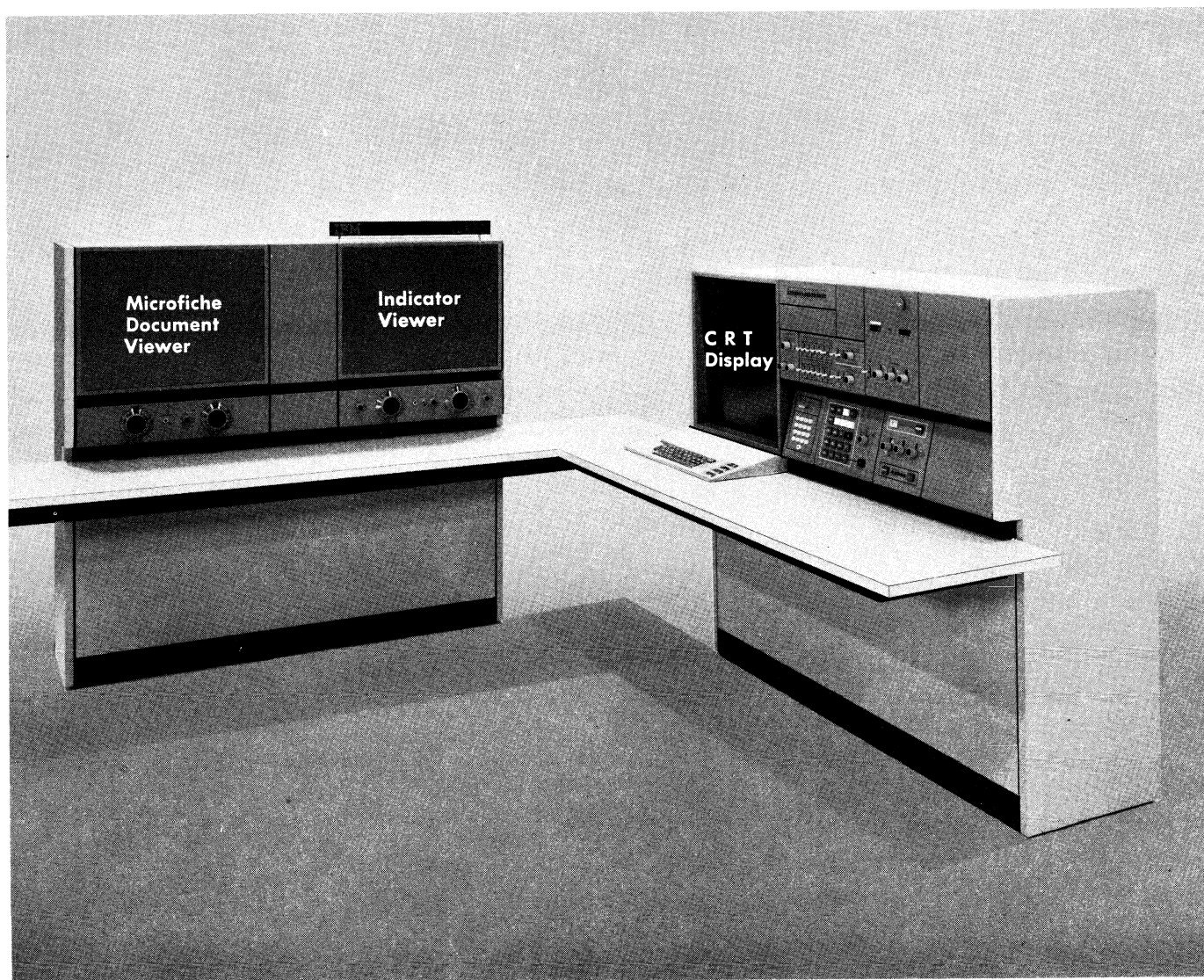


Figure 4. Model 85 System Control Panel with Operator Console Feature

The Model 85 operator console with CRT display is optional on the System/360 Model 85. In its place, the IBM 1052 Printer-Keyboard Model 7 with the IBM 2150 Console may be used (this stand-alone console is supported by the Operating System for other models of System/360).

The Model 85 operator console is supported by MFT and MVT. For output, the console uses the cathode-ray tube (CRT) on the system control panel, and for input it uses a keyboard. The input and output operations can occur virtually simultaneously, in contrast to a printer-keyboard console. Thus the Operating System is able to issue messages quickly and noiselessly while the operator performs his duties, including replying to messages and issuing other commands.

This section describes the physical characteristics of the feature and, in general terms, the functions and capabilities provided by the programming support.

CONSOLE DESCRIPTION

An installed Model 85 operator console consists of an input keyboard plus a character generator and display buffer. The keyboard is located just below the cathode-ray tube screen on the system control panel (see Figure 4). The screen is shared between console use and maintenance use. A switch on the control panel places the screen in operator mode or maintenance mode. The screen is under program control only in operator mode.

A cursor on the cathode-ray tube screen designates the current location for entering or manipulating a character; characters are displayed on the screen as they are typed in. The cursor looks like an underscore character. It is moved, without changing the data it passes, with the ADVANCE, BACKSPACE, UP, and DOWN keys. (The space bar may appear to be simply advancing the cursor, but it enters blank characters.)

The ADVANCE key moves the cursor ahead, one character position at a time. When the cursor reaches the end of a line, it moves to the beginning of the next line; when it reaches the end of the last line, it moves to the beginning of the first line. The BACKSPACE key works in the same manner in the opposite direction. The UP and DOWN

keys cause the cursor to move up or down one line at a time.

The ADVANCE, BACKSPACE, UP, and DOWN keys are typamatic; that is, they operate repeatedly as long as the key is depressed.

The cathode-ray tube screen is formatted into 35 lines of 80 character positions each. The console also contains an audible alarm that sounds for one second, under program control. A warning light goes on whenever the alarm sounds; it must be turned off manually.

OPERATING CONSIDERATIONS

Screen Format

The 35-line screen is formatted by the Operating System as follows:

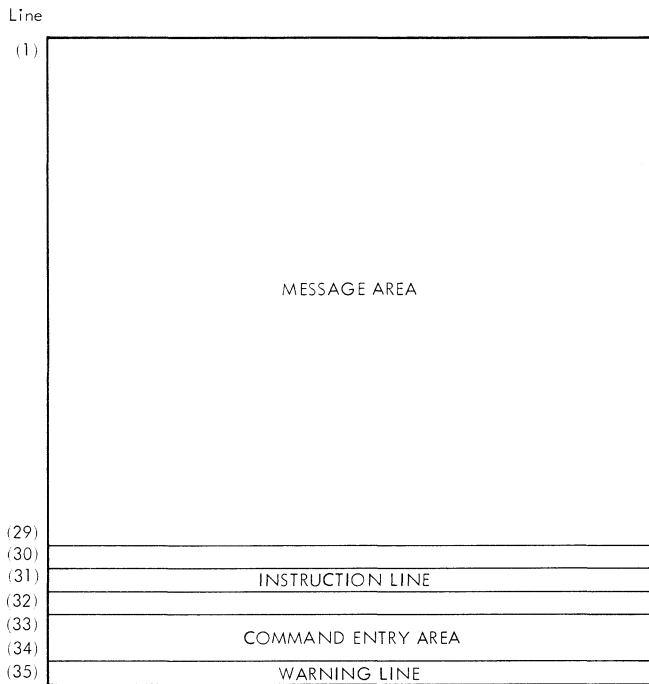
- Lines 1-29 constitute a message area.
- Line 30 is always blank.
- Line 31 is an instruction line for the operator which displays a message or operation instruction associated with the operator console.
- Line 32 is always blank.
- Lines 33 and 34 constitute a command entry area for display of input.
- Line 35 is a warning line.

Figure 5 shows the cathode-ray tube screen format.

CONTROL Command

A new operator command, CONTROL, is provided for the Model 85 operator console. The CONTROL command allows the operator to exercise control over the contents of the cathode-ray tube screen, both dynamically and by specification of parameters that govern certain aspects of screen control.

The operands dynamically provide a capability to display message numbers (for the purpose of controlling erasure of messages), and a capability to erase messages.



Note: The dashed lines and the numbers in parenthesis do not appear on the screen; they are used here to indicate the separate areas of the console display.

Figure 5. Format of the Cathode-Ray Tube Screen Used by the Model 85 Operator Console Feature

The erase operand can include parameters to specify each of the following:

- Erasure of a predefined group of deletable messages, starting at the top of the screen.
- Erasure of a single message or an explicitly designated group of messages.
- Erasure of all messages flagged with a vertical or horizontal line.
- Erasure of an informational display (described later).

All numbers displayed through use of the CONTROL command are erased when the next message erasure is performed.

The specification capability of the CONTROL command is used to initialize or alter the console operating environment. Parameters included in the operand specify:

- Whether automatic message deletion will be in effect. Automatic message deletion occurs only on messages on which action has already been taken, or which have been specifically requested for deletion by the programmer.

- Whether conversational mode shall be in effect. Conversational mode requires verification of message deletion requests before the actual deletion takes place.
- The number of messages in a predefined group.

The initial values for these parameters are "yes" for automatic message deletion and conversational mode, and 20 for the number of messages to be deleted at one time.

Message Display

The format for displaying messages is:

<u>Character Position</u>	<u>Purpose</u>
1-2	Contain the message number.
3	Contains a vertical line() when a message requires no further action and is considered to be automatically deletable, or for deletion verification.
	Contains a horizontal line (-) when the message is an informational-type message which requires no action.
	Contains a blank for other messages or commands.
4	Contains an asterisk when a message requires some action to be taken.
5-76	Contain the message text.
77-80	Reserved for future use.

Messages over 72 characters long are continued on the next line.

The message area is blank at the startup of the system. Thereafter, messages are displayed on successive lines, beginning at line 1. The bottom message on the screen at any given time is always the newest; the top message is always the oldest. Interspersed in the message area are the commands issued by the operator (except CONTROL), appearing in chronological order.

When all message lines are in use and automatic deletion is not in effect, the occurrence of another message causes the audible alarm to sound and a warning to be issued on the warning line. The operator is expected to delete one or more messages in order to receive the new message. The same is true when automatic deletion is in effect but there are no messages that can be deleted automatically.

Message Deletion

Message deletion is accomplished in one of three ways: with the cursor, with the CONTROL command and an erase operand, or automatically.

- The cursor can be used to delete messages by placing it at the beginning of the line (position 1) of the bottom message to be deleted and pressing the END key. All messages above the line where the cursor is located that do not have an asterisk in position 4 are deleted, including the line designated by the cursor.
- The CONTROL command and an erase operand can specify deletion of a predefined group of messages, a single numbered message, a range of numbered messages, or all flagged messages.
- Automatic message deletion can be specified with the CONTROL command and is the initial state. It causes erasure of all messages flagged with a vertical line in position 3 when there is no space in the message area for an incoming message. Any remaining messages are moved up. Automatic message deletion will not occur when a deletion request is pending.

When conversational mode is in effect, messages being deleted with the cursor or the CONTROL command are left in the entry area and marked for verification with a vertical line in position 3. When a message indicating that deletion verification is required appears on the instruction line, the operator must confirm his deletion request by pressing the END key, or he may cancel the request with the CAN (cancel) key.

Note that although the free-floating cursor permits writing in the message area, a message is not permanently changed or deleted by writing over it; the message as it resides in storage can be restored by pressing the CAN (cancel) key.

Deleted messages are not lost, since a hard copy log of all messages is made available. The user must specify a hard copy device, as explained under "Multiple Console Support Environment."

Command Entry

With the cursor at the beginning of the entry area (its normal position), commands are typed in at the keyboard, with a maximum of 126 characters per entry. (Both lines of the entry area are used if more than 80 character positions are needed.) A character may be corrected before the com-

mand is entered into the system by positioning the cursor under it and pressing the key desired.

When the message as displayed in the entry area is complete, including at least one blank character at the end to indicate the end of the command, the END key is pressed to transmit the command to the system. At the time of entry, the cursor may be anywhere within the message area. When the END key is pressed, the cursor moves to the first position in the entry area, which is now blank. If the CAN (cancel) key is pressed instead, the entry area is blanked and the cursor moves to the first position.

Information Display

An information display area temporarily overlays the message area when the operator requests a display of the format of the CONTROL command, shown as a list of options with their meanings. The display occupies the bottom portion of the message area until erased through use of the CONTROL command. The CONTROL command format display requires 15 lines.

The visible message area (29 lines minus the number of lines used by the information display) has the appearance of being the entire message area; when it is full, an incoming message results in automatic message deletion, when that is possible, or a warning to the operator. However, all 29 message lines are maintained in storage. When the information display is erased with the CONTROL command, the entire 29-line message area is restored on the screen in its current state.

PROGRAMMING CONSIDERATIONS

Multiple Console Support Environment

Much of the programming support for the Model 85 operator console is provided by the Multiple Console Support (MCS) option. Consequently, Multiple Console Support must be included at System Generation when the Model 85 operator console is desired.

Multiple Console Support permits a system to operate with multiple consoles, each console performing unique system functions. For example, a console located in a tape pool may receive messages pertaining only to its function, such as MOUNT messages for tape devices but not MOUNT messages for direct access devices.

If the Model 85 operator console is used, a hard copy log is required of all messages and commands. The user may specify System Log as the hard copy log or may

specify any of the following devices to produce a hard copy log:

- 2740 Communications Terminal, Model 1.
- 1052 Printer-Keyboard with a 2150 Console.
- 1443 Printer.

Multiple Console Support provides the necessary programming support to produce the hard copy log.

Delete Operator Message Macro Instruction

The Delete Operator Message (DOM) macro instruction interfaces with the operator console support to delete a message from the cathode-ray tube screen.

When a WTO/R macro instruction is executed, a DOM identification number is assigned to the message and returned to the issuing problem program. When the program no longer requires that the message be displayed, it will issue a DOM macro, specifying the DOM identification number. (DOM identification numbers are not to be confused with the identification numbers assigned for operator reply purposes.)

The DOM macro should be issued against all action messages. When the macro is issued, it causes a vertical line (|) to appear in position 3 of a message line, indicating that the message is ready for deletion.

Descriptor Codes

A new parameter of the WTO/R macro enables the user to specify that a message is to be displayed so as to indicate one of the following:

- Action (displayed with an asterisk in position 4).
- Informational and deletable at job step end (displayed with a horizontal line in position 3).
- Informational but not deletable at job step end (displayed with a horizontal line in position 3).
- Normal message status (displayed with a blank in position 3).

Seven different message descriptor codes are available to designate the exact status of each message.

An integrated emulator is available for the Model 85 which permits application programs written for the IBM 709, 7090, 7094, or 7094 II Data Processing Systems to be executed on the Model 85. Use of the emulator not only eases the user's burden of converting to System/360 programming but also increases performance of the emulated programs.

The 7094 Integrated Emulator is a combination of the 7094 Compatibility Feature and a program that executes under the System/360 Operating System. The 7094 Compatibility Feature must be present on the Model 85 in order for emulation to take place; it makes the emulator program fully relocatable, thus allowing the emulator program to execute in a multiprogramming environment.

The emulator program runs under either the MFT or MVT control program with a minimum main storage requirement of 380K bytes. As an integrated emulator, it has distinct advantages over a stand-alone emulator; it can take advantage of the multiprogramming capabilities of the system by allowing other problem programs to be executed concurrently (including other emulators) and sharing certain system resources with these other programs.

The 7094 Integrated Emulator user can multiprogram the emulator workload with many other types of jobs; this results in the execution of more jobs in a given period of time, thus reducing the cost of each job.

The 7094 Integrated Emulator requires system generation procedures rather than the system initialization procedures necessary for stand-alone emulators. It is tailored at system generation to the configuration and device assignments of the 7094 machine to be emulated, and can thereafter be modified by control statements. It is loaded, initiated, scheduled, and terminated by the Operating System, since it is treated as a problem program in the system.

BASIC SYSTEM REQUIREMENTS

A computing system using the 7094 Integrated Emulator for the Model 85 must include the 7094 Compatibility Feature, devices required for the Operating System, and one System/360 device for each emulated 7094 device.

A variety of System/360 input/output devices may be used to emulate the 7094 devices. All tape drives used for 7094 compatible tapes must be equipped with the Seven-Track Compatibility Feature. In addition, for best performance, emulated 7094 channels should be on separate System/360 2860 channels or 2870 selector subchannels.

To read in binary data, all card read units must be equipped with the Card Image Feature. Binary data may be punched with an online card punch with the Card Image feature, or with a user-written output writer to punch binary data from a SYSOUT data set (See IBM System/360 Operating System, System Programmer's Guide, Form C28-6550).

Table 2 shows the System/360 devices that may be used to emulate 7094 devices.

Table 2. 7094-System/360 Device Equivalents

7094 Devices	System/360 Devices
IBM 729 Tape Unit	Any tape unit supported by the Operating System.
IBM 711 Card Reader	Any card reader* or SYSIN device supported by the Operating System.
IBM 716 Printer	Any printer or SYSOUT device supported by the Operating System.
IBM 721 Card Punch	Any card punch* or SYSOUT device supported by the Operating System.
<p><u>Note:</u> A dedicated printer is recommended when using the 7094 Integrated Emulator.</p> <p>*The Card Image Feature is required to handle binary data.</p>	

The 7094 Integrated Emulator does not support the following 7094 features and devices:

- 7909 Data Channel and attached devices such as:

- 1414 I/O Synchronizer Model 6
- 7631 File Control
- 1301 and 1302 Disk Storage
- 7640 Hypertape Control
- 7340 Hypertape Drives
- 7320 Drum Storage
- 7740 Communication Control System
- 7750 Programmed Transmission Control Data Channel Switch

- Direct Data Connection

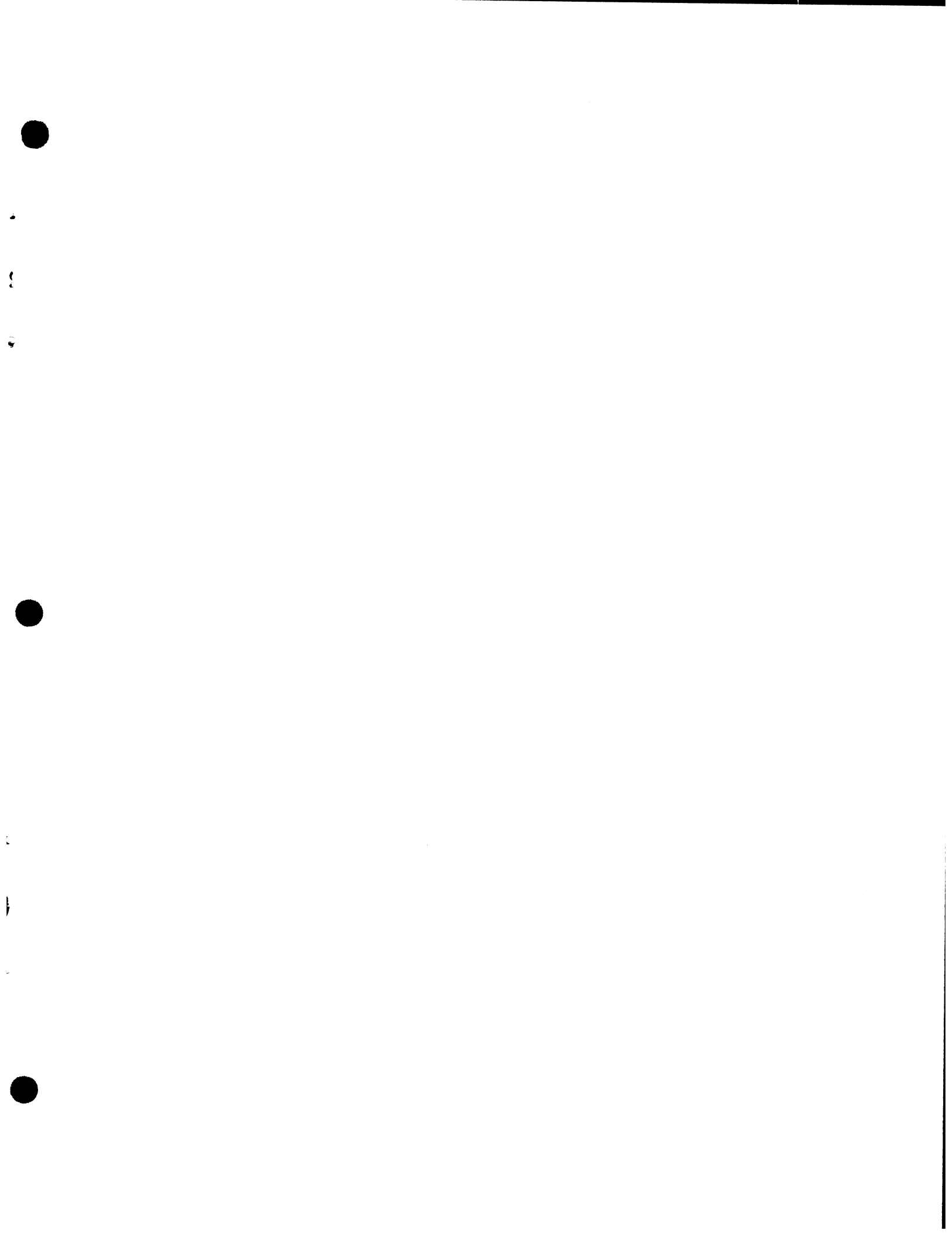
- Direct Couple
- External Signal Trap
- 740 CRT Recorder (709 device)
- 780 CRT Display (709 device)
- 7094 Special and Custom Features
- 704 Compatibility

Concepts and considerations concerning the 709/7090/7094/7094 II Integrated Emulator for the Model 85 are fully documented in IBM System/360 Operating System: 709/7090/7094/7094 II Emulator Program for IBM System/360 Model 85, Form C27-6944.

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