RA60/80/81 UDA50/KDA50-Q FRMTR
UDA50A KDA50Q CZUDKA0

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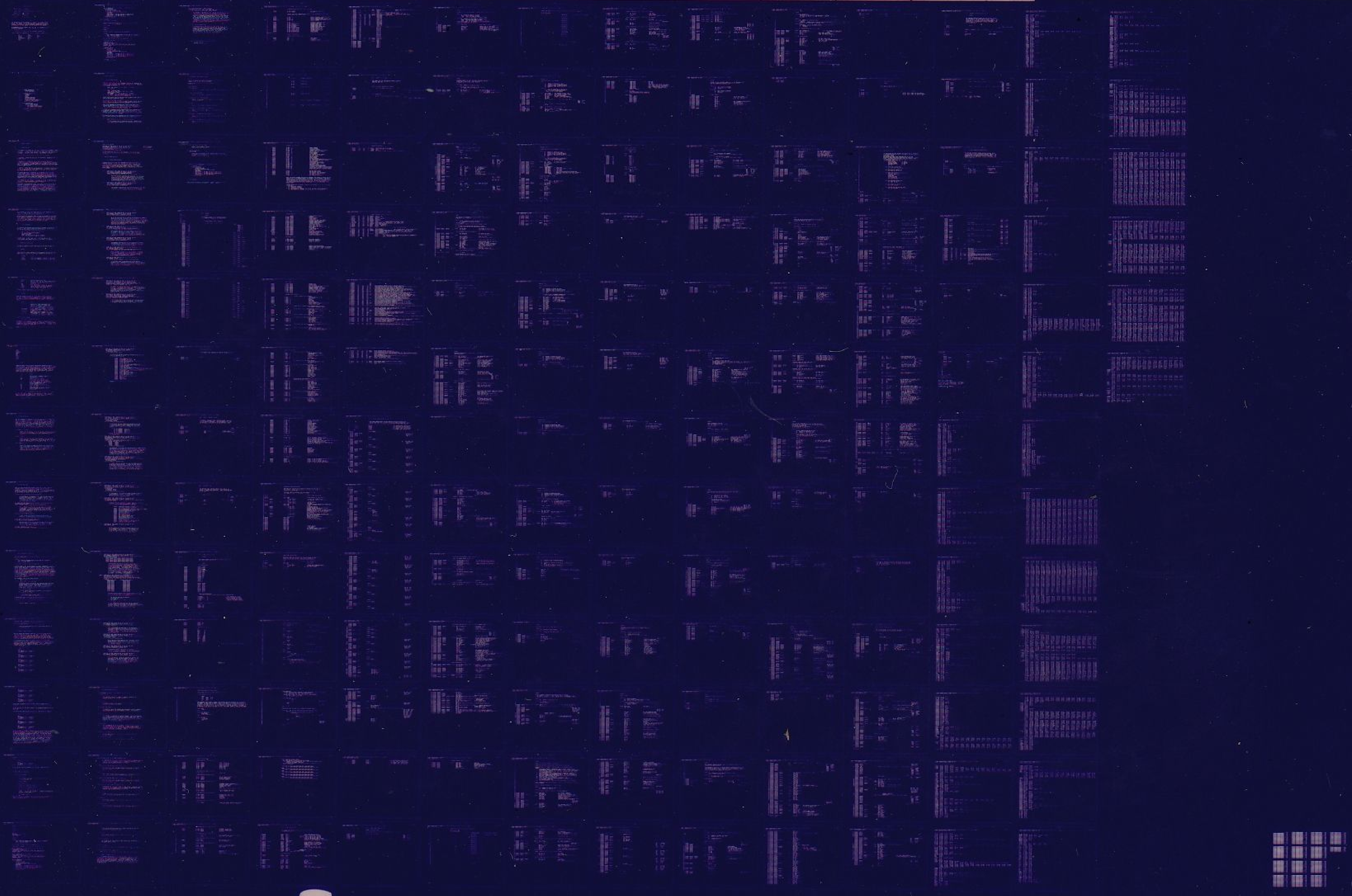

IDENTIFICATION

PRODUCT CODE: AC T938A MC

PRODUCT NAME: CZUDKAO UDA50A/KDA50-Q FORMATTER

PRODUCT DATE: 2-OCT-1984

MAINTAINER: ROGER OAKEY

AUTHOR: BRIAN SCHOW

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```
     1                                  .TITLE  CZUDKO UDA50A/KDA50-Q FORMATTER
                .REM
```

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1.0 GENERAL INFORMATION

1.1 PROGRAM ABSTRACT

This program will format any disk drive connected to a UDA50A or KDA50-Q disk controller. At the time of this writing, there are three such drives in existance -- the RA60, RA80 and RA81. No changes to this program will be needed to format new disk drives as they become available.

There are three ways to format a disk with this program:

1. Reformat - Format the disk with the bad sector information that was written onto the disk at the factory. This is the normal way to format a disk.

2. Reconstruct - Format the disk without using any bad sector information. This should be used only when the bad sector information has been destroyed or for some reason can no longer be read from the disk. This method may also be specified in the disk drive's maintenance manual for special cases (eg. changing an RM/RA80 spare HDA from RM80 format to RA80 format).

3. Restore - Format the disk using bad sector information obtained from a disk file on the XXDP+ system load device. This method is provided for use by manufacturing. No files are provided, nor any method of obtaining the files, at this time.

The format operation is performed by a Diagnostic Utilities and Protocol (DUP) program loaded into the disk controller. The host program simply downline loads the DUP program into the controller and monitors its execution. The DUP program obtains parameters from the host program (eg. drive number and format mode) and requests the hos' program to print error and summary messages. The DUP program is also commonly called a "diagnostic machine" (DM) program.

This program can only format in one mode at a time. In RESTORE mode, only one disk may be selected in the hardware questions or an error message will result and the program will stop.

In REFORMAT and RECONSTRUCT modes, any number of disk drives may be selected. A controller can only format one disk at a time, so each disk on a controller are connected to different controllers, all controllers will be run simultaneously. For example, lets assume three units are selected for formatting in the hardware questions, units 1 and 2 are connected to one controller and unit 3 is connected to a different controller. This program will automatically start format operations on units 1 and 3. When unit 1 finishes (or errors), unit 2 will be started. After units 2 and 3 are finished, the program stops.

This program will stop after each pass (all units formatted once). There is no need to specify a PASS switch on the command line to the Diagnostic Runtime Services (eg. START/PASS:1).

Special provisions have been made to allow this program to run under an APT system in manufacturing. This system does not allow questions to be asked of an operator. Such a condition also exists under XXDP+ when the UAM flag is set. In this condition, only reformat mode can be selected. Selecting RECONSTRUCT or RESTORE will result in an error. Also, a date of 1-JAN-70 will be written on the disk.

1.2 SYSTEM REQUIREMENTS

This program was designed using the PDP-11 Diagnostic Runtime Services revision C. Run time environments are determined by the Runtime Services and may change as new versions of the Services are developed. The initial version will require the following:

PDP-11 Unibus or Q-bus processor
28K words of memory (minimum)
Console terminal
XXDP+ load media containing this program
One or more UDA50A or KDA50-Q subsystems.

A system clock - either type L or P - will be used to time the DUP program and report runtime, if available. If no system clock is available, this program cannot detect a hung DUP program.

2.0 OPERATING INSTRUCTIONS

This section contains a brief description of the Runtime Services. For detailed information, refer to the XXDP+ User's Manual (CHQUS).

2.1 COMMANDS

There are eleven legal commands for the Diagnostic Runtime Services (Supervisor). This section lists the commands and gives a very brief description of them. The XXDP+ User's Manual has more details.

COMMAND	EFFECT
START	Start the diagnostic from an initial state
RESTART	Start the diagnostic without initializing
CONTINUE	Continue at test that was interrupted (after ↑C)

PROCEED	Continue from an error halt
EXIT	Return to XXDP+ Monitor (XXDP+ OPERATION ONLY!)
ADD	Activate a unit for testing (all units are considered to be active at start time
DROP	Deactivate a unit
PRINT	Print statistical information (see section 4.0)
DISPLAY	Type a list of all device information
FLAGS	Type the state of all flags (see section 2.3)
ZFLAGS	Clear all flags (see section 2.3)

A command can be recognized by the first three characters. So you may, for example, type "STA" instead of "START".

2.2 SWITCHES

There are several switches which are used to modify supervisor operation. These switches are appended to the legal commands. All of the legal switches are tabulated below with a brief description of each. In the descriptions below, a decimal number is designated by "DDDDD".

SWITCH	EFFECT
/TESTS:LIST	Execute only those tests specified in the list. List is a string of test numbers, for example - /TESTS:1:5:7-10. This list will cause tests 1,5,7,8,9,10 to be run. All other tests will not be run.
/PASS:DDDDD	Execute DDDDD passes (DDDDD = 1 to 64000)
/FLAGS:FLGS	Set specified flags. Flags are described in section 2.3.
/EOP:DDDDD	Report end of pass message after every DDDDD passes only. (DDDDD = 1 to 64000)
/UNITS:LIST	TEST/ADD/DROP only those units specified in the list. List example - /UNITS:0:5:10-12 use units 0,5,10,11,12 (unit numbers = 0-63).

Example of switch usage:

```
START/TESTS:1-5/PASS:1000/EOP:100
```

The effect of this command will be: 1) tests 1 through 5 will be executed, 2) all units will tested 1000 times and 3) the end of pass messages will be printed after each 100 passes only. A switch can be recognized by the first three characters. You may, for example, type "/TES:1-5" instead of "/TESTS:1-5".

Below is a table that specifies which switches can be used by eacn command.

	TESTS	PASS	FLAGS	EOP	UNITS
START	X	X	X	X	X
RESTART	X	X	X	X	X
CONTINUE		X	X	X	
PROCEED			X		
DROP					X
ADD					X
PRINT					
DISPLAY					X
FLAGS					
ZFLAGS					
EXIT					

2.3 FLAGS

Flags are used to set up certain operational parameters such as looping on error. All flags are cleared at startup and remain cleared until explicitly set using the flags switch. Flags are also cleared after a START or RESTART command unless set using the flag switch. The ZFLAGS command may also be used to clear all flags. With the exception of the START, RESTART and ZFLAGS commands, no commands affect the state of the flags; they remain set or cleared as specified by the last flag switch.

FLAG	EFFECT
HOE	Halt on error - control is returned to runtime services command mode
LOE	Loop on error
IER*	Inhibit all error reports
IBE*	Inhibit all error reports except first level (first level contains error type, number, PC, test and unit)
IXE*	Inhibit extended error reports (those called by PRINTX macro's)
PRI	Direct messages to line printer
PNT	Print test number as test executes
BOE	"BELL" on error
UAM	Unattended mode (no manual intervention)
IDU	Inhibit program dropping of units
LOT	Loop on test

*Error messages are described in section 3.1

See the XXDP+ User's Manual for more details on flags. You may specify more than one flag with the FLAG switch. For example, to cause the program to loop on error, inhibit error reports and type a "BELL" on error, you may use the following string:

```
/FLAGS:LOE:IER:BOE
```

2.4 HARDWARE QUESTIONS

When the formatter is STARTed, the Runtime Services will prompt the user for hardware information by typing "CHANGE HW (L) ?" . When you answer this question with a "Y", the Runtime Services will ask for the number of units (in decimal). You will then be asked the following questions for each unit. When you answer this question with an "N", the Runtime Services will use the answers built into the program by the SETUP utility (see chapter 6 of the XXDP+ User's Manual). If you have never run the SETUP utility on this program file, the default values listed below (just before the question mark) will be used.

CSR ADDRESS (O) 172150 ?

> Answer with the address of the IP register of the controller as addressed by the processor with memory management turned off (i.e., an even 16-bit address in the range of 160000 to 177774).

VECTOR (O) 154 ?

> Answer with the interrupt vector address of the controller. A vector address in the range of 4 to 774 may be specified. The controller does not have a vector "hard wired" to it, so any vector not being used by this program and XXDP+ may be used.

DRIVE NUMBER (D) 0 ?

> Answer with the drive number of the drive you wish to test. This is the number which appears on the "unit plug" on the front of the disk drive. On a multi-unit drive, each sub-unit number on the drive must be tested as a seperate unit to completely test the drive. A maximum of eight logical drives may be tested on one controller at a time.

2.5 SOFTWARE QUESTIONS

After you have answered the hardware questions or after a RESTART or CONTINUE command, the Runtime Services will ask for software parameters. You will be prompted by "CHANGE SW (L) ?" If you wish to change any parameters, answer by typing "Y". The software questions and the default values are described in the next paragraphs. You may change the default values with the SETUP utility.

```
REFORMAT USING EXISTING BAD SECTOR INFORMATION (L) Y ?
```

If this question is answered "YES", then the user wants the REFORMAT mode format operation. REFORMAT mode will use the bad sector information that is already on the disk. Any other mode will destroy this information. If this question is answered "NO", the following will be asked to be sure the user knows what he is doing.

```
NOT USING EXISTING INFORMATION WILL DESTROY THE FACTORY BAD SECTOR
INFORMATION ON THE DISK.
AGAIN - REFORMAT USING EXISTING BAD SECTOR INFORMATION (L) Y ?
```

This is asked to verify that the user does want to destroy the bad sector information on the disk and run another format mode. If this is answered "YES", then the user wants the REFORMAT mode format operation and use the existing bad block information. If again answered "NO", the following question will be asked.

```
RECONSTRUCT BAD SECTOR INFORMATION (L) Y ?
```

A "YES" answer will cause a reconstruct mode format operation. If answered "NO", the following will be asked to verify the user really wants the restore mode format.

```
DO YOU HAVE A FILE ON THE SYSTEM LOAD DEVICE
CONTAINING BAD SECTOR INFORMATION (L) N ?
```

Note that such a file will not be provided with the formatter and this mode is not recommended. The format will begin only on a "YES" answer. Otherwise the following message will be printed and the program will abort.

```
YOU CANNOT PROCEED WITHOUT SUCH A FILE.
RESTART PROGRAM AND SELECT TO REFORMAT OR RECONSTRUCT DISK.
```

2.6 MANUAL INTERVENTION QUESTIONS

When the program starts a warning message is printed to warn of improper use of this formatter.

```
WARNING:
       THIS FORMATTER PROGRAM SHOULD NOT BE USED AS A DIAGNOSTIC
       TOOL.  RUN THIS PROGRAM ONLY AS INSTRUCTED IN THE DISK
       DRIVE'S SERVICE MANUAL.

ARE YOU SURE YOU WANT TO RUN THIS FORMATTER (L) N ?
```

You must answer "YES" or the program will abort immediately. This family of disk drives uses a powerful bad block revectoring mechanism to replace blocks that fall on defective areas of the disk media. As a disk is used and defective blocks are detected, DEC operating systems replace the blocks with other blocks on the disk (reserved for this purpose and otherwise inaccessable) so that the disk constantly appears to have its full storage capacity of error free disk blocks. Formatting a disk of this type destroys this history information and is absolutely not recommended except in the cases specifically described in the disk drive's service manual. These disks are fully formatted when shipped from the factory, therefore there is no reason to run this formatter program at installation.

Upon answering "YES" to the above question, the date will be asked for in the format used by the XXDP+ system.

```
ENTER DATE AS DD-MMM-YY (A) 1-JAN-70 ?
```

The default is provided so the user need not supply the date. The date question will normally only be asked one time. If an improper answer is typed, "INPUT ERROR" is printed and the question is asked again. A two or four digit year may be typed. A four digit year must be 1900 or greater (eg. 14-APR-1982). If only two digits are typed, the year is determined as follows:

1. If the number typed is 70 or greater, a 19 is prefixed. Eg.,   1-JAN-70 translates to year 1970 and 25-DEC-99 translates to year 1999.

2. If the number typed is less than 70, a 20 is prefixed. Eg., 1-APR-21 is translated to year 2021.

If RECONSTRUCT mode is selected, the following question will be asked for each disk before the format operation begins.

```
SERIAL NUMBER FOR UNIT xx CONTROLLER AT xxxxxx DRIVE xxx
 (A) ?
```

A decimal number in the range of 0 to 18446744073709551615 must be entered (no default).

If RESTORE mode is selected, the following question will be asked.

```
NAME OF FILE CONTAINING BAD SECTOR INFORMATION FOR
DISK TO BE FORMATTED (A) ?
```

If the file named does not exist on the system load device, the program will abort back to the XXDP+ prompt after printing an error message.

2.7 EXTENDED P-TABLE DIALOGUE

When you answer the hardware questions, you are building entries in a table that describes the devices under test. The simplest way to build this table is to answer all questions for each unit to be tested. If you have a multiplexed device such as a mass storage controller with several drives or a communication device with several lines, this becomes tedious since most of the answers are repetitious.

To illustrate a more efficient method, suppose you are testing a fictional device, the XY11. Suppose this device consists of a control module with eight units (sub-devices) attached to it. These units are described by the octal numbers 0 through 7. There is one hardware parameter that can vary among units called the Q-factor. This Q-factor may be 0 or 1. Below is a simple way to build a table for one XY11 with eight units.

```
# UNITS (D) ?  8<CR>

UNIT 1
CSR ADDRESS (O) ?  160000<CR>
SUB-DEVICE # (O) ?  0<CR>
Q-FACTOR (O) 0 ?  1<CR>

UNIT 2
CSR ADDRESS (O) ?  160000<CR>
SUB-DEVICE # (O) ?  1<CR>
Q-FACTOR (O) 1 ?  0<CR>

UNIT 3
CSR ADDRESS (O) ?  160000<CR>
SUB-DEVICE # (O) ?  2<CR>
Q-FACTOR (O) 0 ?  <CR>

UNIT 4
CSR ADDRESS (O) ?  160000<CR>
SUB-DEVICE # (O) ?  3<CR>
Q-FACTOR (O) 0 ?  <CR>

UNIT 5
CSR ADDRESS (O) ?  160000<CR>
SUB-DEVICE # (O) ?  4<CR>
Q-FACTOR (O) 0 ?  <CR>
```

```
UNIT 6
CSR ADDRESS (0) ?  160000<CR>
SUB-DEVICE # (0) ?  5<CR>
Q-FACTOR (0) 0 ?  <CR>

UNIT 7
CSR ADDRESS (0) ?  160000<CR>
SUB-DEVICE # (0) ?  6<CR>
Q-FACTOR (0) 0 ?  1<CR>

UNIT 8
CSR ADDRESS (0)  160000<CR>
SUB-DEVICE # (0) ?  7<CR>
Q-FACTOR (0) 1 ?  <CR>
```

Notice that the default value for the Q-factor changes when a non-default response is given. Be careful when specifying multiple units!

As you can see from the above example, the hardware parameters do not vary significantly from unit to unit. The procedure shown is not very efficient.

The Runtime Services can take multiple unit specifications however. Let's build the same table using the multiple specification feature.

```
# UNITS (D) ?  8<CR>

UNIT 1
CSR ADDRESS (0) ?  160000<CR>
SUB-DEVICE # (0) ?  0,1<CR>
Q-FACTOR (0) 0 ?  1,0<CR>

UNIT 3
CSR ADDRESS (0) ?  160000<CR>
SUB-DEVICE # (0) ?  2-5<CR>
Q-FACTOR (0) 0 ?  0<CR>

UNIT 7
CSR ADDRESS (0) ?  160000<CR>
SUB-DEVICE # (0) ?  6,7<CR>
Q-FACTOR (0) 0 ?  1<CR>
```

As you can see in the above dialogue, the runtime services will build as many entries as it can with the information given in any one pass through the questions. In the first pass, two entries are built since two sub-devices and q-factors were specified. The Services assume that the CSR address is 160000 for both since it was specified only once. In the second pass, four entries were built. This is becsuse four sub-devices were specified. The "-" construct tells the Runtime Services to increment the data from the first number to the second. In this case, sub-devices 2, 3, 4 and 5 were specified. (If the sub-devices were specified by addresses, the increment would be by 2 since addresses must be on an even boundary.) The CSR addresses and Q-factors for the four entries are assumed to be 160000 and 0 respectively since they were only specified once. The last two units are specified in the third pass.

The whole process could have been accomplished in one pass as shown below.

```
# UNITS (D) ?  8<CR>

UNIT 1
CSR ADDRESS (O) ?  160000<CR>
SUB-DEVICE # (O) ?  0 7<CR>
Q-FACTOR (O) 0 ?  0,1,0,,,,1,1<CR>
```

As you can see from this example, null replies (commas enclosing a null field) tell the Runtime Services to repeat the last reply.

2.8 QUICK START-UP PROCEDURE

To start-up this program:

1. Boot XXDP+

2. Give the date and answer the LSI and 50HZ (if there is a clock) questions

3. Type "R ZUDKAO"

4. Type "START"

5. Answer the "CHANGE HW" question with "Y"

6. Answer all the hardware questions

7. Answer the "CHANGE SW" question with "N"

8. Answer "Y" to the "ARE YOU SURE ..." question following the warning. Please read the disk drive's service manual before answering this question.

9. Type today's date.

When you follow this procedure you will be using only the defaults for flags and software parameters. These defaults are described in sections 2.3 and 2.5.

Sample of terminal dialogue to test two disks on one controller:

```
DR>STA

CHANGE HW (L)  ? Y

# UNITS (D)  ? 2

UNIT 0
CSR ADDRESS (O)  172150 ?
VECTOR (O)  154 ?
DRIVE NUMBER (D)  0 ? 0,1

CHANGE SW (L)  ? N

WARNING:
      THIS FORMATTER PROGRAM SHOULD NOT BE USED AS A DIAGNOSTIC
      TOOL.  RUN THIS PROGRAM ONLY AS INSTRUCTED IN THE DISK
      DRIVE'S SERVICE MANUAL.

ARE YOU SURE YOU WANT TO RUN THIS FORMATTER (L) N ? Y

ENTER DATE AS DD-MMM-YY (A) 1-JAN-70 ? 14-APR-82

UNIT 0 CONTROLLER AT 172150 DRIVE 0   RUNTIME 0:00:20
Format begun Version 11
STOPPING THIS FORMAT AFTER THIS POINT WILL MAKE THE DISK
UNUSABLE, AND WILL CAUSE THE DISK TO BE SPUN DOWN WHEN
BROUGHT ONLINE.

UNIT 1 CONTROLLER AT 172150 DRIVE 1   RUNTIME 0:00:23
Format begun Version 11
STOPPING THIS FORMAT AFTER THIS POINT WILL MAKE THE DISK
UNUSABLE, AND WILL CAUSE THE DISK TO BE SPUN DOWN WHEN
BROUGHT ONLINE.

UNIT 0 CONTROLLER AT 172150 DRIVE 0   RUNTIME 0:42:20
Format completed
      2 Revectored LBNS
      2 Primary revectored LBNS
      0 Secondary/tertiary revectored LBNS
      0 Bad RBNS
      0 Bad blocks in the RCT area due to data errors
      0 Bad blocks in the DBN area due to data errors
      0 Bad blocks in the XBN area due to data errors
      2 Blocks retried on the check pass
FCT used successfully
```

```
UNIT 1 CONTROLLER AT 172150 DRIVE 1   RUNTIME 1:25:18
Format completed
   131 Revectored LBNS
   131 Primary revectored LBNS
     0 Secondary/tertiary revectored LBNS
     0 Bad RBNS
     1 Bad blocks in the RCT area due to data errors
     0 Bad blocks in the DBN area due to data errors
     0 Bad blocks in the XBN area due to data errors
   249 Blocks retried on the check pass
FCT used successfully

CZUDK EOP    1
    0 CUMULATIVE ERRORS
DR>
```

Sample of terminal dialogue going through software questions.
Only one disk is being tested.

```
DR>STA

CHANGE HW (L)  ? N

CHANGE SW (L)  ? Y

REFORMAT USING EXISTING BAD SECTOR INFORMATION (L) Y ? Y

WARNING:
      THIS FORMATTER PROGRAM SHOULD NOT BE USED AS A DIAGNOSTIC
      TOOL.  RUN THIS PROGRAM ONLY AS INSTRUCTED IN THE DISK
      DRIVE'S SERVICE MANUAL.

ARE YOU SURE YOU WANT TO RUN THIS FORMATTER (L) N ? Y

ENTER DATA AS DD-MMM-YY (A) 1-JAN-70 ? 14-APR-82

  RUNTIME 0:00:20
Format begun Version 8
STOPPING THIS FORMAT AFTER THIS POINT WILL MAKE THE DISK
UNUSABLE, AND WILL CAUSE THE DISK TO BE SPUN DOWN WHEN
BROUGHT ONLINE.

  RUNTIME 1:33:45
Format completed
     2 Revectored LBNS
     2 Primary revectored LBNS
     0 Secondary/tertiary revectored LBNS
     0 Bad RBNS
     0 Bad blocks in the RCT area due to data errors
     0 Bad blocks in the DBN area due to data errors
     0 Bad blocks in the XBN area due to data errors
     2 Blocks retried on the check pass
FCT used successfully

CZUDK EOP     1
    0 CUMULATIVE ERRORS
DR>
```

3.0 ERROR INFORMATION

3.1 TYPES OF ERROR MESSAGES

There are three levels of error messages that may be issued by the formatter: general, basic and extended. General error messages are always printed unless the "IER" flag is set (section 2.3). The general error message is of the form:

```
        NAME  TYPE  NUMBER  ON UNIT NUMBER  TST NUMBER PC:XXXXXX
        error message

where:  NAME = formatter name
        TYPE = error type (SYS FTL ERR, DEV FTL ERR)
        NUMBER = error number
        UNIT NUMBER = 0 - N (N is last unit in PTABLE)
        TST NUMBER = test and subtest where error occurred
        PC:XXXXXX = address of error message call
```

System fatal errors (SYS FTL ERR) are used to report errors that are fatal to the entire formatter program. The formatter stops and the Runtime Services prompt is printed.

Device fatal errors (DVC FTL ERR) are used to report errors that are fatal to the device (may be either the controller or disk drive). Testing stops on that device for the remainder of the current test.

Basic error messages are messages that contain some additional information about the error. These are always printed unless the "IER" or "IBE" flags are set (section 2.3). These messages are printed after the associated general message.

Extended error messages contain supplementary error information such as register contents or good/bad data. These are always printed unless the "IER", "IBE" or "IXE" flags are set (section 2.3). These messages are printed after the associated general error message and any associated basic error messages.

The general and basic error messages from this formatter are always one line each. The basic message defines what program detected the error, the controller being used and the time of the error:

```
HOST  PROGRAM CONTROLLER AT xxxxxx  RUNTIME hhh:mm:ss
```

> The host program (PDP-11) detected the error. CONTROLLER AT xxxxx identifies the address of the controller being tested. It may be omitted if the error is not specific to one controller.

Sample error message:

```
CZUDK DVC FTL ERR  00021 ON UNIT 00 TST 001 SUB 000 PC: xxxxxx        general message
HOST PROGRAM  CONTROLLER AT 172150  RUNTIME 0:00:12                 - basic message
CONTROLLER RESIDENT DIAGNOSTICS DETECTED FAILURE                   \
  SA CONTAINS 104041                                                }-  extended message
REPLACE CONTROLLER PROCESSOR MODULE                                /
```

The DUP program may also print error messages. They are printed exactly as presented by the DUP program and cannot be suppressed by any flags.

3.2 SPECIFIC ERROR MESSAGES

3.2.1 HOST PROGRAM ERROR MESSAGES

Following is a list of the error messages that may be printed by the formatter program. In the list, some of the numbers that may very with execution or program version are shown as "xxx". These include program counters and runtime. Other numbers, such as unit number, drive number, controller address and data in registers are filled with sample numbers. Additional information about the error may follow the error message.

```
00001   CZUDK SYS FTL ERR  00001 ON UNIT 00 TST 001 SUB 000 PC: xxxxxx
        HOST PROGRAM  CONTROLLER AT 172150  RUNTIME x:xx:xx
        INVALID ANSWERS GIVEN TO HARDWARE QUESTIONS
        CONTROLLER HAS MORE THAN ONE VECTOR, BR LEVEL OR BURST RATE
```

When the hardware questions were answered, two units were selected with the same CSR address but with a different vector, BR level or burst rate. A single controller can have only one vector, BR level or burst rate. The program is aborted and returns to the Runtime Services prompt so that the hardware questions may be changed.

```
00002   CZUDK SYS FTL ERR  00002 ON UNIT 00 TST 001 SUB 000 PC: xxxxxx
        HOST PROGRAM  CONTROLLER AT 172150  RUNTIME x:xx:xx
        INVALID ANSWERS GIVEN TO HARDWARE QUESTIONS
        MULTIPLE UNITS SELECT THE SAME DRIVE
```

The hardware questions for two units were exactly the same. The program is aborted and returns to the Runtime Services prompt so that the hardware questions may be changed.

```
00003   CZUDK SYS FTL ERR  00003 ON UNIT 00 TST 001 SUB 000 PC: xxxxxx
        HOST PROGRAM  CONTROLLER AT 172150  RUNTIME x:xx:xx
        INVALID ANSWERS GIVEN TO HARDWARE QUESTIONS
        MORE THAN EIGHT DRIVES SELECTED ON THIS CONTROLLER

                Up to four physical disk drives can be attached to a UDA50A or
                KDA50-Q at one time. A physical disk drive may be from one to
                four logical disk drives. Each logical disk drive is considered
                one unit to the formatter program. Even though more than eight
                logical disk drives can be attached to one UDA50A or KDA50-Q, the
                controller only supports eight. The program is aborted and
                returns to the Runtime Services prompt so that the hardware
                questions may be changed.

00004   CZUDK SYS FTL ERR  00004 ON UNIT 00 TST 001 SUB 000 PC: xxxxxx
        HOST PROGRAM  RUNTIME x:xx:xx
        NOT ENOUGH ROOM IN MEMORY TO FORMAT THE UNITS SELECTED
        PLEASE START PROGRAM OVER AND FORMAT FEWER UNITS AT A TIME

                This program does not limit the number of units that can
                be tested by specifying a maximum number. What limits
                the number is the amount of memory used to store data
                on each unit. The number of units that are testable at one
                time has been exceeded.  Start program over and select fewer
                units.

00008   CZUDK SYS FTL ERR  00008 ON UNIT 00 TST 001 SUB 000 PC: xxxxxx
        HOST PROGRAM  CONTROLLER AT 172150  RUNTIME x:xx:xx
        INVALID ANSWERS GIVEN TO HARDWARE QUESTIONS
        TWO CONTROLLERS USE THE SAME VECTOR

                The hardware questions for two units specified different
                CSR addresses but identical vector addresses. The program
                is aborted and returns to the Runtime Services prompt so
                that the hardware questions may be changed.

00009   CZUDK DVC FTL ERR  00009 ON UNIT 00 TST 001 SUB 000 PC: xxxxxx
        HOST PROGRAM  RUNTIME x:xx:xx
        ONLY ONE DISK CAN BE SELECTED IN HW QUESTIONS IN RESTORE MODE.
        PLEASE START PROGRAM OVER AND SELECT ONLY ONE DISK.

                If the operator chooses to run the formatter in RESTORE
                mode, then only one disk can be selected in the hardware
                questions.  RESTORE mode is run in this way because
                a file containing the bad block information is used and
                that information matches only one drive.

00010   CZUDK DVC FTL ERR  00010 ON UNIT 00 TST 001 SUB 000 PC: xxxxxx
        HOST PROGRAM  RUNTIME x:xx:xx
        THIS PROGRAM CAN ONLY REFORMAT A DISK IN UNATTENDED MODE

                This program needs to ask questions of the operator. It
                refuses to run in RECONSTRUCT and RESTORE modes because the
                questions obtain data that is absolutely necessary. REFORMAT
                mode is allowed to run because only a date is needed. The
                default date of 1-JAN-70 is used.
```

```
00014      CZUDK DVC FTL ERR  00014 ON UNIT 00 TST 001 SUB 000 PC: xxxxxx
           HOST PROGRAM  CONTROLLER AT 172150  RUNTIME x:xx:xx
           CONTROLLER IS NOT SUPPORTED BY THIS FORMATTER PROGRAM.  THIS
           PROGRAM REQUIRES A UDA50-A (MODEL 6) OR A KDA50-Q (MODEL 13)
           CONTROLLER.  CONTROLLER REPORTED MODEL CODE xx.

                   All UDA50-0's (modules M7161-2) are not supported by this
                   formatter.  The module sets M7485-6 and M????-? are the only
                   ones that can be used by this formatter.  If the controller
                   is a UDA50-0 (M7161-2) it will not be tested.  If the
                   controller consists of the M7161-2 modules, install one with
                   M7485-6 modules.  Replace both modules,  mixing the module
                   sets will not work.

00020      CZUDK DVC FTL ERR  00020 ON UNIT 00 TST 001 SUB 000 PC: xxxxxx
           HOST PROGRAM  CONTROLLER AT 172150  RUNTIME x:xx:xx
           MEMORY ERROR TRYING TO READ CONTROLLER REGISTERS
           CHECK CSR SELECTION SWITCHES ON CONTROLLER PROCESSOR MODULE OR BUS
           OR REPLACE CONTROLLER PROCESSOR MODULE

                   A non-existant memory error occurred when the host program
                   tried to access the IP and SA registers.  The controller
                   is at another address (check the CSR selection switches)
                   or the BUS or the controller processor module is broken.
```

```
00021     CZUDK DVC FTL ERR 00021 ON UNIT 00 TST 001 SUB 000 PC: xxxxxx
          HOST PROGRAM  CONTROLLER AT 172150  RUNTIME x:xx:xx
          CONTROLLER RESIDENT DIAGNOSTICS DETECTED FAILURE
            SA CONTAINS  105154
          REPLACE CONTROLLER SDI MODULE

                  The controller Resident diagnostic detected a failure.  The
                  error is displayed in the SA.  Here are the possible error
                  values and their meaning:

                          104000 - Fatal sequencer error
                          104040 - D processor ALU error
                          104041 - D proc ROM parity error
                          105102 - D proc with no Board #2 or RAM parity error
                          105105 - D proc RAM buffer error
                          105152 - D proc SDI error
                          105153 - D proc write mode wrap SERDES error
                          105154 - D proc read mode SERDES, RSGEN, and ECC error
                          106040 - U proc ALU error
                          106041 - U proc Control Register error
                          106042 - U proc DFAIL/ROM parity error/Board #1 test count is wrong
                          106047 - U proc Constant ROM error with D proc running SDI test
                          106055 - Unexpectant trap found, aborted diagnostic
                          106071 - U proc ROM error
                          106072 - U proc ROM parity error
                          106200 - Step 1 data error (MSB not set)
                          107103 - U proc RAM parity error
                          107107 - U proc RAM buffer error
                          107115 - Board #2 test count was wrong
                          112300 - Step 2 error
                          122240 - NPR error
                          122300 - Step 3 error
                          142300 - Step 4 error

                  Replace the board specified in the last line of the error
                  message.
```

```
        00022   CZUDK DVC FTL ERR  00022 ON UNIT 00 TST 001 SUB 000 PC: xxxxxx
                HOST PROGRAM  CONTROLLER AT 172150  RUNTIME x:xx:xx
                STEP BIT DID NOT SET IN SA REGISTER DURING INITIALIZATION
                STEP BIT EXPECTED 004000
                  SA CONTAINS  000000
                REPLACE CONTROLLER PROCESSOR MODULE

                        The controller did not respond as expected during the
                        initialization sequence which communicates using data
                        in the SA register. A normal response from the controller
                        contains either a STEP bit or an ERROR bit defined as
                        follows:
                                Bit 15 (100000)   Error bit
                                Bit 14 (040000)   Step 4 bit
                                Bit 13 (020000)   Step 3 bit
                                Bit 12 (010000)   Step 2 bit
                                bit 11 (004000)   Step 1 bit
                        Neither the expected step bit nor the error bit set within
                        the expected time.

        00023   CZUDK DVC FTL ERR  00023 ON UNIT 00 TST 001 SUB 000 PC: xxxxx.
                HOST PROGRAM  CONTROLLER AT 172150  RUNTIME x:xx:xx
                CONTROLLER DID NOT CLEAR RING STRUCTURE IN HOST MEMORY DURING
                INITIALIZATION
                6 WORDS WERE TO BE CLEARED STARTING AT ADDRESS 040644
                FIRST SEVERAL WORDS NOT CLEARED (UP TO 6):
                      ADDRESS    CONTENTS
                       040644     000010
                       040650     000010
                       040652     000010
                REPLACE CONTROLLER PROCESSOR MODULE

                        The controller is to clear the ring structure (a communications
                        area used by the controller to talk to the host) in host memory
                        before Step 4 of initialization.  If the controller diagnostics
                        did not clear memory and did not flag an error, then error
                        message 00023 is displayed. The contents of each word in memory
                        is set to 177777 before the test. Failure of the controller
                        to clear each word indicates a fault in the address
                        interface to the Unibus or Q-bus.

        00024   CZUDK DVC FTL ERR  00024 ON UNIT 00 TST 001 SUB 000 PC: xxxxxx
                HOST PROGRAM  CONTROLLER AT 172150  RUNTIME x:xx:xx
                SA REGISTER DID NOT GO TO ZERO AFTER STEP 3 WRITE OF INITIALIZATION
                PURGE/POLE DIAGNOSTICS WERE REQUESTED
                  SA CONTAINS 004400
                REPLACE CONTROLLER PROCESSOR MODULE

                        For better testing, the host can test the PURGE and POLE
                        mechanism of the controller.  To do so the host sets bit15
                        of the step 3 data and sends the data to the controller.
                        The controller must go to zero and wait for the purge and
                        pole.  If the controller never went to zero, then error
                        message 00024 is displayed.  The controller may have a bad
                        processor module or the UNIBUS or Q-bus may be broken.
```

```
00025   CZUDK DVC FTL ERR  00025 ON UNIT 00 TST 001 SUB 000 PC: xxxxxx
        HOST PROGRAM  CONTROLLER AT 172150  RUNTIME x:xx:xx
        CONTROLLER DID NOT RETURN CORRECT DATA IN SA REGISTER DURING
        INITIALIZATION
          SA EXPECTED  004400
          SA CONTAINS  004000
        REPLACE CONTROLLER PROCESSOR MODULE

                For each step of initialization, specific data is expected
                to be displayed in the SA.  If the SA does not match
                the expected data, then error message 00025 is displayed.
                Replace controller processor module.

00030   CZUDK DVC FTL ERR  00030 ON UNIT 00 TST 001 SUB 000 PC: xxxxxx
        HOST PROGRAM  CONTROLLER AT 172150  RUNTIME x:xx:xx
        CONTROLLER REPORTED FATAL ERROR IN SA REGISTER WHILE RUNNING FORMATTER
          SA CONTAINS  100004

                A message from the controller firmware reports an unexpected
                failure.  An error code is presented in the SA.
                Here is a list of the codes and their meanings:

                        004400 - Controller has been inited by either a bus
                                 init or by writing into the IP.
                        100001 - BUS envelope/packet read error (parity or timeout)
                        100002 - BUS envelope/packet write error (parity or timeout)
                        100003 - Controller ROM and RAM parity error
                        100004 - Controller RAM parity error
                        100005 - Controller ROM parity error
                        100006 - BUS ring read error
                        100007 - BUS ring write error
                        100010 - BUS interrupt master failure
                        100011 - Host access timeout error
                        100012 - Host exceeded credit limit
                        100013 - Controller SDI hardware fatal error
                        100014 - DM XFC fatal error
                        100015 - Hardware timeout of instruction loop
                        100016 - Invalid virtual circuit identifier
                        100017 - Interrupt write error on BUS

00031   CZUDK DVC FTL ERR  00031 ON UNIT 00 TST 001 SUB 000 PC: xxxxxx
        HOST PROGRAM  CONTROLLER AT 172150  RUNTIME x:xx:xx
        FORMATTER IS HUNG

                All DM programs are required to communicate with the
                host program; so as to assure the host program that
                the DM program is not hung up or in an endless loop.
                If the DM program has not done so, the host program
                assumes the DM is hung and this message appears.
```

```
00032   CZUDK DVC FTL ERR  00032 ON UNIT 00 TST 001 SUB 000 PC: xxxxxx
        HOST PROGRAM  CONTROLLER AT 172150  RUNTIME x:xx:xx
        MESSAGE BUFFER RECEIVED FROM FORMATTER WITH UNKNOWN REQUEST NUMBER
        MESSAGE BUFFER CONTAINS:
           000001 000002 000003 000004 000005 000006 000007
           000008 000009 000010 000011 000012 000013 000014
           000015 000016 000017 000018 000019 000020 000021
           000022 000023 000024 000025 000026 000027 000028
           000029 000030 000031 000032 000033 000034 000035
```

The DM program and the host program communicate with each other using packets. Each packet must have a request number set up by the DM program and interpreted by the host program. This request number is not a known request number. The problem may be the BUS or either one of the controller modules or a corrupted DM program. Word 1 contains the DM request number, and word 2 typically contains the drive number. The rest of the buffer contains information specific to a DM request. The numbers in the example show the order in which words are displayed.

```
00033   CZUDK DVC FTL ERR  00033 ON UNIT 00 TST 001 SUB 000 PC: xxxxxx
00034   HOST PROGRAM  CONTROLLER AT 172150  RUNTIME x:xx:xx
        RESPONSE PACKET FROM CONTROLLER DOES NOT CONTAIN EXPECTED DATA
        EITHER CONTROLLER RETURNED ERROR STATUS OR PACKET WAS NOT RECEIVED
        CORRECTLY
           COMMAND PACKET SENT       RESPONSE PACKET RECEIVED
              000000 000020             000000 000020
              000000 000000             000000 000000
              000000 000002             000000 000202
              000000 014336             000000 014336
              000000 034674             000000 034674
              000000 000000             000000 000000
              000000 000000             000000 000000
              000000 051232             000000 051232
              000000 000000             000000 000000
              000000 000000             000000 000000
              000000 000000             000000 000000
              000000 000000             000000 000000
```

The host program inspected the response packet which was given by the controller. The response packet may have been in error with one of the following points:

1) The end code was not as expected.
2) The status code showed an error occurred with the last command.
3) The command reference numbers (the first word) did not match.

If 1 or 3 occurred, there may have been a transmission problem between the controller and the host program. If 2 occurred, check the error code in the MSCP specification for further information. The packets are displayed two long words per line, low order word and byte to the right (corresponding to the MSCP long-word entity).

```
00036   CZUDK DVC FTL ERR  00036 ON UNIT 00 TST 001 SUB 000 PC: xxxxxx
        HOST PROGRAM  CONTROLLER AT 172150  RUNTIME x:xx:xx
        NO INTERRUPT RECEIVED FROM CONTROLLER FOR 30 SECONDS
        WHILE LOADING FORMATTER

                After a DM program has been sent to the controller, the
                host program expects an interrupt within 30 seconds.  The
                interrupt is used to assure the host program that the
                DM program is sane.  If no interrupt occurred, then
                error message 00036 is displayed and the DM program is
                assumed to be hung.

00037   CZUDK DVC FTL ERR  00037 ON UNIT 00 TST 001 SUB 000 PC: xxxxxx
        HOST PROGRAM  CONTROLLER AT 172150  RUNTIME x:xx:xx
        CONTROLLER REPORTED FATAL ERROR IN SA REGISTER WHILE LOADING FORMATTER
          SA CONTAINS  100004
        REPLACE CONTROLLER PROCESSOR MODULE

                While loading the DM program to the controller, the SA
                became non-zero.  When this occurs, it signifies that
                the controller microcode has run across a fatal error.
                The displayed value is in octal.  Check the error code
                with the list in 00030.

00100   CZUDK DVC FTL ERR  00100 ON UNIT 00 TST 001 SUB 000 PC: xxxxxx
        HOST PROGRAM  CONTROLLER AT 172150  RUNTIME x:xx:xx
        FORMATTER ASKED UNEXPECTED QUESTION (25)

                The formatter sends a value that corresponds to
                a specific question or message.  If this value does not
                fit into the range of questions, then this error appears.

00101   CZUDK DVC FTL ERR  00101 ON UNIT 00 TST 001 SUB 000 PC: xxxxxx
        HOST PROGRAM  CONTROLLER AT 172150  RUNTIME x:xx:xx
        FORMATTER REJECTED ANSWER TO DATE OR SERIAL NUMBER QUESTION

                After the operator inputs the date/serial number, the
                formatter will ask the host program for them.  If for
                some reason the date/serial number was unacceptable to
                the formatter, this error message will appear.  Retry
                the program and if this error appears again, get out
                of the diagnostic runtime services and back to the
                XXDP+ prompt and reload the program.
```

3.2.2 DUP PROGRAM ERROR MESSAGES

Error messages returned by the formatter are as follows:

GET STATUS failure

This could be caused by a number of reasons. Examples: the RUN/STOP switch is out, the WRITE PROTECT switch is in, or the DIAGNOSTIC REQUEST bit is set by the drive.

SDI send error

An attempt to send an SDI command failed. The signal RECEIVER READY was not asserted.

Unsuccessful SDI command

The response from an SDI command was unsuccessful and all commands should be successful for the formatter to work. There may be a cable problem, drive receiver problem or controller transmitter problem.

SDI receive error

This message is presented for several reasons. The drive timed out, the first word from the drive was not a start frame, there was a framing error on the SDI level 0 read (cable/receiver/transmitter problem), checksum error, or the buffer size given by the formatter wasn't large enough for the controller. Again, there may be a cable/receiver/transmitter problem.

BUS read error

This is caused by one of two problems. While trying to read an overlay into the controller buffer memory, the formatter came across a nonexistent memory error. Or, there was a failure while downline loading the bad block information. There may be something wrong with the BUS or the controller processor module.

Formatter initialization error

For this error to occur, the controller must be processing the DM code improperly.

Non-existant unit number

The desired disk drive wasn't attached to the controller.

DBN/XBN format error (drive FORMAT command failed)

All attempts and retries to format a track failed. There may have been a timeout of drive signals, the drive dropped the READ/WRITE READY signal during the format operation or the drive clock timed out (which indicates cable/transmitter/receiver failures).

FCT does not have enough good copies of each block

There must be at least two good copies of every block in the FCT. For this error to occur, the media is badly corrupted or the read/write logic is failing

SEEK error

After a seek command completed successfully, the READ/WRITE READY signal was never set or the ATTENTION signal was set.

RCT does not have enough good copies of each block

There must be at least two good copies of every block in the RCT. For this error to occur, the media is badly corrupted or the read/write logic is failing.

LBN format error (drive FORMAT command failed)

All attempts and retries to format a track failed. There may have been a timeout of drive signals, the drive dropped the READ/WRITE READY signal during the format operation or the drive clock timed out (which indicates cable/transmitter/receiver failures).

FCT write error

A particular block failed to be written into every copy of the FCT. There is either terribly bad media or a write logic failure.

RCT read error

The formatter could not read at least one good copy of a particular block in the RCT area.

RCT write error

A particular block failed to be written into every copy of the RCT. There is either terribly bad media or a write logic failure.

RCT full

There were so many bad blocks on the media that the RCT area was filled and could not hold any more. There could be read/write logic failure or bad cable connection.

FCT read error

The formatter could not read at least one good copy of a particular block in the FCT area.

FCT downline-load error

The formatter was led to believe that a bad block information file was larger than it really was. There may be a BUS or controller processor module problem.

Drive init timeout

After the drive was inited, the RECEIVER READY signal never asserted.

Illegal response to start-up question

An overflow occurred when the serial number went over 64 bits.

FCT corrupted - Format Invalid

A problem was detected while using the data in the FCT. Either the data was not written properly or it has been corrupted since the last format. The format on the disk is no good and the disk will not be usable by any DEC operating system. Running the formatter again may have a slight chance of succeeding. Otherwise, replace the disk or HDA. If you do not have a spare disk or HDA you may try to format the disk in RECONSTRUCT mode. If the disk is not an RA80, order a replacement disk or HDA immediately.

```
DRIVE ERROR ENCOUNTERED - STATUS RESPONSE:
STATUS (R TO L):  1AF1  0304  E100  8800  0080  0013  1000
LAST BLOCK ACCESSED (16-BIT OCTAL): 000000  000000
```

The disk drive reported an error. You may see the drive's fault light come on. The formatter will attempt to clear the error in the drive and continue. This error does not mean that anything is necessarily wrong unless this error is printed many times. If you see many of these errors, you may wish to stop the format and run diagnostics on the disk drive. But remember, if you stop the formatter the disk will not be usable and the diagnostics will report that the format is bad. The drive's status is presented in hexidecimal in the same format as the diagnostic programs. The last block accessed is a representation of the last block header written onto the disk.

```
MORE THAN 12.5% OF TRACK IS BAD
```

The formatter found more than one eighth of the blocks on a single track bad. This error does not mean that anything is necessarily wrong unless this error is printed many times. If you see many of these errors, you may wish to stop the format and run diagnostics on the disk drive. But remember, if you stop the formatter the disk will not be usable and the diagnostics will report that the format is bad.

An example of how the errors are presented is below:

```
    RUNTIME  0:00:18
Non-existant unit number
```

4.0 PERFORMANCE AND PROGRESS REPORTS

There is no statistical report that can be printed using the Diagnostic Runtime Services PRINT command.

The DUP program issues the following messages upon normal completion:

```
Format completed

n Revectored LBNS

        Where n is the number of LBNs revectored in the user data area.


n Primary revectored LBNS

        Where n is the number of LBNs which were primary revectors.


n Secondary/tertiary revectored LBNS

        Where n is the number of the LBNs which were secondary or
        tertiary revectors.


n Bad RBNS

        Where n is the number of RBNs which were bad.


n Bad blocks in the RCT area due to data errors

        Where n is the number of blocks in the total RCT area which
        were bad.


n Bad blocks in the DBN area due to data errors

        Where n is the number of blocks in the total DBN area which
        were bad.


n Bad blocks in the XBN area due to data errors

        Where n is the number of blocks in the total XBN area which
        were bad.
```

n Blocks retried on the check pass

Where n is the number of blocks which had an error on the first read attempt after formatting.

FCT used successfully or
FCT was not used

Depending on the answers to the software questions and the availability of the bad sector information (FCT), one of these messages will be printed.

An example of how the messages are presented is below.

```
    RUNTIME 1:24:57
Format completed
     5 Revectored LBNS
     5 Primary revectored LBNS
     0 Secondary/tertiary revectored LBNS
     0 Bad RBNS
     0 Bad blocks in the RCT area due to data errors
     0 Bad blocks in the DBN area due to data errors
     0 Bad blocks in the XBN area due to data errors
     5 Blocks retried on the check pass
FCT was not used
```

5.0 TEST SUMMARIES

There is only one test in this program - Test #1 Its only purpose is to load and run the format program in a UDA50A or KDA50-Q.

```
                                .SBTTL  PROGRAM

002000                                  BGNMOD
                                ;**
                                ; THE PROGRAM HEADER IS THE INTERFACE BETWEEN
                                ; THE DIAGNOSTIC PROGRAM AND THE SUPERVISOR.
                                ;--

002000                                  POINTER BGNSW, BGNSFT, BGNSETUP

002000                                  HEADER  CZUDK,A,0,7200.,1,PRIO7
002000                                                                      L$NAME::
002000        103                                                                   .ASCII /C/
002001        132                                                                   .ASCII /Z/
002002        125                                                                   .ASCII /U/
002003        104                                                                   .ASCII /D/
002004        113                                                                   .ASCII /K/
002005        000                                                                   .BYTE   0
002006        000                                                                   .BYTE   0
002007        000                                                                   .BYTE   0
002010                                                                      L$REV::
002010        101                                                                   .ASCII  /A/
002011                                                                      L$DEPO::
002011        060                                                                   .ASCII  /0/
002012                                                                      L$UNIT::
002012    000001                                                                    .WORD   T$PTHV
002014                                                                      L$TIML::
002014    016040                                                                    .WORD   7200.
002016                                                                      L$HPCP::
002016    022754                                                                    .WORD   L$HARD
002020                                                                      L$SPCP::
002020    023032                                                                    .WORD   L$SOFT
002022                                                                      L$HPTP::
002022    002130                                                                    .WORD   L$HW
002024                                                                      L$SPTP::
002024    002136                                                                    .WORD   L$SW
002026                                                                      L$LADP::
002026    000124'                                                                   .WORD   L$LAST
002030                                                                      L$STA::
002030    000000                                                                    .WORD   0
002032                                                                      L$CO::
002032    000000                                                                    .WORD   0
002034                                                                      L$DTYP::
002034    000001                                                                    .WORD   1
002036                                                                      L$APT::
002036    000000                                                                    .WORD   0
002040                                                                      L$DTP::
002040    002124                                                                    .WORD   L$DISPATCH
002042                                                                      L$PRIO::
002042    000340                                                                    .WORD   PRIO7
002044                                                                      L$ENVI::
002044    000000                                                                    .WORD   0
002046                                                                      L$EXP1::
002046    000000                                                                    .WORD   0
002050                                                                      L$MREV::
002050        003                                                                   .BYTE   C$REVISION
002051        003                                                                   .BYTE   C$EDIT
```

```
      002052                                  L$EF::
      002052   000000                                 .WORD   0
      002054   000000                                 .WORD   0
      002056                                  L$SPC::
      002056   000000                                 .WORD   0
      002060                                  L$DEVP::
      002060   003454                                 .WORD   L$DVTYP
      002062                                  L$REPP::
      002062   000000                                 .WORD   0
      002064                                  L$EXP4::
      002064   000000                                 .WORD   0
      002066                                  L$EXP5::
      002066   000000                                 .WORD   0
      002070                                  L$AUT::
      002070   000000                                 .WORD   0
      002072                                  L$DUT::
      002072   000000                                 .WORD   0
      002074                                  L$LUN::
      002074   000000                                 .WORD   0
      002076                                  L$DESP::
      002076   003502                                 .WORD   L$DESC
      002100                                  L$LOAD::
      002100   104035                                 EMT     E$LOAD
      002102                                  L$ETP::
      002102   000000                                 .WORD   0
      002104                                  L$ICP::
      002104   021242                                 .WORD   L$INIT
      002106                                  L$CCP::
      002106   022200                                 .WORD   L$CLEAN
      002110                                  L$ACP::
      002110   022176                                 .WORD   L$AUTO
      002112                                  L$PRT::
      002112   021234                                 .WORD   L$PROT
      002114                                  L$TEST::
      002114   000000                                 .WORD   0
      002116                                  L$DLY::
      002116   000000                                 .WORD   0
      002120                                  L$HIME::
      002120   000000                                 .WORD   0
```

```
                                   .SBTTL  DISPATCH TABLE

                                   ;++
                                   ; THE DISPATCH TABLE CONTAINS THE STARTING ADDRESS OF EACH TEST.
                                   ; IT IS USED BY THE SUPERVISOR TO DISPATCH TO EACH TEST.
                                   ;--

 002122                            DISPATCH 1
 002122  000001                                                                .WORD   1
 002124                                                                 L$DISPATCH::
 002124  022264                                                                .WORD   T1
```

```
                                      .SBTTL  DEFAULT HARDWARE P-TABLE

                                      ;++
                                      ; THE DEFAULT HARDWARE P-TABLE CONTAINS DEFAULT VALUES OF
                                      ; THE TEST-DEVICE PARAMETERS.  THE STRUCTURE OF THIS TABLE
                                      ; IS IDENTICAL TO THE STRUCTURE OF THE HARDWARE P-TABLES,
                                      ; AND IS USED AS A "TEMPLATE" FOR BUILDING THE P-TABLES.
                                      ;

   002126                                   BGNHW   DFPTBL
   002126  000002                                                                       .WORD   L10000-L$HW/2
   002130                                                                       L$HW::
   002130                                                                       DFPTBL::

   002130  172150                           .WORD   172150              ; UNIBUS ADDRESS
   002132  000000                           .WORD   0.                  ; LOGICAL DRIVE NUMBER
   002134                                   ENDHW
   002134                                                                       L10000:
```

```
                                .SBTTL  SOFTWARE P-TABLE

                                ;++
                                ; THE SOFTWARE TABLE CONTAINS VARIOUS DATA USED BY THE
                                ; PROGRAM AS OPERATIONAL PARAMETERS.  THESE PARAMETERS ARE
                                ; SET UP AT ASSEMBLY TIME AND MAY BE VARIED BY THE OPERATOR
                                ; AT RUN TIME.
                                ;--

002134                                  BGNSW   SFPTBL
002134  000001                                                                                   .WORD   L10001-L$SW/2
002136                                                                                   L$SW::
002136                                                                                   SFPTBL::

                                                                ;OFFSET         USE
002136  000007                          .WORD   7               ; 0.    YES/NO ANSWERS
002140                                  ENDSW
002140                                                                                   L10001:

002140                                  ENDMOD
```

```
                                      .SBTTL  GLOBAL EQUATES SECTION

         002140                               BGNMOD

                                      ;++
                                      ; THE GLOBAL EQUATES SECTION CONTAINS PROGRAM EQUATES THAT
                                      ; ARE USED IN MORE THAN ONE TEST.
                                      ;--

         002140                               EQUALS
                                      ;
                                      ; BIT DIFINITIONS
                                      ;
                 100000               BIT15== 100000
                 040000               BIT14== 40000
                 020000               BIT13== 20000
                 010000               BIT12== 10000
                 004000               BIT11== 4000
                 002000               BIT10== 2000
                 001000               BIT09== 1000
                 000400               BIT08== 400
                 000200               BIT07== 200
                 000100               BIT06== 100
                 000040               BIT05== 40
                 000020               BIT04== 20
                 000010               BIT03== 10
                 000004               BIT02== 4
                 000002               BIT01== 2
                 000001               BIT00== 1
                                      ;
                 001000               BIT9==  BIT09
                 000400               BIT8==  BIT08
                 000200               BIT7==  BIT07
                 000100               BIT6==  BIT06
                 000040               BIT5==  BIT05
                 000020               BIT4==  BIT04
                 000010               BIT3==  BIT03
                 000004               BIT2==  BIT02
                 000002               BIT1==  BIT01
                 000001               BIT0==  BIT00
                                      ;
                                      ; EVENT FLAG DEFINITIONS
                                      ;   EF32:EF17 RESERVED FOR SUPERVISOR TO PROGRAM COMMUNICATION
                                      ;
                 000040               EF.START==      32.                        ; START COMMAND WAS ISSUED
                 000037               EF.RESTART==    31.                        ; RESTART COMMAND WAS ISSUED
                 000036               EF.CONTINUE==   30.                        ; CONTINUE COMMAND WAS ISSUED
                 000035               EF.NEW==        29.                        ; A NEW PASS HAS BEEN STARTED
                 000034               EF.PWR==        28.                        ; A POWER-FAIL/POWER-UP OCCURRED
                                      ;
                                      ;
                                      ; PRIORITY LEVEL DEFINITIONS
                                      ;
                 000340               PRI07== 340
                 000300               PRI06== 300
                 000240               PRI05== 240
                 000200               PRI04== 200
                 000140                 PRI03== 140
                 000100                 PRI02== 100
                 000040                 PRI01== 40
                 000000                 PRI00== 0
                                        ;
                                        ;OPERATOR FLAG BITS
                                        ;
                 000004                 EVL==        4
                 000010                 LOT==       10
                 000020                 ADR==       20
                 000040                 IDU==       40
                 000100                 ISR==      100
                 000200                 UAM==      200
                 000400                 BOE==      400
                 001000                 PNT==     1000
                 002000                 PRI==     2000
                 004000                 IXE==     4000
                 010000                 IBE==    10000
                 020000                 IER==    20000
                 040000                 LOE==    40000
                 100000                 HOE==   100000
     11
     12          000015                 CR=     15                        ;VALUE TO PASS TO PRINT MACRO TO END LINE
```

```
;MACRO DEFINITIONS FOR GLOBAL EQUATES

;THESE MACROS ARE USED TO DEFINE INDEXES INTO A TABLE
;
;CALLING SEQUENCE MUST BE
;
;       TABLE
;       ITEM    NAME    BYTES
;       ITEM    NAME    BYTES
;       ITEM    NAME    BYTES
;       END     SIZE
;
;TABLE DEFINES THAT A TABLE IS ABOUT TO BE DEFINED AND END TERMINATES THE DEFINITION.
;ANY NUMBER OF ITEM LINES CAN APPEAR. NAME IS THE NAME OF THE SYMBOL BEING EQUATED TO
;THE INDEX. THE INDEX ALWAYS STARTS AT ZERO. BYTES SPECIFIES THE SIZE OF THE VALUE TO BE
;STORED AT THAT INDEX IN BYTES. THE SIZE ARGUMENT TO THE END STATEMENT IS OPTIONAL, IT
;BE EQUATED TO THE SIZE OF THE TABLE IN BYTES. THE SYMBOL TINDEX IS USED TO KEEP TRACK
;OF THE INDEX VALUE AND WILL BE EQUAL TO THE SIZE OF THE TABLE AFTER THE END STATEMENT.

.MACRO TABLE
        TINDEX=0
.ENDM

.MACRO ITEM NAME BYTES
        NAME=TINDEX
        TINDEX=TINDEX+BYTES
.ENDM

.MACRO END SIZE
        .IF NB SIZE
        SIZE=TINDEX
        .ENDC
.ENDM
```

```
                        ;UDA BIT DEFINITIONS

                        ;UDASA REGISTER UNIVERSAL READ BITS

        004000          SA.S1=  004000                  ;STEP 1 STATUS BIT
        010000          SA.S2=  010000                  ;STEP 2 STATUS BIT
        020000          SA.S3=  020000                  ;STEP 3 STATUS BIT
        040000          SA.S4=  040000                  ;STEP 4 STATUS BIT
        100000          SA.ERR= 100000                  ;ERROR INDICATOR
        001000          SA.QB=  1000                    ;QB BIT MASK
        000100          SA.MP=  100                     ;MP BIT MASK
        000040          SA.SM=  40                      ;SA BIT MASK

                        ;UDASA REGISTER ERROR STATUS BITS

        003777          SA.ERC= 003777                  ;ERROR CODE

                        ;UDASA REGISTER STEP ONE READ BITS

        002000          SA.NV=  002000                  ;NON SETTABLE INTERRUPT VECTOR
        001000          SA.A2=  001000                  ;22 BIT ADDRESS BUS
        000400          SA.DI=  000400                  ;ENHANCED DIAGNOSTICS
                        ;       000377                  ;ALL BITS RESERVED

                        ;UDASA REGISTER STEP ONE WRITE BITS

        000177          SA.VEC= 000177                  ;INTERRUPT VECTOR (DIVIDED BY 4)
        000200          SA.INT= 000200                  ;INTERRUPT ENABLE DURING INITIALIZATION
        003400          SA.MSG= 003400                  .MESSAGE RING LENGTH
        034000          SA.CMD= 034000                  ;COMMAND RING LENGTH
        040000          SA.WRP= 040000                  ;WRAP BIT
        100000          SA.STP= 100000                  ;STEP - MUST ALWAYS BE WRITTEN A ONE

        000400          SA.MS1= 000400                  ;LSB OF MESSAGE RING LENGTH
        004000          SA.CM1= 004000                  ;LSB OF COMMAND RING LENGTH

                        ;UDASA REGISTER STEP TWO READ BITS

        000007          SA.MSE= 000007                  ;MESSAGE RING LENGTH ECHO
        000070          SA.CME= 000070                  ;COMMAND RING LENGTH ECHO
                        ;       000100                  ;RESERVED
        000200          SA.STE= 000200                  ;STEP ECHO
        003400          SA.CTP= 003400                  ;CONTROLLER TYPE

                        ;UDASA REGISTER STEP TWO WRITE BITS

        000001          SA.PRG= 000001                  ;ENABLE VAX UNIBUS ADAPTER PURGE INTERRUPT
                        ;       177776                  ;LOW ORDER MESSAGE RING BYTE ADDRESS
```

```
                                  ;UDASA REGISTER STEP THREE READ BITS

        000177                    SA.VCE= 000177                  ;INTERRUPT VECTOR ECHO
        000200                    SA.INE= 000200                  ;INTERRUPT ENABLE ECHO
        000400                    SA.NVE= 000400                  ;VECTOR NOT PROGRAMMABLE
                                  ;       003000                  ;RESERVED

                                  ;UDASA REGISTER STEP THREE WRITE BITS

                                  ;       077777                  ;HIGH ORDER MESSAGE RING BYTE ADDRESS
        100000                    SA.TST= 100000                  ;PURGE POLE TEST ENABLE

                                  ;UDASA REGISTER STEP FOUR READ BITS

        000017                    SA.MCV= 000017                  ;UDA MICROCODE VERSION
        003760                    SA.CNT= 003760                  ;CONTROLLER MODEL

                                  ;UDASA REGISTER STEP FOUR WRITE BITS

        000001                    SA.GO=  000001                  ;GO BIT TO START UDA FIRMWARE
        000002                    SA.LFC= 000002                  ;LAST FAILURE CODE REQUEST
        000374                    SA.BST= 000374                  ;BURST LEVEL

                                  ;INIT ROUTINE FLAGS

        000002                    ICONT   == BIT1                 ;CONTINUE EVENT FLAG
        000004                    IREST   == BIT2                 ;RESTART FLAG
        000010                    ISTRT   == BIT3                 ;START FLAG
        000020                    ISTRTH  == BIT4                 ;START FLAG HOLD FOR DMRQ4 ROUTINE
```

```
                              ;COMMAND/MESSAGE DESCRIPTOR BIT DEFINITIONS

          100000              RG.OWN= 100000                  ;SET WHEN UDA OWNS RING
          040000              RG.FLG= 040000                  ;FLAG BIT

                              ;OFFSETS INTO HOST COMMUNICATIONS AREA WITH ONE DESCRIPTOR TO EACH RING
                              ;AND TWO PACKET AND BUFFER AREAS.

          000004              HC.ISZ=  4.                     ;SIZE OF INTERRUPT INDICATOR WORDS
          000004              HC.RSZ=  4.                     ;SIZE OF RING IN BYTES
          000004              HC.ESZ=  4.                     ;SIZE OF ENVELOPE WORDS BEFORE PACKET
          000060              HC.PSZ= 48.                     ;SIZE OF COMMAND AND MESSAGE PACKETS
          000244              HC.BSZ= 164.                    ;SIZE OF BUFFER

          000000              HC.INT=  0.                     ;INTERRUPT INDICATOR WORDS START
          000004              HC.MSG= HC.INT+HC.ISZ           ;MESSAGE RING START
          000006              HC.MCT= HC.MSG+2.               ;MESSAGE RING CONTROL WORD
          000010              HC.CMD= HC.MSG+HC.RSZ           ;COMMAND RING START
          000012              HC.CCT= HC.CMD+2.               ;COMMAND RING CONTROL WORDS
          000014              HC.MEV= HC.CMD+HC.RSZ           ;MESSAGE ENVELOPE START
          000020              HC.MPK= HC.MEV+HC.ESZ           ;MESSAGE PACKET START
          000100              HC.CEV= HC.MPK+HC.PSZ           ;COMMAND ENVELOPE START
          000104              HC.CPK= HC.CEV+HC.ESZ           ;COMMAND PACKET START
          000164              HC.BF1= HC.CPK+HC.PSZ           ;FIRST BUFFER
          000430              HC.BF2= HC.BF1+HC.BSZ           ;SECOND BUFFER

          000674              HC.SIZ= HC.BF2+HC.BSZ           ;TOTAL SIZE OF HOST COMM AREA

                              ;VIRTUAL CIRCUIT IDENTIFIERS

          000000              MSCP=     0                     ;MSCP CIRCUIT
          000001              LOG=      1                     ;LOG CIRCUIT
          177777              DIAG=    -1                     ;DIAGNOSTIC CIRCUIT
          001000              DUP=    1000                    ;DIAGNOSTIC AND UTILITIES PROTOCOL
```

```
;                  +--------------------------------------------------+
;         HC.INT   !        INTERRUPT INDICATORS                      !    4 BYTES
;                  !                                                  !
;                  +--------------------------------------------------+
;         HC.MSG   !        MESSAGE RING                              !    4 BYTES
;         HC.MCT   !                                                  !
;                  +--------------------------------------------------+
;         HC.CMD   !        COMMAND RING                              !    4 BYTES
;         HC.CCT   !                                                  !
;                  +--------------------------------------------------+
;         HC.MEV   !        MESSAGE ENVELOPE                          !   52 BYTES
;         HC.MPK   !                                                  !
;                  !                                                  !
;                  !                                                  !
;                  !                                                  !
;                  !                                                  !
;                  +--------------------------------------------------+
;         HC.CEV   !        COMMAND ENVELOPE                          !   52 BYTES
;         HC.CPK   !                                                  !
;                  !                                                  !
;                  !                                                  !
;                  !                                                  !
;                  !                                                  !
;                  +--------------------------------------------------+
;         HC.BF1   !        BUFFER # 1 (RESPONSE TO DM PROGRAM)       !   82 BYTES
;                  !                                                  !
;                  !                                                  !
;                  !                                                  !
;                  +--------------------------------------------------+
;         HC.BF2   !        BUFFER # 2 (REQUEST FROM DM PROGRAM)      !   82 BYTES
;                  !                                                  !
;                  !                                                  !
;                  !                                                  !
;                  +--------------------------------------------------+
                                  ;COMMAND PACKET OPCODES

      000001                      OP.ABO=   1                        ;ABORT COMMAND
      000020                      OP.ACC=  20                        ;ACCESS COMMAND
      000010                      OP.AVL=  10                        ;AVAILABLE COMMAND
      000021                      OP.CCD=  21                        ;COMPARE CONTROLLER DATA COMMAND
      000040                      OP.CMP=  40                        ;COMPARE HOST DATA COMMAND
      000022                      OP.ERS=  22                        ;ERASE COMMAND
      000023                      OP.FLU=  23                        ;FLUSH COMMAND
      000002                      OP.GCS=   2                        ;GFT COMMAND STATUS COMMAND
      000003                      OP.GUS=   3                        ;GET UNIT STATUS COMMAND
      000011                      OP.ONL=  11                        ;ONLINE COMMAND
      000041                      OP.RD=   41                        ;READ COMMAND
      000024                      OP.RPL=  24                        ;REPLACE COMMAND
      000004                      OP.SCC=   4                        ;SET CONTROLLER CHARACTERISTICS COMMAND
      000012                      OP.SUC=  12                        ;SET UNIT CHARACTERISTICS COMMAND
      000042                      OP.WR=   42                        ;WRITE COMMAND
      000030                      OP.MRD=  30                        ;MAINTENANCE READ COMMAND
      000031                      OP.MWR=  31                        ;MAINTENANCE WRITE COMMAND
      000200                      OP.END= 200                        ;END PACKET FLAG
      000007                      OP.SEX=   7                        ;SERIOUS EXCEPTION END PACKET
      000100                      OP.AVA= 100                        ;AVAILABLE ATTENTION MESSAGE
      000101                      OP.DUP= 101                        ;DUPLICATE UNIT NUMBER ATTENTION MESSAGE
      000102                      OP.SHC= 102                        ;SHADOW COPY COMPLETE ATTENION MESSAGE
      000103                      OP.RLC= 103                        ;RESET COMMAND LIMIT ATTENTION MESSAGE

      000001                      OP.GDS=   1                        ;DUP GET DUST STATUS
      000001                      OP.GSS=   1                        ;DUP GET DUST STATUS
      000002                      OP.ESP=   2                        ;DUP EXECUTE SUPPLIED PROGRAM
      000003                      OP.ELP=   3                        ;DUP EXECUTE LOCAL PROGRAM
      000004                      OP.SSD=   4                        ;DUP SEND STUD DATA
      000005                      OP.RSD=   5                        ;DUP RECEIVE STUD DATA

                                  ;NOTE: END PACKET OPCODES (ALSO CALLED ENDCODES) ARE FORMED BY ADDING THE END
                                  ;PACKET FLAG TO THE COMMAND UPCODE. FOE EXAMPLE, A READ COMMAND'S END PACKET
                                  ;CONTAINS THE VALUE OP.RD+OP.END IN ITS OPCODE FIELD. THE INVALID COMMAND END
                                  ;PACKET CONTAINS JUST THE END PACKET FLAG (I.E., OP.END) IN ITS OPCODE FIELD.
                                  ;THE SERIOUS EXCEPTION END PACKET CONTAINS THE SUM OF THE END PACKET FLAG
                                  ;PLUS THE SERIOUS EXCEPTION OPCODE SHOWN ABOVE (I.E., OP.SEX+OP.END) IN ITS
                                  ;OPCODE FIELD.
                                  ;
                                  ;COMMAND OPCODE BITS 3 THROUGH 5 INDICATE THE COMMAND CLASS, WHICH IS ENCODED
                                  ;AS FOLLOWS:
                                  ;   000  IMMEDIATE COMMANDS
                                  ;   001  SEQUENTIAL COMMANDS
                                  ;   010  NON-SEQUENTIAL COMMANDS THAT DO NOT INCLUDE A BUFFER DESCRIPTOR
                                  ;   100  NON-SEQUENTIAL COMMANDS THAT DO INCLUDE A BUFFER DESCRIPTOR
```

```
                                ;COMMAND MODIFIERS

                                ;     = 020000                  ;CLEAR SERIOUS EXCEPTION
        040000                  MD.CMP= 040000                  ;COMPARE
        100000                  MD.EXP= 100000                  ;EXPRESS REQUEST
        010000                  MD.ERR= 010000                  ;FORCE ERROR
        004000                  MD.SCH= 004000                  ;SUPPRESS CACHING (HIGH SPEED)
        002000                  MD.SCL= 002000                  ;SUPPRESS CACHING (LOW SPEED)
        000100                  MD.SEC= 000100                  ;SUPPRESS ERROR CORRECTION
        000400                  MD.SER= 000400                  ;SUPPRESS ERROR RECOVERY
        000200                  MD.SSH= 000200                  ;SUPPRESS SHADOWING
        000100                  MD.WBN= 000100                  ;WRITE-BACK (NON-VOLATILE)
        000400                  MD.WBV= 000400                  ;WRITE BACK (VOLATILE)
        000020                  MD.SEQ= 000020                  ;WRITE SHADOW SET ONE UNIT AT A TIME
        000001                  MD.SPD= 000001                  ;SPIN-DOWN
        000001                  MD.FEU= 000001                  ;FLUSH ENTIRE UNIT
        000002                  MD.VOL= 000002                  ;VOLATILE ONLY
        000001                  MD.NXU= 000001                  ;NEXT UNIT
        000001                  MD.RIP= 000001                  ;ALLOW SELF DESTRUCTION
        000002                  MD.IMF= 000002                  ;IGNORE MEDIA FORMAT ERROR
        000004                  MD.SWP= 000004                  ;SET WRITE PROTECT
        000010                  MD.CWB= 000010                  ;CLEAR WRITE-BACK DATA LOST
        000001                  MD.PRI= 000001                  ;PRIMARY REPLACEMENT BLOCK

                                ;END PACKET FLAGS

        000200                  EF.BBR= 000200                  ;BAD BLOCK REPORTED
        000100                  EF.BBU= 000100                  ;BAD BLOCK UNREPORTED
        000040                  EF.LOG= 000040                  ;ERROR LOG GENERATED
        000020                  EF.SEX= 000020                  ;SERIOUS EXCEPTION

                                ;CONTROLLER FLAGS

        000200                  CF.ATN= 000200                  ;ENABLE ATTENTION MESSAGES
        000100                  CF.MSC= 000100                  ;ENABLE MISCELLANEOUS ERROR LOG MESSAGES
        000040                  CF.OTH= 000040                  ;ENABLE OTHER HOST'S ERROR LOG MESSAGES
        000020                  CF.THS= 000020                  ;ENABLE THIS HOST'S ERROR LOG MESSAGES
        000002                  CF.SHD= 000002                  ;SHADOWING
        000001                  CF.576= 000001                  ;576 BYTE SECTORS
```

```
                                ;UNIT FLAGS

        000001                  UF.CMR= 000001                          ;COMPARE READS
        000002                  UF.CMW= 000002                          ;COMPARE WRITES
        100000                  UF.RPL= 100000                          ;HOST INITIATED BAD BLOCK REFLACEMENT
        040000                  UF.INA= 040000                          ;INACTIVE SHADOW SET UNIT
        004000                  UF.SCH= 004000                          ;SUPPRESS CACHING (HIGH SPEED)
        002000                  UF.SCL = 002000                         ;SUPPRESS CACHING (LOW SPEED)
        000100                  UF.WBN= 000100                          ;WRITE-BACK (NON-VOLATILE)
        020000                  UF.WPH= 020000                          ;WRITE PROTECT (HARDWARE)
        001000                  UF.WPS= 001000                          ;WRITE PROTECT (SOFTWARE OR VOLUME)
        000004                  UF.576= 000004                          ;576 BYTE SECTORS

                                ;COMMAND PACKET OFFSETS

                                ;         GENERIC COMMAND PACKET OFFSETS:
        000000                  P.CRF=   0.                             ;COMMAND REFERENCE NUMBER
        000004                  P.UNIT=  4.                             ;UNIT NUMBER
        000010                  P.OPCD=  8.                             ;OPCODE
        000012                  P.MOD=  10.                             ;MODIFIERS
        000014                  P.BCNT= 12.                             ;BYTE COUNT
        000020                  P.BUFF= 16.                             ;BUFFER DESCRIPTOR
        000020                  P.UADR= 16.                             ;UNIBUS ADDRESS OF BUFFER DESCRIPTOR
        000034                  P.LBN=  28.                             ;LOGICAL BLOCK NUMBER

                                ;         ABORT AND GET COMMAND STATUS COMMAND PACKET OFFSETS:
        000014                  P.OTRF= 12.                             ;OUTSTANDING REFERENCE NUMBER

                                ;         ONLINE AND SET UNIT CHARACTERISTICS COMMAND PACKET OFFSETS:
        000016                  P.UNFL= 14.                             ;UNIT FLAGS
        000020                  P.HSTI= 16.                             ;HOST IDENTIFIER / RESERVED
        000034                  P.ELGF= 28.                             ;ERROR LOG FLAGS
        000040                  P.SHUN= 32.                             ;SHADOW UNIT
        000042                  P.CPSP= 34.                             ;COPY SPEED
                                ;         REPLACE COMMAND PACKET OFFSETS:
        000014                  P.RBN=  12.                             ;REPLACEMENT BLOCK NUMBER

                                ;         SET CONTROLLER CHARACTERISTICS COMMAND PACKET OFFSETS:
        000014                  P.VRSN= 12.                             ;MSCP VERSION
        000016                  P.CNTF= 14.                             ;CONTROLLER FLAGS
        000020                  P.HTMO= 16.                             ;HOST TIMEOUT
        000022                  P.USEF= 18.                             ;USE FRACTION
        000024                  P.TIME= 20.                             ;QUAD-WORD TIME AND DATE

                                ;         MAINTENANCE READ AND MAINTENANCE WRITE COMMAND PACKET OFFSETS:
        000034                  P.RGID= 28.                             ;REGION ID
        000040                  P.RGOF= 32.                             ;REGION OFFSET

                                ;         EXECUTE SUPPLIED PROGRAM COMMAND PACKET OFFSETS:
        000024                  P.DMDT= 20.                             ;DMDT TERMINAL ADDRESS (MAINT WRITE ONLY)
        000034                  P.OVRL= 28.                             ;BUFFER DESCRIPTOR FOR OPERLAYS
```

```
                        ;END PACKET OFFSETS

                        ;               GENERIC END PACKET OFFSETS:
        000000          P.CRF=   0.                             ;COMMAND REFERENCE NUMBER
        000004          P.UNIT=  4.                             ;UNIT NUMBER
        000010          P.OPCD=  8.                             ;OPCODE (ALSO CALLED ENDCODE)
        000011          P.FLGS=  9.                             ;END PACKET FLAGS
        000012          P.STS=  10.                             ;STATUS
        000014          P.BCNT= 12.                             ;BYTE COUNT
        000034          P.FBBK= 28.                             ;FIRST BAD BLOCK

                        ;               GET COMMAND STATUS END PACKET OFFSETS:
        000014          P.OTRF= 12.                             ;OUTSTANDING REFERENCE NUMBER
        000020          P.CMST= 16.                             ;COMMAND STATUS

                        ;               GET UNIT STATUS END PACKET OFFSETS:
        000014          P.MLUN= 12.                             ;MULTI-UNIT CODE
        000016          P.UNFL= 14.                             ;UNIT FLAGS
        000020          P.HSTI= 16.                             ;HOST IDENTIFIER
        000024          P.UNTI= 20.                             ;UNIT IDENTIFIER
        000034          P.MEDI= 28.                             ;MEDIA TYPE IDENTIFIER
        000040          P.SHUN= 32.                             ;SHADOW UNIT
        000042          P.SHST= 34.                             ;SHADOW STATUS
        000044          P.TRCK= 36.                             ;TRACK SIZE
        000046          P.GRP=  38.                             ;GROUP SIZE
        000050          P.CYL=  40.                             ;CYLINDER SIZE
        000054          P.RCTS= 44.                             ;RCT TABLE SIZE
        000056          P.RBNS= 46.                             ;RBNS / TRACK
        000057          P.RCTC= 47.                             ;RCT COPIES

                        ;               ONLINE AND SET UNIT CHARACTERISTICS END PACKET AND AVAILABLE
                        ;               ATTENTION MESSAGE OFFSETS:
        000014          P.MLUN= 12.                             ;MULTI-UNIT CODE
        000016          P.UNFL= 14.                             ;UNIT FLAGS
        000020          P.HSTI= 16.                             ;HOST IDENTIFIER
        000024          P.UNTI= 20.                             ;UNIT IDENTIFIER
        000034          P.MEDI= 28.                             ;MEDIA TYPE IDENTIFIER
        000040          P.SHUN= 32.                             ;SHADOW UNIT
        000042          P.SHST= 34.                             ;SHADOW STATUS
        000044          P.UNCL= 36.                             ;UNIT COMMAND LIMIT
        000050          P.UNSZ= 40.                             ;UNIT SIZE
        000054          P.VSER= 44.                             ;VOLUME SERIAL NUMBER

                        ;               SET CONTROLLER CHARACTERISTICS END PACKET OFFSETS:
        000014          P.VRSN= 12.                             ;MSCP VERSION
        000016          P.CNTF= 14.                             ;CONTROLLER FLAGS
        000020          P.CTMO= 16.                             ;CONTROLLER TIMEOUT
        000022          P.CNCL= 18.                             ;CONTROLLER COMMAND LIMIT
        000024          P.CNTI= 20.                             ;CONTROLLER ID

                        ;               GET DUST STATUS END PACKET OFFSETS:
        000014          P.DEXT= 12.                             ;DUST PROGRAM EXTENSION
        000017          P.DFLG= 15.                             ;STATUS FLAGS
        000020          P.DPI=  16.                             ;PROGRESS INDICATOR
        000024          P.DTO=  20.                             ;TIMEOUT VALUE
```

```
                         ;STATUS AND EVENT CODE DEFINITIONS

        000037           ST.MSK= 37                        ;STATUS / EVENT CODE MASK
        000040           ST.SUB= 40                        ;SUB-CODE MULTIPLIER
        000000           ST.SUC=  0                        ;SUCCESS
        000001           ST.CMD=  1                        ;INVALID COMMAND
        000002           ST.ABO=  2                        ;COMMAND ABORTED
        000003           ST.OFL=  3                        ;UNIT-OFFLINE
        000004           ST.AVL=  4                        ;UNIT-AVAILABLE
        000005           ST.MFE=  5                        ;MEDIA FORMAT ERROR
        000006           ST.WPR=  6                        ;WRITE PROTECTED
        000007           ST.CMP=  7                        ;COMPARE ERROR
        000010           ST.DAT= 10                        ;DATA ERROR
        000011           ST.HST= 11                        ;HOST BUFFER ACCESS ERROR
        000012           ST.CNT= 12                        ;CONTROLLER ERROR
        000013           ST.DRV= 13                        ;DRIVE ERROR
        000037           ST.DIA= 37                        ;MESSAGE FROM AN INTERNAL DIAGNOSTIC

                         ;GET DUST STATUS FLAGS

        000010           DF.ACT= 010                       ;SET IF THIS DUST CURRENTLY ACTIVE
        000004           DF.NES= 004                       ;SET IF THIS DUST WILL NOT ACCEPT THE EXECUTE
                                                           ;SUPPLIED PROGRAM COMMAND
        000002           DF.LCL= 002                       ;SET IF THIS DUST HAS A LOCAL LOAD MEDIA FOR LOADING
                                                           ;DIAGNOSTICS AND OTHER UTILITIES
        000001           DF.SA=  001                       ;SET IF ANY PROGRAM EXECUTION UNDER THIS DUST
                                                           ;DISABLES THE OPERATION OF ALL OTHER SERVERS IN THE
                                                           ;SAME SYSTEM AS THE DUST


                         ;DUP MESSAGE TYPES

        010000           DU.QUE = 10000                    ;QUESTION
        020000           DU.DFL = 20000                    ;DEFAULT QUESTION
        030000           DU.INF = 30000                    ;INFORMATION
        040000           DU.TER = 40000                    ;TERMINATOR
        050000           DU.FTL = 50000                    ;FATAL ERROR
        060000           DU.SPC = 60000                    ;SPECIAL

        170000           DU.TYP= 170000                    ;MESSAGE TYPE FIELD

                         ;DM PROGRAM HEADER DEFINITIONS

        000000           DMTRLN= 0                         ;OFFSET TO SIZE OF PROGRAM NEEDING DOWNLINE LOAD
        000004           DMOVRL= 4                         ;OFFSET TO SIZE OF OVERLAY
        000021           DMTMO=  21                        ;TIMEOUT VALUE IN SECONDS (ONE BYTE)
        000040           DMMAIN= 40                        ;OFFSET TO FIRST WORD OF MAIN PROGRAM
        001000           DMFRST= 1000                      ;ADDRESS IN DM FILE CONTAINING FIRST BYTE OF HEADER
```

```
                        ;CONTROLLER TABLE DEFINITIONS
                        ;
                        ;ONE TABLE WILL BE SET UP BY INITIALIZE SECTION FOR EACH UDA SELECTED
                        ;FOR TESTING.  TABLES ARE CONTIGUOUS.  THE END OF THE TABLES IS
                        ;MARKED BY A WORD OF ZEROS.
                        ;
                        ;THE FIRST TABLE IS POINTED TO BY THE CONTENTS OF CTABS.
                        ;THE NUMBER OF TABLES IS CONTAINED IN CTRLRS.

002140                  TABLE                           ;START A TABLE DEFINITION

002140                  ITEM C.UADR     2               ;UNIBUS ADDRESS OF UDAIP REGISTER
002140                  ITEM C.UNIT     2
        000077                  CT.UNT= 000077          ; LOGICAL UNIT NUMBER (FIRST)
        100000                  CT.AVL= BIT15           ; SET WHEN NOT AVAILABLE FOR TESTING
002140                  ITEM C.VEC      2
        000777                  CT.VEC= 000777          ; VECTOR ADDRESS
        007000                  CT.BRL= 007000          ; BR LEVEL
002140                  ITEM C.JSR      2               ;INTERRUPT SERVICE ROUTINE FOR CONTROLLER
002140                  ITEM C.JAD      2               ;  THESE TWO WORDS LOADED WITH [JSR R0,UDASRV]
002140                  ITEM C.FLG      2               ;FLAGS
        000002                  CT.RN=  BIT1            ;DM PROGRAM RUNNING
        000004                  CT.CMD= BIT2            ;COMMAND ISSUED, WAITING FOR RESPONSE
        000010                  CT.MSG= BIT3            ;MESSAGE RESPONSE RECEIVED
                                                        ;WHENEVER THIS BIT IS SET, CT.CMD IS CLEARED
        000020                  CT.REQ= BIT4            ;BUFFER HAS BEEN GIVEN TO UDA FOR REQUEST
                                                        ;SET WHENEVER READ STUD DATA COMMAND
                                                        ;GIVEN TO UDA
        000040                  CT.STA= BIT5            ;GET DUST STATUS COMMAND HAS BEEN SENT
        000100                  CT.TM1= BIT6            ;ONE TIMEOUT PERIOD HAS EXPIRED BETWEEN SEND OR
                                                        ;RECEIVE DATA RESPONSE
        000200                  CT.TM2= BIT7            ;SECOND TIMEOUT HAS EXPIRED
002140                  ITEM C.RING     2               ;RING BUFFER ADDRESS
002140                  ITEM C.DR0      2               ;POINTER TO DRIVE TABLES
002140                  ITEM C.DR1      2               ;  IF ZERO, NO DRIVE TABLE EXISTS
002140                  ITEM C.DR2      2
002140                  ITEM C.DR3      2
002140                  ITEM C.DR4      2
002140                  ITEM C.DR5      2
002140                  ITEM C.DR6      2
002140                  ITEM C.DR7      2
002140                  ITEM C.TO       2               ;TIMEOUT COUNTER
002140                  ITEM C.TOH      2               ;  (TWO WORDS)
002140                  ITEM C.TOT      2               ;DUP PROGRAM TIMEOUT VALUE IN SECONDS
002140                  ITEM C.PRI      4               ;DUP PROGRAM PROGRESS INDICATOR
002140                  ITEM C.REF      2               ;COMMAND REFERENCE NUMBER

002140                  END C.SIZE                      ;SIZE OF CONTROLLER TABLE IN BYTES
```

```
                                      ;DRIVE TABLE DEFINITIONS
                                      ;
                                      ;ONE DRIVE TABLE WILL BE SET UP BY THE INITIALIZE SECTION FOR EACH
                                      ;DRIVE SELECTED FOR TESTING.  EACH TABLE IS POINTED TO BY A
                                      ;WORD IN THE CONTROLLER TABLE ON WHICH THE DRIVE EXISTS.

002140                                TABLE                          ;START A TABLE DEFINITION

002140                                ITEM D.DRV      2                        ;DRIVE NUMBER
002140                                ITEM D.UNIT     2
              000077                          DT.UNT= 000077                   ; LOGICAL UNIT NUMBER OF DRIVE
              100000                          DT.AVL= BIT15                    ; SET WHEN NOT AVAILABLE FOR TESTING
002140                                ITEM D.SERN     22.                      ;DISK SERIAL NUMBER

002140                                END D.SIZE                               ;SIZE OF DRIVE TABLE IN BYTES
```

```
;USEFUL INSTRUCTION DEFINITIONS

.MACRO  AND ARG,ADR                     ;LOGICAL AND INSTRUCTION
        .LIST
                                                                   BIC #↑C<ARG>,ADR
        .NLIST
.ENDM

.MACRO  OR ARG,ADR                      ;LOGICAL OR INSTRUCTION
        .LIST
                                                                   BIS #ARG,ADR
        .NLIST
.ENDM

.MACRO  PUSH ARG                        ;PUSH INSTRUCTION
        .IRP X,<ARG>
        .LIST
                                                                   MOV X,-(SP)
        .NLIST
        .ENDM
.ENDM

.MACRO  POP ARG                         ;POP INSTRUCTION
        .IRP X,<ARG>
        .LIST
                                                                   MOV (SP)+,X
        .NLIST
        .ENDM
.ENDM

.MACRO  .BR ADR                         ;A BRANCH TO THE NEXT LOCATION
        .IF P2
            .IF NE .-ADR
                .ERROR ;ILLEGAL .BR TO ADR
            .ENDC
        .ENDC
.ENDM

.MACRO  ASSUME FIRST CONDITION SECOND
            .IF CONDITION <FIRST>-<SECOND>
            .IFF
                .ERROR ;BAD ASSUME OF <FIRST> CONDITION <SECOND>
            .ENDC
.ENDM
```

```
;PRINT CHARACTER
;  ARGUMENT MUST BE SOURCE STATEMENT TO MOVE CHARACTER TO PRINT (MOV ARG,R0)
;       EX: "PRINT R1" WILL PRINT THE CHARACTER IN R1
;  SPECIAL CASE: "PRINT #CR" WILL PRINT END OF LINE SEQUENCE
;  THE PRINTING IS DONE AT THE MODE OF THE LAST PRINT LINE CALL
;       IE., PNTX, PNTB, PNTX, PNTS

.MACRO PRINT ARG1
        .IF DIF <ARG1>,R0
                .LIST
                                                                MOVB ARG1,R0

                .NLIST
        .ENDC
        .LIST
                                                                CALL CPNT

        .NLIST
.ENDM

;PROCESSING MACRO FOR NEXT SET OF FORMATTED MESSAGE MACROS

.MACRO PNT... RTN,ADR,ARG1,ARG2,ARG3,ARG4,ARG5,ARG6,ARG7,ARG8
        PNT.CT=0
        .IRP AA,<ARG8,ARG7,ARG6,ARG5,ARG4,ARG3,ARG2,ARG1>
                .IF NB,<AA>
                        .LIST
                                                                MOV AA,-(SP)

                        .NLIST
                        PNT.CT=PNT.CT+2
                .ENDC
        .ENDM
        .LIST
                                                                JSR R1,RTN
                                                                .WORD ADR
                                                                .WORD PNT.CT

        .NLIST
.ENDM
```

```
;PRINT FORMATTED MESSAGE MACROS
;  USE THESE MACROS TO PRINT A FORMATTED MESSAGE
;  FIRST ARGUMENT MUST BE ADDRESS OF FIRST CHARACTER OF MESSAGE STRING
;         TO BE PUT INTO WORD (.WORD ARG)
;  UP TO 8 SOURCE STATEMENTS MAY FOLLOW TO SPECIFY PARAMETERS TO BE
;  USED BY THE FORMAT

.MACRO PNTF ADR ARG1,ARG2,ARG3,ARG4,ARG5,ARG6,ARG7,ARG8
        PNT... LPNTF ADR ARG1,ARG2,ARG3,ARG4,ARG5,ARG6,ARG7,ARG8
.ENDM
.MACRO PNTB ADR ARG1,ARG2,ARG3,ARG4,ARG5,ARG6,ARG7,ARG8
        PNT... LPNTB ADR ARG1,ARG2,ARG3,ARG4,ARG5,ARG6,ARG7,ARG8
.ENDM
.MACRO PNTX ADR ARG1,ARG2,ARG3,ARG4,ARG5,ARG6,ARG7,ARG8
        PNT... LPNTX ADR ARG1,ARG2,ARG3,ARG4,ARG5,ARG6,ARG7,ARG8
.ENDM
.MACRO PNTS ADR ARG1,ARG2,ARG3,ARG4,ARG5,ARG6,ARG7,ARG8
        PNT... LPNTS ADR ARG1,ARG2,ARG3,ARG4,ARG5,ARG6,ARG7,ARG8
.ENDM
.MACRO PNT ADR ARG1,ARG2,ARG3,ARG4,ARG5,ARG6,ARG7,ARG8
        PNT... LPNT ADR ARG1,ARG2,ARG3,ARG4,ARG5,ARG6,ARG7,ARG8
.ENDM
```

```
                                .SBTTL  GLOBAL DATA SECTION

                                ;++
                                ; THE GLOBAL DATA SECTION CONTAINS DATA THAT ARE USED
                                ; IN MORE THAN ONE TEST.
                                ;--

002140                          FFREE:: .BLKW 1                             ;FIRST FREE WORD IN MEMORY
002142                          FSIZE:: .BLKW 1                             ;SIZE OF FREE MEMORY IN WORDS
002144                          FMEM:   .BLKW 1                       ;COPY OF FFREE AT END OF INIT SECTION
002146                          FMEMS:  .BLKW 1                       ;COPY OF FSIZE AT END OF INIT SECTION
002150                          CTABS:: .BLKW 1                             ;START OF CONTROLLER TABLE STORAGE
002152                          CTRLRS: .BLKW 1                             ;COUNT OF UDA CONTROLLERS IN PTABLES
002154                          TSTTAB: .BLKW 1                             ;POINTER TO FIRST CONTROLLER TABLE UNDER TEST
                                        .GLOBL RAFMT
002156  000000G                 DMPROG: .WORD RAFMT                         ;START ADDRESS OF DM PROGRAM
002160                          URUN:   .BLKW 1                             ;NUMBER OF UNITS TO RUN AT ONE TIME
002162                          URNING: .BLKW 1                             ;NUMBER OF UNITS STILL RUNNING
002164                          UCNT:   .BLKW 1                             ;COUNTER OF UNITS UNDER TEST
002166  000000                  FILOPN: .WORD 0                             ; FILE OPEN
002170                          UFREEZ: .BLKW 1                             ;FREEZE ON UNIT WHEN NOT ZERO
002172                          NXMAD:  .BLKW 1                             ;SET TO ALL ONES BY NON-EXISTANT ADDRESS
002174  000000                  FDATA:  .WORD 0
002176                          FCTBUF: .BLKB 512.              ;STORAGE FOR FCT BLOCK
003176                          FCTNUM: .BLKW 1         ;FCT BLOCK NUMBER
003200                          MODE:   .BLKW 1 ;MODE WORD, SAME BIT DEFS AS SO.BIT

                                ;INIT ROUTINE DATA

003202                          DTABS:: .BLKW 1                             ;START OF DRIVE TABLE STORAGE
003204                          IFLAGS::.BLKW 1                             ;FLAGS FROM INIT CODE

                                ;CLOCK CONTROL

003206  000000                  KW.CSR: .WORD 0                             ;CSR OF CLOCK
003210                          KW.BRL: .BLKW 1                             ;BR LEVEL
003212                          KW.VEC: .BLKW 1                             ;VECTOR
003214                          KW.HZ:  .BLKW 1                             ;HERTZ (50. OR 60.)
003216                          KW.EL:  .BLKW 2                             ;ELAPSED TIME

003222  016270                  PTYPE:  .WORD PF                            ;PRINT TYPE
003224     000      000         ERRCHR: .BYTE 0,0                           ;FIRST BYTE LOADED WITH OUTPUT CHARACTER
003226  000000                  NULL:   .WORD 0                             ;USED TO PRINT A NULL CHARACTER
003230                          FNAME:  .BLKB 10.
```

```
003242                            TEMP:    .BLKB 22.                        ;USED TO GET ANSWER FROM GMANID CALL
003270      061      055      112 DATEI:   .ASCIZ\1-JAN-70\                 ;DEFAULT DATE
003301                                     .BLKB 3
003304   000000                   DATEO:   .WORD 0 ;DATE STRING IN FORMATTER FORMAT
003306                                     .BLKB 10.       ;(FIRST WORD ZERO SAYS NO DATE HERE YET)
003320      061      070      064 HIGHEST:.ASCIZ\18446744073709551615\      ;HIGHEST DISK SERIAL NUMBER
003345      104      105      103 MONTHS:  .ASCII\DEC\         ;NAME OF MONTHS
003350      116      117      126          .ASCII\NOV\
003353      117      103      124          .ASCII\OCT\
003356      123      105      120          .ASCII\SEP\
003361      101      125      107          .ASCII\AUG\
003364      112      125      114          .ASCII\JUL\
003367      112      125      116          .ASCII\JUN\
003372      115      101      131          .ASCII\MAY\
003375      101      120      122          .ASCII\APR\
003400      115      101      122          .ASCII\MAR\
003403      106      105      102          .ASCII\FEB\
003406      112      101      116          .ASCII\JAN\
003411      037                   DAYS:    .BYTE 31.           ;NUMBER OF DAYS IN EACH MONTH
003412      035                            .BYTE 29.
003413      037                            .BYTE 31.
003414      036                            .BYTE 30.
003415      037                            .BYTE 31.
003416      036                            .BYTE 30.
003417      037                            .BYTE 31.
003420      037                            .BYTE 31.
003421      036                            .BYTE 30.
003422      037                            .BYTE 31.
003423      036                            .BYTE 30.
003424      037                            .BYTE 31.
003425      061      071      000 YEAR19:  .ASCIZ\19\
003430      062      060      000 YEAR20:  .ASCIZ\20\
                                           .EVEN
003434   000000                   IPADRS:  .WORD 0
003436   000000                            .WORD 0
003440   000000                            .WORD 0
003442   000000                            .WORD 0
003444   000000                            .WORD 0
003446   000000                            .WORD 0
003450   000000                            .WORD 0
003452   000000                            .WORD 0
```

C5

```
                                          .SBTTL  GLOBAL TEXT SECTION

                                          ;**
                                          ; THE GLOBAL TEXT SECTION CONTAINS FORMAT STATEMENTS,
                                          ; MESSAGES, AND ASCII INFORMATION THAT ARE USED IN
                                          ; MORE THAN ONE TEST.
                                          ;

                                          ;
                                          ; NAMES OF DEVICES SUPPORTED BY PROGRAM
                                          ;
        003454                                  DEVTYP <RA SERIES DISK DRIVE>
        003454                                                                          L$DVTYP::
        003454      122      101      040                                                        .ASCIZ  /RA SERIES DISK DRIV
E/
                                                                                                 .EVEN

                                          ; TEST DESCRIPTION
                                          ;
        003502                                  DESCRIPT <CZUDKO UDA50A,KDA50A-Q FORMATTER>
        003502                                                                          L$DESC::
        003502      103      132      125                                                        .ASCIZ  /CZUDKO UDA50A,KDA50
A Q FORMATTER/
                                                                                                 .EVEN
```

```
                                        ;UNFORMATTED MESSAGES

  003544      105      116      124     DATEQ:  .ASCIZ\ENTER DATE AS DD-MMM-YY\
  003574      040      106      117     FILNAQ: .ASCIZ\ FOR DISK TO BE FORMATTED\
  003626      040      000              SERNQ:  .ASCIZ\ \
  003630      101      122      105     WNQUES:  ASCIZ\ARE YOU SURE YOU WANT TO RUN THIS FORMATTER\
                                        ; FORMAT STATEMENTS USED IN PRINT CALLS

003704     045     124     000     ERRONE: .ASCIZ\%T\
003707     045     116     000     ERRNL:  .ASCIZ\%N\
003712     042     040     040     RNTIM:  .ASCIZ\"  RUNTIME "D16":"\
003735     104     071     042     RNTIM1: .ASCIZ\D9":"\
003743     104     071     000     RNTIM2: .ASCIZ\D9\
003746     042     040     040     ERRME1: .ASCIZ\"  *  *  *  ERROR PROCESSING MESSAGE STRING  *  *  *"N\
004035     116     042     125     MESSG:  .ASCIZ\N"UNIT "D6" CONTROLLER AT "O16" DRIVE "D9S\
004110     042     116     117     NOCLOCK:.ASCIZ\"NO LINE CLOCK AVAILABLE FOR TIMING EVENTS"N\
004165     042     110     117     BASNO:  .ASCIZ\"HOST PROGRAM"\
004204     042     040     040     BASL2:  .ASCIZ\"  CONTROLLER AT "O16\
004232     042     040     040     BASL3:  .ASCIZ\"  DRIVE "D9\
004247     000                     BAS:    .BYTE 0                         ;NULL TO PRINT NOTHING

004250     122     066     122     BASLN:  .ASCIZ\R6R6R6R6\                ;USED TO PRINT BASIC LINE OF ERROR MESSAGE
004261     116     042     123     SERNUM: .ASCIZ\N"SERIAL NUMBER FOR UNIT "D6" CONTROLLER AT "O16" DRIVE "D9\
004355     042     123     124     WNSTOP: .ASCII\"STOPPING THIS FORMAT AFTER THIS POINT WILL MAKE THE DISK"N\
004450     042     125     116             .ASCII\"UNUSABLE, AND WILL CAUSE THE DISK TO BE SPUN DOWN WHEN"N\
004541     042     102     122             .ASCIZ\"BROUGHT ONLINE."NN\
004565     116     042     127     WNSTRT: .ASCII\N"WARNING:"N\
004601     042     040     040             .ASCII\"        THIS FORMATTER PROGRAM SHOULD NOT BE USED AS A DIAGNOSTIC"N\
004703     042     040     040             .ASCII\"        TOOL.  RUN THIS PROGRAM ONLY AS INSTRUCTED IN THE DISK"N\
005002     042     040     040             .ASCIZ\"        DRIVE'S SERVICE MANUAL."N\
  005043                            X1A:
  005043                            X2A:
  005043                            X3A:
  005043     042     111     116    X8A:     .ASCIZ\"INVALID ANSWERS GIVEN TO HARDWARE QUESTIONS"N\
  005122     122     065     122    X1:      .ASCIZ\R5R6"CONTROLLER HAS MORE THAN ONE VECTOR, BR LEVEL OR BURST RATE"N\
  005225     122     065     122    X2:      .ASCIZ\R5R6"MULTIPLE UNITS SELECT THE SAME DRIVE"N\
  005301     122     065     122    X3:      .ASCIZ\R5R6"MORE THAN EIGHT DRIVES SELECTED ON THIS CONTROLLER"N\
  005373     122     064     042    X4:      .ASCII\R4"NOT ENOUGH ROOM IN MEMORY TO FORMAT THE UNITS SELECTED"N\
  005466     042     120     114             .ASCIZ\"PLEASE START PROGRAM OVER AND FORMAT FEWER UNITS AT A TIME"N\
  005564     122     065     122    X8:      .ASCIZ\R5R6"TWO CONTROLLERS USE THE SAME VECTOR"N\
  005637     122     064     042    X9:      .ASCII\R4"ONLY ONE DISK CAN BE SELECTED IN HW QUESTIONS IN RESTORE MODE."N\
  005742     042     120     114             .ASCIZ\"PLEASE START PROGRAM OVER AND SELECT ONLY ONE DISK."N\
  006031     122     064     042    X10:     .ASCIZ\R4"THIS PROGRAM CAN ONLY REFORMAT A DISK IN UNATTENDED MODE."N\
  006130     122     065     042    X14:     .ASCII\R5"CONTROLLER IS NOT SUPPORTED BY THIS FORMATTER PROGRAM.  THIS"N\
  006231     042     120     122             .ASCII\"PROGRAM REQUIRES A UDA50-A (MODEL 6) OR A KDA50-Q (MODEL 13)"N\
  006330     042     103     117             .ASCIZ\"CONTROLLER.  CONTROLLER REPORTED MODEL CODE "D4"."N\
  006415     122     065     042    X20:     .ASCII\R5"MEMORY ERROR TRYING TO READ CONTROLLER REGISTERS"N\
  006502     042     103     110             .ASCII\"CHECK CSR SELECTION SWITCHES ON CONTROLLER PROCESSOR MODULE OR BUS"N\
  006607     042     117     122             .ASCIZ\"OR REPLACE CONTROLLER PROCESSOR MODULE"N\
  006661     122     065     042    X21:     .ASCII\R5"CONTROLLER RESIDENT DIAGNOSTICS DETECTED FAILURE"NR8\
  006750     042     122     105             .ASCIZ\"REPLACE CONTROLLER SDI MODULE"N\
  007011     122     065     042    X21A:    .ASCIZ\R5"CONTROLLER RESIDENT DIAGNOSTICS DETECTED FAILURE"NR8R7\
  007103     122     065     042    X22:     .ASCII\R5"STEP BIT DID NOT SET IN SA REGISTER DURING INITIALIZATION"N\
  007201     042     123     124             .ASCIZ\"STEP BIT EXPECTED "O16NR8R7\
  007236     122     065     042    X23A:    .ASCII\R5"CONTROLLER DID NOT CLEAR RING STRUCTURE IN HOST MEMORY DURING INITIALIZATI
ON"
  007357     104     071     042             .ASCII\D9" WORDS WERE TO BE CLEARED STARTING AT ADDRESS "O16N\
  007445     042     106     111             .ASCII\"FIRST SEVERAL WORDS NOT CLEARED (UP TO 6):"N\
  007522     123     066     042             .ASCIZ\S6"ADDRESS"S4"CONTENTS"N\
  007553     123     067     117    X23B:    .ASCIZ\S7O16S5O16N\
  007567     122     065     042    X24:     .ASCII\R5"SA REGISTER DID NOT GO TO ZERO AFTER STEP 3 WRITE OF INITIALIZATION"N\
  007677     042     120     125             .ASCIZ\"PURGE/POLE DIAGNOSTICS WERE REQUESTED"NR8R7\
  007754     122     065     042    X25:     .ASCII\R5"CONTROLLER DID NOT RETURN CORRECT DATA IN SA REGISTER DURING"N\
  010055     042     111     116             .ASCII\"INITIALIZATION"N\
  010076     042     040     040             .ASCIZ\"  SA EXPECTED  "O16NR8R7\
  010130     122     065     042    X30:     .ASCIZ\R5"CONTROLLER REPORTED FATAL ERROR IN SA REGISTER WHILE RUNNING FORMATTER"NR8
\
  010246     122     065     042    X31:     .ASCIZ\R5"FORMATTER PROGRAM IS HUNG"N\
  010305     122     065     042    X32:     .ASCIZ\R5"MESSAGE BUFFER RECEIVED FROM FORMATTER WITH UNKNOWN REQUEST NUMBER"N\
  010415     122     065     042    X36:     .ASCII\R5"NO INTERRUPT RECEIVED FROM CONTROLLER FOR 30 SECONDS"N\
  010506     042     127     110             .ASCIZ\"WHILE LOADING FORMATTER"N\
  010541     122     065     042    X37:     .ASCIZ\R5"CONTROLLER REPORTED FATAL ERROR IN SA REGISTER WHILE LOADING FORMATTER"NR8
R7\
  010661     122     065     042    X100:    .ASCIZ\R5"FORMATTER ASKED UNEXPECTED QUESTION ("D12")"N\
  010742     122     065     042    X101:    .ASCIZ\R5"FORMATTER REJECTED ANSWER TO DATE OR SERIAL NUMBER QUESTION"N\
  011043      042      115      105  XMSG1:  .ASCIZ\"MESSAGE BUFFER CONTAINS:"N\
  011077      123      063      117  XMSG2:  .ASCIZ\S3016S1016S1016S1016S1016S1016S1016N\
  011144      122      065      042  XPKT1:  .ASCII\R5"RESPONSE PACKET FROM CONTROLLER DOES NOT CONTAIN EXPECTED DATA"N\
  011247      042      105      111          .ASCII\"EITHER CONTROLLER RETURNED ERROR STATUS OR PACKET WAS NOT RECEIVED"N\
  011354      042      103      117          .ASCII\"CORRECTLY"N\
  011370      123      063      042          .ASCIZ\S3"COMMAND PACKET SENT"S6"RESPONSE PACKET RECEIVED"N\
  011455      123      066      117  XPKT2:  .ASCIZ\S6016S1016S14016S1016N\
  011504      042      040      040  XSA:    .ASCIZ\"  SA CONTAINS  "016N\
  011532      042      122      105  XFRU:   .ASCIZ\"REPLACE CONTROLLER PROCESSOR MODULE"N\


  011601      045      101      111  SERNX:  .ASCIZ\%AINPUT ERROR. ANSWER WITH DECIMAL NUMBER LO= 0  HI= %T\
  011671      042      111      116  DATEX:  .ASCIZ\"INPUT ERROR."\
  011710      042      116      101  FILNAM: .ASCIZ\"NAME OF FILE CONTAINING BAD SECTOR INFORMATION"\
                                             .EVEN
```

```
                                .SBTTL  GLOBAL ERROR REPORT SECTION

                                ;++
                                ; THE GLOBAL ERROR REPORT SECTION CONTAINS MESSAGE PRINTING AREAS
                                ; USED BY MORE THAN TEST TO OUTPUT ADDITIONAL ERROR INFORMATION.  PRINTB
                                ; (BASIC) AND PRINTX (EXTENDED) CALLS ARE USED TO CALL PRINT SERVICES.
                                ;--
        177777                  SVCINS= -1                      ; LIST INSTRUCTIONS, SHIFTED RIGHT
        177777                  SVCTST= -1                      ; LIST TEST TAGS, SHIFTED RIGHT
        177777                  SVCSUB= -1                      ; LIST SUBTEST TAGS, SHIFTED RIGHT
        177777                  SVCGBL= -1                      ; LIST GLOBAL TAGS, SHIFTED RIGHT
        177777                  SVCTAG= -1                      ; LIST OTHER TAGS, SHIFTED RIGHT

011772                          BGNMSG ERR001
011772                                  PNTB X1,#X1A
011772  012746  005043                                                          MOV #X1A,-(SP)
011776  004137  016422                                                          JSR R1,LPNTB
012002  005122                                                                  .WORD X1
012004  000002                                                                  .WORD PNT.CT
012006                          ENDMSG

012010                          BGNMSG ERR002
012010                                  PNTB X2,#X2A
012010  012746  005043                                                          MOV #X2A,-(SP)
012014  004137  016422                                                          JSR R1,LPNTB
012020  005225                                                                  .WORD X2
012022  000002                                                                  .WORD PNT.CT
012024                          ENDMSG

012026                          BGNMSG ERR003
012026                                  PNTB X3,#X3A
012026  012746  005043                                                          MOV #X3A,-(SP)
012032  004137  016422                                                          JSR R1,LPNTB
012036  005301                                                                  .WORD X3
012040  000002                                                                  .WORD PNT.CT
012042                          ENDMSG

012044                          BGNMSG ERR004
012044                                  PNTB X4
012044  004137  016422                                                          JSR R1,LPNTB
012050  005373                                                                  .WORD X4
012052  000000                                                                  .WORD PNT.CT
012054                          ENDMSG

012056                          BGNMSG ERR008
012056                                  PNTB X8,#X8A
012056  012746  005043                                                          MOV #X8A,-(SP)
012062  004137  016422                                                          JSR R1,LPNTB
012066  005564                                                                  .WORD X8
012070  000002                                                                  .WORD PNT.CT
012072                          ENDMSG

012074                          BGNMSG ERR009
012074                                  PNTB X9
012074  004137  016422                                                          JSR R1,LPNTB
012100  005637                                                                  .WORD X9
012102  000000                                                                  .WORD PNT.CT
```

```
 36 012104                              ENDMSG
 37
 38 012106                              BGNMSG ERR010
 39 012106                                      PNTB X10
    012106  004137  016422                                                  JSR R1,LPNTB
    012112  006031                                                          .WORD X10
    012114  000000                                                          .WORD PNT.CT
 40 012116                              ENDMSG
 41
 42 012120                              BGNMSG ERR014
 43 012120                                      PNTB X14,R2
    012120  010246                                                          MOV R2,-(SP)
    012122  004137  016422                                                  JSR R1,LPNTB
    012126  006130                                                          .WORD X14
    012130  000002                                                          .WORD PNT.CT
 44 012132                              ENDMSG
 45
 46 012134                              BGNMSG ERR020
 47 012134                                      PNTB X20
    012134  004137  016422                                                  JSR R1,LPNTB
    012140  006415                                                          .WORD X20
    012142  000000                                                          .WORD PNT.CT
 48 012144                              ENDMSG
 49
 50 012146                              BGNMSG ERR021
 51 012146  010201                              MOV R2,R1
 52 012150  000301                              SWAB R1
 53 012152                                      AND 2,R1
    012152  042701  177775                                                  BIC #↑C<2>,R1
 54 012156  001406                              BEQ ERR21A
 55 012160                                      PNTB X21,R2
    012160  010246                                                          MOV R2,-(SP)
    012162  004137  016422                                                  JSR R1,LPNTB
    012166  006661                                                          .WORD X21
    012170  000002                                                          .WORD PNT.CT
 56 012172  000405                              BR EOFMSG
 57 012174                              ERR21A:
 58 012174                                      PNTB X21A,R2
    012174  010246                                                          MOV R2,-(SP)
    012176  004137  016422                                                  JSR R1,LPNTB
    012202  007011                                                          .WORD X21A
    012204  000002                                                          .WORD PNT.CT
 59 012206                              EOFMSG:
 60 012206                              ENDMSG
 61
 62 012210                              BGNMSG ERR022
 63 012210  042737  100000  020356              BIC #SA.ERR,UDARSD
 64 012216                                      PNTB X22,UDARSD,R2
    012216  010246                                                          MOV R2,-(SP)
    012220  013746  020356                                                  MOV UDARSD,-(SP)
    012224  004137  016422                                                  JSR R1,LPNTB
    012230  007103                                                          .WORD X22
    012232  000004                                                          .WORD PNT.CT
 65 012234                              ENDMSG
 66
 67 012236                              BGNMSG ERR023
 68 012236                                      PNTB X23A,R3,R1
```

```
         012236  010146                                                                      MOV R1,-(SP)
         012240  010346                                                                      MOV R3,-(SP)
         012242  004137  016422                                                              JSR R1,LPNTB
         012246  007236                                                                      .WORD X23A
         012250  000004                                                                      .WORD PNT.CT
      69 012252  005742                            TST -(R2)
      70 012254  005712                   ERR23A:  TST (R2)
      71 012256  001406                            BEQ ERR23B
      72 012260                                    PNTB X23B,R2,(R2)
         012260  011246                                                                      MOV (R2),-(SP)
         012262  010246                                                                      MOV R2,-(SP)
         012264  004137  016422                                                              JSR R1,LPNTB
         012270  007553                                                                      .WORD X23B
         012272  000004                                                                      .WORD PNT.CT
      73 012274  005722                   ERR23B:  TST (R2)+
      74 012276  005303                            DEC R3
      75 012300  001365                            BNE ERR23A
      76 012302                           ERR23C:  PNTB XFRU
         012302  004137  016422                                                              JSR R1,LPNTB
         012306  011532                                                                      .WORD XFRU
         012310  000000                                                                      .WORD PNT.CT
      77 012312                           ENDMSG
      78
      79 012314                           BGNMSG ERR024
      80 012314                                    PNTB X24,R2
         012314  010246                                                                      MOV R2,-(SP)
         012316  004137  016422                                                              JSR R1,LPNTB
         012322  007567                                                                      .WORD X24
         012324  000002                                                                      .WORD PNT.CT
      81 012326                           ENDMSG
      82
      83 012330                           BGNMSG ERR025
      84 012330                                    PNTB X25,R1,R2
         012330  010246                                                                      MOV R2,-(SP)
         012332  010146                                                                      MOV R1,-(SP)
         012334  004137  016422                                                              JSR R1,LPNTB
         012340  007754                                                                      .WORD X25
         012342  000004                                                                      .WORD PNT.CT
      85 012344                           ENDMSG
      86
      87 012346                           BGNMSG ERR030
      88 012346                                    PNTB X30,R1
         012346  010146                                                                      MOV R1,-(SP)
         012350  004137  016422                                                              JSR R1,LPNTB
         012354  010130                                                                      .WORD X30
         012356  000002                                                                      .WORD PNT.CT
      89 012360                           ENDMSG
      90
      91 012362                           BGNMSG ERR031
      92 012362                                    PNTB X31
         012362  004137  016422                                                              JSR R1,LPNTB
         012366  010246                                                                      .WORD X31
         012370  000000                                                                      .WORD PNT.CT
      93 012372                           ENDMSG
      94
      95 012374                           BGNMSG ERR032
      96 012374                                    PNTB X32
```

```
 012374  004137  016422                                          JSR R1,LPNTB
 012400  010305                                                  .WORD X32
 012402  000000                                                  .WORD PNT.CT
 012404  004737  012574             CALL MSGPKT
 012410                     ENDMSG

 012412                     BGNMSG ERR033
 012412  004737  012502             CALL PNTPKT
 012416                     ENDMSG

 012420                     BGNMSG ERR034
 012420  004737  012502             CALL PNTPKT
 012424                     ENDMSG

 012426                     BGNMSG ERR036
 012426                             PNTB X36
 012426  004137  016422                                          JSR R1,LPNTB
 012432  010415                                                  .WORD X36
 012434  000000                                                  .WORD PNT.CT
 012436                     ENDMSG

 012440                     BGNMSG ERR037
 012440                             PNTB X37,R1
 012440  010146                                                  MOV R1,-(SP)
 012442  004137  016422                                          JSR R1,LPNTB
 012446  010541                                                  .WORD X37
 012450  000002                                                  .WORD PNT.CT
 012452                     ENDMSG

 012454                     BGNMSG ERR100
 012454                             PNTB X100,(R4)
 012454  011446                                                  MOV (R4), (SP)
 012456  004137  016422                                          JSR R1,LPNTB
 012462  010661                                                  .WORD X100
 012464  000002                                                  .WORD PNT.CT
 012466                     ENDMSG

 012470                     BGNMSG ERR101
 012470                             PNTB X101
 012470  004137  016422                                          JSR R1,LPNTB
 012474  010742                                                  .WORD X101
 012476  000000                                                  .WORD PNT.CT
 012500                     ENDMSG

 012502                     PNTPKT: PNTB XPKT1
 012502  004137  016422                                          JSR R1,LPNTB
 012506  011144                                                  .WORD XPKT1
 012510  000000                                                  .WORD PNT.CT
 012512  010401                     MOV R4,R1
 012514  062701  000104             ADD #HC.CPK,R1
 012520  010402                     MOV R4,R2
 012522  062702  000020             ADD #HC.MPK,R2
 012526  012703  000014             MOV #12.,R3
 012532                     PNTPKL: PNTB XPKT2,2(R1),(R1),2(R2),(R2)
 012532  011246                                                  MOV (R2),-(SP)
 012534  016246  000002                                          MOV 2(R2),-(SP)
 012540  011146                                                  MOV (R1),-(SP)
```

L5

```
    012542 016146 000002                                                                  MOV 2(R1),-(SP)
    012546 004137 016422                                                                  JSR R1,LPNTB
    012552 011455                                                                         .WORD XPKT2
    012554 000010                                                                         .WORD PNT.CT
131 012556 062701 000004                ADD #4,R1
132 012562 062702 000004                ADD #4,R2
133 012566 005303                       DEC R3
134 012570 001360                       BNE PNTPKL
135 012572 000207                       RETURN
136
137 012574                      MSGPKT: PNTB XMSG1
    012574 004137 016422                                                                  JSR R1,LPNTB
    012600 011043                                                                         .WORD XMSG1
    012602 000000                                                                         .WORD PNT.CT
138 012604 016504 000014                MOV C.RING(R5),R4
139 012610 062704 000430                ADD #HC.BF2,R4
140 012614 012703 000005                MOV #5,R3
141 012620                      MSGPKL: PNTB XMSG2,(R4),2(R4),4(R4),6(R4),8.(R4),10.(R4),12.(R4)
    012620 016446 000014                                                                  MOV 12.(R4),-(SP)
    012624 016446 000012                                                                  MOV 10.(R4),-(SP)
    012630 016446 000010                                                                  MOV 8.(R4),-(SP)
    012634 016446 000006                                                                  MOV 6(R4),-(SP)
    012640 016446 000004                                                                  MOV 4(R4),-(SP)
    012644 016446 000002                                                                  MOV 2(R4),-(SP)
    012650 011446                                                                         MOV (R4),-(SP)
    012652 004137 016422                                                                  JSR R1,LPNTB
    012656 011077                                                                         .WORD XMSG2
    012660 000016                                                                         .WORD PNT.CT
142 012662 062704 000016                ADD #14.,R4
143 012666 005303                       DEC R3
144 012670 001353                       BNE MSGPKL
145 012672 000207                       RETURN
```

```
     1          000001                    SVCINS= 1                                 ; LIST INSTRUCTIONS, SHIFTED RIGHT
     2          000001                    SVCTST= 1                                 ; LIST TEST TAGS, SHIFTED RIGHT
     3          000001                    SVCSUB= 1                                 ; LIST SUBTEST TAGS, SHIFTED RIGHT
     4          000001                    SVCGBL= 1                                 ; LIST GLOBAL TAGS, SHIFTED RIGHT
     5          000001                    SVCTAG= 1                                 ; LIST OTHER TAGS, SHIFTED RIGHT
```

```
                            .SBTTL  GLOBAL SUBROUTINES SECTION

                            ;MEMORY ALLOCATION ERROR
                            ;
                            ;THIS ROUTINE PRINTS A SYSTEM FATAL ERROR AND EXITS THE TEST

012674                      FMERR:  ERRSF 4,,ERR004
012674  104454                                                              TRAP    C$ERSF
012676  000004                                                              .WORD   4
012700  000000                                                              .WORD   0
012702  012044                                                              .WORD   ERR004
012704                              DOCLN                   ;ABORT
012704  104444                                                              TRAP    C$DCLN
```

```
                                  ;ALOCM
                                  ;
                                  ;ALLOCATE A BLOCK OF FREE MEMORY.  REPORT ERROR IF MEMORY EXHAUSTED
                                  ;
                                  ;INPUTS:
                                  ;       R1 - NUMBER OF WORDS TO ALLOCATE
                                  ;       FFREE - FIRST FREE WORD IN MEMORY
                                  ;       FSIZE - SIZE OF FREE MEMORY AVAILABLE IN WORDS
                                  ;OUTPUTS:
                                  ;       R1 - ADDRESS OF FIRST WORD OF ALLOCATED MEMORY
                                  ;       FFREE - NEW FIRST FREE WORD IN MEMORY
                                  ;       FSIZE - SIZE OF FREE MEMORY LEFT AFTER ALLOCATION
                                  ;SYSTEM FATAL ERROR WILL BE REPORTED IF NOT ENOUGH MEMORY AVAILABLE
                                  ;AND ENTIRE PROGRAM WILL BE STOPPED.

 012706                           ALOCM:  PUSH FFREE                      ;SAVE FFREE AT ENTRY
 012706  013746  002140                                                                   MOV FFREE,-(SP)
 012712  160137  002142                   SUB R1,FSIZE                    ;REDUCE SIZE OF FREE MEMORY
 012716  002766                           BLT FMERR                       ;REPORT ERROR IF NOT ENOUGH MEMORY
 012720  060101                           ADD R1,R1                       ;CHANGE WORDS TO BYTES
 012722  060137  002140                   ADD R1,FFREE                    ;CALCULATE NEW START OF FREE MEMORY
 012726                                   POP R1                          ;GET START OF ALLOCATED MEMORY
 012726  012601                                                                           MOV (SP)+,R1
 012730  000207                           RETURN
```

```
                                          ;HCOMM
                                          ;
                                          ;ALLOCATES MEMORY FOR HOST COMM AREA AND PACKET BUFFERS WITH ONE
                                          ;DESCRIPTOR IN EACH RING. TO BE CALLED WHEN INITIALIZING
                                          ;A CONTROLLER WITH SA.MSG=0 AND SA.CMD=0.
                                          ;
                                          ;INPUTS:
                                                  R5 - ADDRESS OF CONTROLLER TABLE
                                          ;
                                          ;OUTPUTS:
                                          ;       CONTROLLER TABLE POINTING TO HOST COMM AREA
                                          ;       R4 - ADDRESS OF HOST COMM AREA
                                          ;

012732  012701  000336                    HCOMM:  MOV #HC.SIZ/2,R1                  ;GET SIZE OF AREA TO ALLOCATE
012736  004737  012706                            CALL ALOCM                        ;ALLOCATE THE MEMORY
012742  010165  000014                            MOV R1,C.RING(R5)                          ;GET ADDRESS OF HOST COMM AREA
                                                                                    ;PLACE IN CONTROLLER TABLE
012746  000207                                    RETURN
```

```
                               ;RESET
                               ; RESET ALL UDA-50S IN THE CONTROLLER TABLES
                               ;
                               ; INPUTS:
                               ;       IPADRS - CONTAINS ALL IP ADDRESSES
                               ; OUTPUTS:
                               ;       NONE
                               ;
012750                         RESET:  PUSH  <R3,R4>
        012750  010346                                                                 MOV R3,-(SP)
        012752  010446                                                                 MOV R4,-(SP)
012754  005037  002172                 CLR     NXMAD
012760                                 SETVEC #4,#NXMI,#PRI07
        012760  012746  000340                                                         MOV     #PRI07,-(SP)
        012764  012746  017332                                                         MOV     #NXMI,-(SP)
        012770  012746  000004                                                         MOV     #4,-(SP)
        012774  012746  000003                                                         MOV     #3,-(SP)
        013000  104437                                                                 TRAP    C$SVEC
        013002  062706  000010                                                         ADD     #10,SP
013006                                 BREAK
        013006  104422                                                                 TRAP    C$BRK
013010  012703  000010                 MOV     #8.,R3          ; R3 = COUNTER OF ENTRIES
013014  012704  003434                 MOV     #IPADRS,R4      ; R4 -> IP ADDRESS
013020  005714                 1$:     TST     (R4)            ; IS THERE AN ENTRY?
013022  001406                         BEQ     2$              ; IF NOT, DONE
013024  005034                         CLR     @(R4)+          ; INIT UDA
013026  005737  002172                 TST     NXMAD           ; WAS THERE AN ERROR?
013032  001010                         BNE     3$              ; IF SO, EXIT
013034  005303                         DEC     R3              ; MAKE SURE WE DO NOT EXTEND OVER AREA
013036  001370                         BNE     1$              ; IF NOT DONE, BRANCH
013040                         2$:     CLRVEC  #4
        013040  012700  000004                                                         MOV     #4,R0
        013044  104436                                                                 TRAP    C$CVEC
013046                                 POP     <R4,R3>
        013046  012604                                                                 MOV (SP)+,R4
        013050  012603                                                                 MOV (SP)+,R3
013052  000207                         RETURN

013054  005744                 3$:     TST     -(R4)           ; R4 -> UDAIP THAT FAILED
013056  010405                         MOV     R4,R5           ; SAVE IN R5 FOR REPORT
013060                                 ERRDF   20.,ERR020
        013060  104455                                                                 TRAP    C$ERDF
        013062  000024                                                                 .WORD   20
        013064  000000                                                                 .WORD   0
        013066  012134                                                                 .WORD   ERR020
013070  005014                         CLR     (R4)            ; DESTROY ENTRY SO NOT TO FALL INTO RESET ERROR LOOP
013072                                 DOCLN
        013072  104444                                                                 TRAP    C$DCLN
```

```
                                      ;RUNDM
                                      ;
                                      ;LOAD AND RUN A DM PROGRAM IN THE CONTROLLERS. RETURN WHEN ALL
                                      ;DM PROGRAMS HAVE TERMINATED.
                                      ;
                                      ;INPUTS:
                                      ;       TSTTAB - POINTER TO FIRST CONTROLLER TABLE
                                      ;       R1 - NUMBER OF CONTROLLERS TO TEST
                                      ;IMPLICIT INPUTS:
                                      ;       DMPROG - POINTER TO START OF DM PROGRAM IN MEMORY
                                      ;OUTPUTS:
                                      ;       Z SET IF NO CONTROLLERS SUCCESSFULLY STARTED
                                      ;ALL REGISTERS ARE USED AND PREVIOUS CONTENTS DESTROYED.

013074  010137  002160                RUNDM:  MOV R1,URUN                     ;SAVE NUMBER OF UNITS TO RUN
013100  005037  002162                        CLR URNING                      ;CLEAR NUMBER OF UNITS RUNNING

                                      ;LOAD DM PROGRAM INTO EACH CONTROLLER

013104  013737  002160  002164                MOV URUN,UCNT                   ;SET COUNTER OF UNITS
013112  013705  002154                        MOV TSTTAB,R5                   ;GET FIRST CONTROLLER TABLE
013116                                LDDM:
013116  005065  000012                        CLR C.FLG(R5)                   ;CLEAR ALL FLAGS
013122  116537  000002  002074                MOVB C.UNIT(R5),L$LUN           ;SEE IF UNIT TO BE TESTED
013130  005765  000002                        TST C.UNIT(R5)
013134  100407                                BMI LDNEXT                      ;IF NOT, DON'T LOAD THIS UNIT
013136                                                ASSUME CT.AVL EQ BIT15
013136  004737  012732                        CALL HCOMM                      ;ALLOCATE SPACE FOR HOST COMM AREA
013142  004737  016554                        CALL LOADDM                     ;LOAD THE DM PROGRAM
013146  001402                                BEQ LDNEXT                      ;IF ERROR, GO TO NEXT CONTROLLER
013150  005237  002162                        INC URNING                      ;IF NO ERROR, COUNT UNIT RUNNING
013154  062705  000052                LDNEXT: ADD #C.SIZE,R5                  ;MOVE TO NEXT CONTROLLER TABLE
013160  005337  002164                        DEC UCNT                        ;CHECK IF MORE CONTROLLERS
013164  001354                                BNE LDDM                        ;LOAD NEXT
013166  005037  002170                        CLR UFREEZ                      ;CLEAR UNIT FREEZE FLAG
013172  012737  177777  003176                MOV #-1,FCTNUM  ;INVALIDATE FCT BLOCK NUMBER (BLOCK IN MEMORY)

                                      ;CHECK IF ANY CONTROLLERS LOADED

013200  005737  002162                        TST URNING                      ;ANY UNITS LOADED?

                                      ;THE DM PROGRAMS ARE NOW IN CONTROL
                                      ;RESPDM MUST BE CALLED TO RESPOND TO THEIR REQUESTS

013204  000207                                RETURN
```

```
                                   ;CLOSEF
                                   ;
                                   ;CLOSE DATA FILE FOR DM PROGRAMS
                                   ;
                                   ;INPUTS:
                                   ;       FILOPN - ZERO IF FILE NOT OPEN
                                   ;OUTPUTS:
                                   ;       NONE

   013206  005737  002166          CLOSEF: TST FILOPN                      ;SEE IF FILE CURRENTLY OPEN
   013212  001403                          BEQ 1$
   013214                                  CLOSE                           ; IF SO, CLOSE IT
   013214  104435                                                                   TRAP    C$CLOS
   013216  005037  002166                  CLR FILOPN                      ;AND MARK AS SO
   013222  000207                  1$:     RETURN
```

```
                                        ;RESPDM
                                        ;
                                        ;RESPOND TO DM REQUESTS. RETURN WHEN ALL DM PROGRAMS
                                        ;HAVE TERMINATED.

013224  013705  002154                  RESPDM: MOV TSTTAB,R5                   ;GET CONTROLLER TABLE ADDRESS
013230  013737  002160  002164                  MOV URUN,UCNT                   ;SET COUNTER OF UNITS
013236                                  RESPCT: BREAK   ;ALLOW DRS TO SEE TERMINAL INPUT
013236  104422                                                                          TRAP    C$BRK
013240  016504  000014                          MOV C.RING(R5),R4               ;GET HOST COMM AREA ADDRESS
013244  032765  000002  000012                  BIT #CT.RN,C.FLG(R5)            ;CHECK IF PROGRAM RUNNING
013252  001502                                  BEQ RSPNXT                      ;IF NOT, LOOK AT NEXT
013254  116537  000002  002074                  MOVB C.UNIT(R5),L$LUN           ;STORE UNIT NUMBER UNDER TEST
013262  032765  000010  000012                  BIT #CT.MSG,C.FLG(R5)           ;SEE IF INTERRUPT RECEIVED
013270  001150                                  BNE RSPIN                       ;IF SO, LOOK AT PACKET
013272  032765  000004  000012                  BIT #CT.CMD,C.FLG(R5)           ;SEE IF COMMAND HAS BEEN SENT
013300  001002                                  BNE 1$                          ;IF NOT, SEND ONE
013302  000137  014050                          JMP RSPOUT

                                        ;CHECK IF UDA STILL RUNNING

013306  011503                          1$:     MOV (R5),R3                     ;GET ADDRESS OF UDAIP
013310  016301  000002                          MOV 2(R3),R1                    ;LOOK AT UDASA REGISTER
013314  001405                                  BEQ RSPTM                       ;IF ZERO, UDA STILL RUNNING
013316                                          ERRDF 30,,ERR030                ;REPORT UDA HAS FATAL ERROR
013316  104455                                                                          TRAP    C$ERDF
013320  000036                                                                          .WORD   30
013322  000000                                                                          .WORD   0
013324  012346                                                                          .WORD   ERR030
013326  000465                                  BR RSPDRP                       ;DROP CONTROLLER FROM TESTING

                                        ;CHECK FOR TIMEOUT OF RESPONSE

013330  005765  000042                  RSPTM:  TST C.TOT(R5)                   ;SEE IF DUP PROGRAM TO BE TIMED
013334  001451                                  BEQ RSPNTO
013336  005737  003206                          TST KW.CSR                      ;SEE IF A CLOCK ON SYSTEM
013342  001446                                  BEQ RSPNTO                      ;DON'T TIME IF NO CLOCK
013344  023765  003220  000040                  CMP KW.EL+2,C.TOH(R5)           ;COMPARE TO TIMEOUT COUNTER
013352  101005                                  BHI RSPTMO
013354  001041                                  BNE RSPNTO
013356  023765  003216  000036                  CMP KW.EL,C.TO(R5)
013364  103435                                  BLO RSPNTO                      ;IF TOO MUCH TIME ELAPSED SINCE LAST INTERRUPT
013366  032765  000040  000012          RSPTMO: BIT #CT.STA,C.FLG(R5)           ;SEE IF A GET DUST STATUS COMMAND OUTSTANDING
013374  001101                                  BNE RSPTOE                      ;REPORT ERROR IF SO
013376  005764  000012                          TST HC.CCT(R4)                  ;SEE IF UDA TOOK LAST COMMAND PACKET
013402  100476                                  BMI RSPTOE                      ;REPORT ERROR IF NOT
013404  012700  000100                          MOV #CT.TM1,R0                  ;SEE IF FIRST TIMEOUT ALREADY HAPPENED
013410  032765  000100  000012                  BIT #CT.TM1,C.FLG(R5)
013416  001401                                  BEQ 1$                          ;IF SO,
013420  006300                                  ASL R0                          ;SET SECOND TIME OUT FLAG
013422  052700  000040                  1$:     BIS #CT.STA,R0                  ;SET THE PROPER TIMEOUT BIT
013426  050065  000012                          BIS R0,C.FLG(R5)                ;  AND STATUS REQUESTED BIT
013432  012700  000001                          MOV #OP.GDS,R0                  ;BUILD GET DUST STATUS COMMAND
013436  004737  016754                          CALL BLDCMD
013442  012764  100000  000012                  MOV #RG.OWN,HC.CCT(R4)          ;MARK COMMAND TO UDA
013450  005775  000000                          TST @(R5)                       ;TELL UDA COMMAND IS THERE
013454  000137  014130                          JMP RSPOU4
```

```
     53 013460                    RSPNTO:
```

```
                                  ;SWITCH TO NEXT CONTROLLER

013460  005737  002170            RSPNXT: TST UFREEZ       ;FROZEN TO ONE UNIT?
013464  001264                            BNE RESPCT       ;STAY THERE IF SO
013466  062705  000052                    ADD #C.SIZE,R5               ;MOVE TO NEXT TABLE
013472  005337  002164                    DEC UCNT                     ;CHECK IF MORE CONTROLLERS
013476  001257                            BNE RESPCT                   ;LOOK AT NEXT CONTROLLER
013500  000651                            BR RESPDM                    ;LOOK AT FIRST CONTROLLER AGAIN

                                  ;REMOVE A CONTROLLER FROM TESTING

013502  005065  000012            RSPDRP: CLR C.FLG(R5)    ;CLEAR PROGRAM RUNNING
013506  005037  002170                    CLR UFREEZ
013512  010504                            MOV R5,R4
013514  062704  000016                    ADD #C.DR0,R4
013520  012702  000010                    MOV #8.,R2
013524  012403                    1$:     MOV (R4)+,R3
013526  001420                            BEQ 3$
013530  005763  000002                    TST D.UNIT(R3)
013534                                            ASSUME DT.AVL EQ BIT15
013534  100003                            BPL 2$
013536  005302                            DEC R2
013540  001371                            BNE 1$
013542  000412                            BR 3$
013544  052763  100000  000002    2$:     BIS #DT.AVL,D.UNIT(R3)
013552  005302                            DEC R2
013554  001405                            BEQ 3$
013556  005714                            TST (R4)
013560  001403                            BEQ 3$
013562  004737  016554                    CALL LOADDM      ;START DM PROGRAM AGAIN
013566  001223                            BNE RESPCT
013570  005337  002162            3$:     DEC URNING                   ;REDUCE RUNNING CONTROLLERS COUNT
013574  001331                            BNE RSPNXT                   ;IF ANY STILL RUNNING, LOOK AT THEM
013576  000207                            RETURN                       ;ELSE RETURN TO TEST SECTION

013600                            RSPTOE: ERRDF 31.,ERR031             ;REPORT TIMEOUT ERROR
013600  104455                                                                     TRAP    C$ERDF
013602  000037                                                                     .WORD   31
013604  000000                                                                     .WORD   0
013606  012362                                                                     .WORD   ERR031
013610  000734                            BR RSPDRP                    ;DROP CONTROLLER FROM TESTING
```

```
                                       ;CONTROLLER HAS RESPONDED, LOOK AT MESSAGE PACKET

                                       ;CHECK FOR PROPER OPCODE IN END PACKET

013612  012700  000204                 RSPIN:  MOV #OP.END+OP.SSD,R0               ;GET SEND DATA END PACKET OPCODE
013616  032765  000020  000012                 BIT #CT.REQ,C.FLG(R5)               ;LOOK IF SEND DATA OR RECEIVE DATA
013624  001402                                 BEQ RSPMWR
013626  012700  000205                         MOV #OP.END+OP.RSD,R0               ;CHANGE TO RECEIVE DATA END PACKET OPCODE
013632  120064  000030                 RSPMWR: CMPB R0,HC.MPK+P.OPCD(R4)           ;COMPARE TO OPCODE IN END PACKET
013636  001145                                 BNE RSPERR

                                       ;LOOK AT STATUS CODE

013640  032764  000037  000032                 BIT #ST.MSK,HC.MPK+P.STS(R4)        ;CHECK FOR STATUS CODE ST.SUC (ZERO)
013646  001004                                 BNE RSPERW

                                       ;CHECK FOR EXPECTED REFERENCE NUMBER

013650  026564  000050  000020                 CMP C.REF(R5),HC.MPK+P.CRF(R4)      ;CHECK IF CORRECT REF NUMBER
013656  001405                                 BEQ RSPPTW
013660                                 RSPERW: ERRDF 33,,ERR033
013660  104455                                                                                          TRAP    C$ERDF
013662  000041                                                                                          .WORD   33
013664  000000                                                                                          .WORD   0
013666  012412                                                                                          .WORD   ERR033
013670  000704                                 BR RSPDRP                           ;DROP UNIT FROM TESTING

                                       ;CHECK IF RESPONSE FROM SEND OR RECEIVE DATA COMMAND

013672  032765  000020  000012         RSPPTW: BIT #CT.REQ,C.FLG(R5)               ;CHECK IF RESPONSE FROM DM PROGRAM
013700  001463                         RSPOU:  BEQ RSPOUT                          ;LOOK AT REQUEST NUMBER IF SO
```

```
                                        ;MAINTENANCE READ END PACKET RECEIVED, LOOK AT REQUEST FROM DM PROGRAM

013702  016401  000430          RSPPT2: MOV HC.BF2(R4),R1               ;GET REQUEST NUMBER
013706  042701  007777                  BIC     #^C<DU.TYP>,R1          ;CHECK TYPE
013712  001403                          BEQ 1$                          ;IF ZERO, ERROR
013714  020127  060000                  CMP R1,#DU.SPC                  ;CHECK IF IN EXPECTED RANGE
013720  101405                          BLOS RSPPT3
013722                          1$:     ERRDF 32,,ERR032                ;BAD REQUEST NUMBER
013722  104455                                                                  TRAP    C$ERDF
013724  000040                                                                  .WORD   32
013726  000000                                                                  .WORD   0
013730  012374                                                                  .WORD   ERR032
013732  000663                          BR RSPDRP                       ;DROP UNIT FROM TESTING

013734  016403  000034          RSPPT3: MOV HC.MPK+P.BCNT(R4),R3        ;GET BYTE COUNT OF CHARACTERS RECEIVED IN R3
013740  162703  000002                  SUB #2,R3                       ;(FIRST TWO CHARACTERS ARE TYPE WORD)
013744  012700  000004                  MOV #OP.SSD,R0                  ;BUILD A SEND DATA COMMAND PACKET
013750  004737  016754                  CALL BLDCMD                     ;  FOR ANSWER TO DM PROGRAM
013754  012700  000164                  MOV #HC.BF1,R0                  ;POINT TO BUFFER IN PACKET
013760  004737  017116                  CALL CLRBUF                     ; AND CLEAR BUFFER
013764  010402                          MOV R4,R2                       ;R2 POINTS TO SEND BUFFER
013766  062704  000244                  ADD #HC.BSZ,R4          ;R4 POINTS TO CHARACTERS IN RECEIVE BUFFER
013772  042724  170000                  BIC #DU.TYP,(R4)+       ;CLEAR TYPE FIELD IN BUFFER
013776  000301                          SWAB R1                         ;GET TYPE RIGHT JUSTIFIED
014000  006201                          ASR R1                          ;TIMES TWO
014002  006201                          ASR R1
014004  006201                          ASR R1
014006  010100                          MOV R1,R0                       ;COPY MESSAGE TYPE TO R0
014010  005001                          CLR R1                          ;R1 CONTAINS ZERO SEND BYTE COUNT
014012  004770  014276                  CALL @RSPDSP-2(R0)              ;CALL REQUESTED ROUTINE
014016  001231                          BNE RSPDRP                      ;ROUTINE RETURNS Z CLEAR TO DROP UNIT FROM TESTING
                                                                        ; Z SET IF UNIT TO CONTINUE RUNNING
014020  016504  000014                  MOV C.RING(R5),R4               ;GET RING ADDRESS
014024  032701  000001                  BIT #1,R1                       ;LOOK AT CHARACTER COUNT TO SEND TO DUP PROGRAM
014030  001401                          BEQ 1$                          ;IF AN ODD COUNT
014032  005201                          INC R1                          ;  INCREASE BY ONE
014034  010164  000120          1$:     MOV R1,HC.CPK+P.BCNT(R4)        ;PUT CHARACTER COUNT IN COMMAND PACKET
014040  100003                          BPL RSPOUT                      ;IF NEGATIVE BYTE COUNT RETURNED
014042  042765  000020  000012          BIC #CT.REQ,C.FLG(R5)           ;  DON'T SEND ANY DATA TO UDA

                                ;SEND COMMAND BACK TO UDA

014050  042765  000350  000012  RSPOUT: BIC #CT.MSG+CT.STA+CT.TM1+CT.TM2,C.FLG(R5)      ;CLEAR MESSAGE RECEIVED FLAG
014056  032765  000020  000012          BIT #CT.REQ,C.FLG(R5)           ;CHECK WHICH COMMAND TO SEND
014064  001014                          BNE RSPOU2                      ;BRANCH IF RESPONSE TO REQUEST

014066  012700  000005                  MOV #OP.RSD,R0                  ;BUILD RECEIVE DATA COMMAND
014072  004737  016754                  CALL BLDCMD
014076  012700  000430                  MOV #HC.BF2,R0                  ;POINT TO MESSAGE BUFFER
014102  004737  017116                  CALL CLRBUF                     ;  AND CLEAR IT
014106  052765  000020  000012          BIS #CT.REQ,C.FLG(R5)           ;SET REQUEST BIT
014114  000403                          BR RSPOU3

014116  042765  000020  000012  RSPOU2: BIC #CT.REQ,C.FLG(R5)           ;CLEAR REQUEST BIT
014124                          RSPOU3:
014124  004737  017040                  CALL SNDCMD                     ;SEND COMMAND TO UDA
014130  016500  000042          RSPOU4: MOV C.TOT(R5),R0                ;SET TIMEOUT
```

```
014134  010501                            MOV R5,R1
014136  062701  000036                    ADD #C.TO,R1                          ;PUT TIME IN CONTROLLER TABLE
014142  004737  017352                    CALL SETTO
014146  000137  013460                    JMP RSPNXT                            ;NOW WAIT FOR END PACKET
014152  122764  000201  000030  RSPERR:  CMPB #OP.END+OP.GDS,HC.MPK+P.OPCD(R4)   ;SEE IF GET DUST STATUS OPCODE
014160  001237                            BNE RSPERW
014162  132764  000010  000037           BITB #DF.ACT,HC.MPK+P.DFLG(R4)        ;IF DUST NO LONGER RUNNING
014170  001603                            BEQ RSPTOE                            ;  REPORT ERROR
014172  042765  000050  000012           BIC #CT.STA+CT.MSG,C.FLG(R5)          ;CLEAR CONTROL BITS
014200  032765  000200  000012           BIT #CT.TM2,C.FLG(R5)                 ;IF AT SECOND TIMEOUT
014206  001413                            BEQ 1$
014210  026465  000040  000044           CMP HC.MPK+P.DPI(R4),C.PRI(R5)        ;COMPARE PROGRESS INDICATOR
014216  001004                            BNE 2$
014220  026465  000042  000046           CMP HC.MPK+P.DPI+2(R4),C.PRI+2(R5)         ;COMPARE PROGRESS INDICATOR
014226  001422                            BEQ 4$                                ;REPORT ERROR IF NOT CHANGED
014230  042765  000200  000012  2$:      BIC #CT.TM2,C.FLG(R5)                 ;CLEAR TIMEOUT 2 FLAG
014236  032765  000100  000012  1$:      BIT #CT.TM1,C.FLG(R5)                 ;IF AT FIRST TIMEOUT
014244  001406                            BEQ 3$
014246  016465  000040  000044           MOV HC.MPK+P.DPI(R4),C.PRI(R5)        ;GET COPY OF PROGRESS INDICATOR
014254  016465  000042  000046           MOV HC.MPK+P.DPI+2(R4),C.PRI+2(R5)         ;GET COPY OF PROGRESS INDICATOR
014262  012764  140000  000006  3$:      MOV #RG.OWN+RG.FLG,HC.MCT(R4)         ;GIVE MESSAGE BUFFER BACK TO UDA
014270  000137  013460                    JMP RSPNXT
014274  000137  013600          4$:      JMP RSPTOE
```

```
                                   ;RESPONSE REQUEST DISPATCH TABLE

  014300  014314                  RSPDSP: .WORD QUEST                 ;QUESTION
  014302  014366                          .WORD DQUEST                ;QUESTION WITH DEFAULT ANSWER
  014304  014540                          .WORD INFO                  ;INFORMATION MESSAGE FOR OPERATOR
  014306  014666                          .WORD TERM                  ;NORMAL TERMINATION
  014310  014676                          .WORD ERRTRM                ;FATAL ERROR TERMINATION
  014312  014706                          .WORD SPECL                 ;SPECIAL
          000006                          DSPSIZ=<.-RSPDSP>/2         ;LEGAL NUMBERS ARE LOWER THAN THIS
```

```
;NORMAL DUP RECEIVE DATA BUFFER DESCRIPTION

;BYTE OFFSET FROM
;START OF BUFFER               +---------------------------------+
;       0                      ! TYPE !     MESSAGE NUMBER       !   USED TO SELECT ROUTINE
;                              +---------------------------------+
;       2                      !           DATA BYTES            !   R4 CONTAINS THIS ADDRESS
;                              +---------------------------------+
;       4                      !           DATA BYTES            !
;                              +---------------------------------+
;       6                      !           DATA BYTES            !
;                              +---------------------------------+
;       8                      !           DATA BYTES            !
;                              +---------------------------------+
;      10                      !           DATA BYTES            !
;                              +---------------------------------+
;      12                      !           DATA BYTES            !
;                              +---------------------------------+
;      14                      !           DATA BYTES            !
;                              +---------------------------------+
;      16                      !           DATA BYTES            !
;                              +---------------------------------+
;      18                      !           DATA BYTES            !
;                              +---------------------------------+
;      20                      !           DATA BYTES            !
;                              +---------------------------------+
;      22                      !           DATA BYTES            !
;                              +---------------------------------+
;
;       .                                   .
;
;       .                                   .
;
;       .                                   .
;
;                              +---------------------------------+
;      80                      !           DATA BYTES            !
;                              +---------------------------------+
                        ;NORMAL DUP SEND DATA BUFFER DESCRIPTION GIVEN IN RESPONSE TO ABOVE PACKET

                        ;BYTE OFFSET FROM
                        ;START OF BUFFER           +-------------------------------+
                        ;     0                    !          DATA BYTES           !  R2 CONTAINS THIS ADDRESS
                        ;                          +-------------------------------+
                        ;     2                    !          DATA BYTES           !
                        ;                          +-------------------------------+
                        ;     4                    !          DATA BYTES           !
                        ;                          +-------------------------------+
                        ;     6                    !          DATA BYTES           !
                        ;                          +-------------------------------+
                        ;     8                    !          DATA BYTES           !
                        ;                          +-------------------------------+
                        ;    10                    !          DATA BYTES           !
                        ;                          +-------------------------------+
                        ;    12                    !          DATA BYTES           !
                        ;                          +-------------------------------+
                        ;    14                    !          DATA BYTES           !
                        ;                          +-------------------------------+
                        ;    16                    !          DATA BYTES           !
                        ;                          +-------------------------------+
                        ;    18                    !          DATA BYTES           !
                        ;                          +-------------------------------+
                        ;    20                    !          DATA BYTES           !
                        ;                          +-------------------------------+
                        ;    22                    !          DATA BYTES           !
                        ;                          +-------------------------------+
                        ;
                        ;     .                               .
                        ;
                        ;     .                               .
                        ;
                        ;     .                               .
                        ;
                        ;                          +-------------------------------+
                        ;    80                    !          DATA BYTES           !
                        ;                          +-------------------------------+
```

C7

```
                                  ;MESSAGE TYPE 1
                                  ;
                                  ;ANSWER QUESTION FOR DUP PROGRAM
                                  ;
                                  ;INPUT:
                                  ;       R5 - ADDRESS OF CONTROLLER TABLE
                                  ;       R4 - POINTER TO DATA IN RECEIVE BUFFER
                                  ;       R3 - CHARACTER COUNT IN RECEIVE BUFFER
                                  ;       R2 - POINTER TO SEND BUFFER (BUFFER IS CLEARED)
                                  ;       R1 - ZERO
                                  ;OUTPUT:
                                  ;       R1 - COUNT OF CHARACTERS IN SEND BUFFER
                                  ;       Z SET TO CONTINUE RUNNING DUP PROGRAM
                                  ;       Z CLEAR TO STOP THE DUP PROGRAM

014314  004737  015040            QUEST:  CALL GTDRVT        ;GET POINTER TO DRIVE TABLE
014320  062700  000004                    ADD #D.SERN,R0     ;BUMP POINTER TO SERIAL NUMBER
014324  014403                            MOV -(R4),R3       ;GET QUESTION NUMBER
014326  001411                            BEQ QUE0           ;BRANCH IF QUESTION NUMBER 0
014330  020327  000007                    CMP R3,#7          ;IF NOT, SEE IF QUESTION NUMBER 7
014334  001410                            BEQ QUE7
014336                                    ERRDF 100,,ERR100          ;ANY OTHER NUMBER IS AN ERROR
014336  104455                                                                                   TRAP     C$ERDF
014340  000144                                                                                   .WORD    100
014342  000000                                                                                   .WORD    0
014344  012454                                                                                   .WORD    ERR100
014346  000244                            CLZ      ;CLEAR Z TO STOP DUP PROGRAM
014350  000207                            RETURN

014352  012700  003304            QUE0.   MOV #DATE0,R0    ;POINT TO DATE STRING
014356                            QUE7:
014356  005201                    QUEL:   INC R1   ;COUNT THE CHARACTERS
014360  112022                            MOVB (R0)+,(R2)+        ; AND PUT THEM IN OUTPUT BUFFER
014362  001375                            BNE QUEL           ;  UNTIL A NUL CHARACTER FOUND
014364  000207                            RETURN   ;RETURN WITH Z SET
```

```
                                ;MESSAGE TYPE 2
                                ;
                                ;ANSWER QUESTION FOR DUP PROGRAM WITH DEFAULT ANSWER
                                ;
                                ;INPUT:
                                ;       R5 - ADDRESS OF CONTROLLER TABLE
                                ;       R4 - POINTER TO DATA IN RECEIVE BUFFER
                                ;       R3 - CHARACTER COUNT IN RECEIVE BUFFER
                                ;       R2 - POINTER TO SEND BUFFER (BUFFER IS CLEARED)
                                ;       R1 - ZERO
                                ;OUTPUT:
                                ;       R1 - COUNT OF CHARACTERS IN SEND BUFFER
                                ;       Z SET TO CONTINUE RUNNING DUP PROGRAM
                                ;       Z CLEAR TO STOP THE DUP PROGRAM

014366  004737  015040          DQUEST: CALL GTDRVT      ;GET DRIVE TABLE ADDRESS INTO R0
014372  014403                          MOV -(R4),R3     ;GET QUESTION NUMBER
014374  020327  000006                  CMP R3,#DQUESZ
014400  101035                          BHI DQUEX
014402  006303                          ASL R3
014404  000173  014410                  JMP @DQUEJP(R3)
014410  014474                  DQUEJP: .WORD DQUEX      ; 0  (NOT USED)
014412  014426                          .WORD DQUNIT     ; 1  ENTER UNIT NUMBER TO FORMAT
014414  014474                          .WORD DQUEX      ; 2  (NOT USED)
014416  014474                          .WORD DQUEX      ; 3  (NOT USED)
014420  014500                          .WORD DQRFMT     ; 4  USE EXISTING BAD SECTOR INFORMATION
014422  014520                          .WORD DQRSTR     ; 5  DOWN-LINE LOAD BAD SECTOR BLOCK INFORMATION
014424  014530                          .WORD DQCONT     ; 6  CONTINUE IF BAD BLOCK INFO INACCESSIBLE
        000006                                  DQUESZ=<<.-DQUEJP>/2>-1

                                ;ENTER UNIT NUMBER TO FORMAT

014426                          DQUNIT: PUSH R5
014426  010546                                                                          MOV R5,-(SP)
014430  005004                          CLR R4
014432  011003                          MOV (R0),R3      ;GET DRIVE NUMBER
014434                                          ASSUME D.DRV EQ 0
014434  012700  000012                  MOV #10.,R0      ;RADIX 10.
014440  004737  016516          DQUNL1: CALL DIVIDE
014444                                  PUSH R5
014444  010546                                                                          MOV R5,-(SP)
014446  005201                          INC R1
014450  005703                          TST R3
014452  001372                          BNE DQUNL1
014454  010100                          MOV R1,R0
014456                          DQUNL2: POP R5
014456  012605                                                                          MOV (SP)+,R5
014460  062705  000060                  ADD #'0,R5
014464  110522                          MOVB R5,(R2)+
014466  005300                          DEC R0
014470  001372                          BNE DQUNL2
014472                                  POP R5
014472  012605                                                                          MOV (SP)+,R5
014474  000264                  DQUEX:  SEZ
014476  000207                          RETURN

014500  032737  000003  003200  DQRFMT: BIT #SO.FMT,MODE
```

```
     54 014506  001410                           BEQ DQNO
     55 014510  112712  000131          DQYES:   MOVB #'Y,(R2)
     56 014514  005201                           INC R1
     57 014516  000766                           BR DQUEX
     58
     59 014520  032737  000010  003200  DQRSTR:  BIT #SO.STR,MODE
     60 014526  001370                           BNE DQYES
     61 014530                          DQCONT:
     62 014530  112712  000116          DQNO:    MOVB #'N,(R2)
     63 014534  005201                           INC R1
     64 014536  000756                           BR DQUEX
```

```
                                        ;MESSAGE TYPE 3
                                        ;
                                        ;PRINT INFORMATION FROM DUP PROGRAM
                                        ;
                                        ;INPUT:
                                        ;       R5 - POINTER TO CONTROLLER TABLE
                                        ;       R4 - POINTER TO DATA IN RECEIVE BUFFER
                                        ;       R3 - CHARACTER COUNT IN RECEIVE BUFFER
                                        ;       R2 - POINTER TO SEND BUFFER (BUFFER IS CLEARED)
                                        ;       R1 - ZERO
                                        ;OUTPUT:
                                        ;       R1 - BIT 15 SET TO PREVENT SENDING DATA TO DUP PROGRAM
                                        ;       Z SET TO CONTINUE RUNNING DUP PROGRAM

014540  016400  177776          INFO:   MOV -2(R4),R0   ;GET MESSAGE NUMBER
014544  001434                          BEQ INFOB       ;IF ZERO, PRINT BEGUN MESSAGE
014546  020027  000100                  CMP R0,#100     ;IF OCTAL 100
014552  001423                          BEQ INFOE       ;  PRINT ERROR MESSAGE
014554  020027  000200                  CMP R0,#200     ;SEE IF 200 OR GREATER
014560  002005                          BGE INFOH       ;  IF SO, PRINT WITHOUT FREEZING
014562  005737  002170                  TST UFREEZ
014566  001007                          BNE INFOP
014570  005237  002170                  INC UFREEZ
014574  004737  015040          INFOH:  CALL GTDRVT
014600  010002                          MOV R0,R2
014602  004737  015064                  CALL HEADER
014606  004737  015004          INFOP:  CALL MESG       ;PRINT THE MESSAGE
014612  012701  100000          INFOX:  MOV #BIT15,R1                   ;RETURN A NEGATIVE BYTE COUNT
014616  000264                          SEZ
014620  000207                          RETURN                          ;RETURN WITH Z SET

014622                          INFOE:  ERRDF 101,,ERP101       ;ANSWER WAS REJECTED BY DUP PROGRAM
014622  104455                                                                          TRAP    C$ERDF
014624  000145                                                                          .WORD   101
014626  000000                                                                          .WORD   0
014630  012470                                                                          .WORD   ERR101
014632  000244                          CLZ     ;RETURN WITH Z CLEAR TO STOP DUP PROGRAM
014634  000207                          RETURN

014636  004737  015040          INFOB:  CALL GTDRVT     ;PRINT FORMAT BEGUN MESSAGE
014642  010002                          MOV R0,R2
014644  004737  015064                  CALL HEADER
014650  004737  015004                  CALL MESG
014654                                  PNT WNSTOP      ;PRINT WARNING NOT TO STOP NOW
014654  004137  016450                                                                  JSR R1,LPNT
014660  004355                                                                          .WORD WNSTOP
014662  000000                                                                          .WORD PNT.CT
014664  000752                          BR INFOX
```

```
                                ;MESSAGE TYPE 4
                                ;
                                ;TERMINATION MESSAGE
                                ;
                                ;INPUT:
                                ;       R5 - POINTER TO CONTROLLER TABLE
                                ;       R4 - POINTER TO DATA IN RECEIVE BUFFER
                                ;       R3 - CHARACTER COUNT IN RECEIVE BUFFER
                                ;       R2 - POINTER TO SEND BUFFER (BUFFER IS CLEARED)
                                ;       R1 - ZERO
                                ;OUTPUT:
                                ;       Z CLEAR TO TERMINATE DUP PROGRAM

014666  004737  014540          TERM:   CALL INFO       ;PRINT THE MESSAGE
014672  000244                          CLZ
014674  000207                          RETURN                          ;RETURN Z CLEAR TO TERMINATE DUP PROGRAM
```

```
                                          ;MESSAGE TYPE 5
                                          ;
                                          ;ERROR TERMINATION MESSAGE
                                          ;
                                          ;INPUT:
                                          ;       R5 - POINTER TO CONTROLLER TABLE
                                          ;       R4 - POINTER TO DATA IN RECEIVE BUFFER
                                          ;       R3 - CHARACTER COUNT IN RECEIVE BUFFER
                                          ;       R2 - POINTER TO SEND BUFFER (BUFFER IS CLEARED)
                                          ;       R1 - ZERO
                                          ;OUTPUT:
                                          ;       Z CLEAR TO TERMINATE DUP PROGRAM

 014676  004737  014540                   ERRTRM: CALL INFO
 014702  000244                                   CLZ
 014704  000207                                   RETURN                       ;RETURN Z CLEAR TO TERMINATE DUP PROGRAM
```

```
                                ;MESSAGE TYPE 6
                                ;
                                ;SPECIAL TYPE - READ FCT BLOCK FROM FILE
                                ;
                                ;INPUT:
                                ;       R5 - POINTER TO CONTROLLER TABLE
                                ;       R4 - POINTER TO DATA IN RECEIVE BUFFER
                                ;       R3 - CHARACTER COUNT IN RECEIVE BUFFER
                                ;       R2 - POINTER TO SEND BUFFER (BUFFER IS CLEARED)
                                ;       R1 - ZERO
                                ;OUTPUT:
                                ;       Z SET TO SEND DATA TO PROGRAM

014706  023714  003176          SPECL:  CMP FCTNUM,(R4) ;SEE IF DESIRED BLOCK IS IN MEMORY
014712  001425                          BEQ SPECLX      ; IF SO, SEND TO DUP PROGRAM
014714  002407                          BLT SPECLR      ; IF LOWER NUMBERED BLOCK IN MEMORY,
                                                        ;   GO READ NEXT BLOCK
014716                          SPECLC:
014716                                  CLOSE   ;OTHERWISE, START READING FROM BEGINNING AGAIN
014716  104435                                                                          TRAP    C$CLOS
014720                                  OPEN #FNAME
014720  012700  003230                                                                  MOV     #FNAME,R0
014724  104434                                                                          TRAP    C$OPEN
014726  012737  177777  003176          MOV #-1,FCTNUM
014734  012703  001000          SPECLR: MOV #512.,R3    ;GET BYTE COUNT IN A BLOCK
014740  012701  002176                  MOV #FCTBUF,R1  ;POINT TO STORAGE AREA
014744                          SPECLL: GETBYTE (R1)+   ;READ THE FILE
014744  104426                                                                          TRAP    C$GETB
014746  110021                                                                          MOVB    R0,(R1)+
014750                                  BNCOMPLETE SPECLE       ;PRINT ERROR IF NO MORE BYTES IN FILE
014750  103005                                                                          BCC     SPECLE
014752  005303                          DEC R3  ;COUNT THE BYTES
014754  001373                          BNE SPECLL
014756  005237  003176                  INC FCTNUM      ;KEEP COUNT OF BLOCK IN MEMORY
014762  000751                          BR SPECL

014764  005212                  SPECLE: INC (R2)        ;TELL DUP PROGRAM DATA NOT AVAILABLE
014766  012762  002176  000002  SPECLX: MOV #FCTBUF,2(R2)       ;PUT ADDRESS OF DATA IN OUTPUT BUFFER
014774  012701  000006                  MOV #6,R1       ;SEND 3 WORDS TO DUP PROGRAM
015000  000264                          SEZ
015002  000207                          RETURN                          ;RETURN WITH Z SET TO SEND DATA TO DUP PROGRAM
```

```
                                ;PRINT A MESSAGE IN THE RECEIVE BUFFER FROM THE DUP PROGRAM
                                ;
                                ;INPUT:
                                ;       R4 - POINTER TO DATA IN RECEIVE BUFFER
                                ;       R3 - CHARACTER COUNT IN RECEIVE BUFFER
                                ;OUTPUT:
                                ;       R4 - POINTER TO CHARACTER AFTER MESSAGE IN RECEIVE BUFFER
                                ;       R3 - ZERO
                                ;       R1 - BIT 15 SET TO PREVENT SENDING DATA TO DUP PROGRAM
                                ;       R0 - CONTENTS DESTROYED
                                ;       Z SET TO CONTINUE RUNNING DUP PROGRAM

015004                          MESG:
015004  112400                  1$:     MOVB (R4)+,R0              ;PRINT CHARACTERS FROM DUP PROGRAM
015006  001405                          BEQ 2$                     ;  DISCARDING LF AND NULL CHARACTERS
015010  020027  000012                  CMP R0,#12
015014  001402                          BEQ 2$
015016                                  PRINT R0
015016  004737  016240                                                               CALL CPNT
015022  005303                  2$:     DEC R3                     ;COUNT THE CHARACTERS
015024  003367                          BGT 1$
015026                                  PRINT #CR
015026  112700  000015                                                               MOVB #CR,R0
015032  004737  016240                                                               CALL CPNT
015036  000207                          RETURN
```

```
                                        ;GTDRVT
                                        ;
                                        ;GET DRIVE TABLE ADDRESS FROM CONTROLLER TABLE
                                        ;
                                        ;INPUTS:
                                        ;       R5 - CONTROLLER TABLE ADDRESS
                                        ;OUTPUTS:
                                        ;       R0 - ADDRESS OF FIRST DRIVE TABLE AVAILABLE FOR TESTING
                                        ;               (WITH DT.AVL BIT CLEAR)

015040                                  GTDRVT: PUSH R5
015040  010546                                                                          MOV R5, (SP)
015042  062705  000016                          ADD #C.DR0,R5
015046  012500                          GTDRVL: MOV (R5)+,R0
015050  016037  000002  002074                  MOV D.UNIT(R0),L$LUN
015056                                                  ASSUME DT.AVL EQ BIT15
015056  100773                                  BMI GTDRVL
015060                                          POP R5
015060  012605                                                                          MOV (SP)+,R5
015062  000207                                  RETURN
```

```
                                           ;HEADER
                                           ;
                                           ;PRINT A HEADER IN FRONT OF EACH MESSAGE FROM DUP PROGRAM.
                                           ;A UDA ADDRESS IS PRINTED IF MORE THAN ONE UDA IS IN HARDWARE P-TABLE.
                                           ;A RUNTIME IS PRINTED IF A CLOCK IS BEING USED TO TIME PROGRAM EXECUTION.
                                           ;
                                           ;INPUT:
                                           ;        R5 - POINTER TO CONTROLLER TABLE
                                           ;OUTPUT:
                                           ;        R0 - POINTER TO DRIVE TABLE
                                           ;        PRINTED MESSAGE

015064  022737  000001  002012  HEADER:  CMP #1,L$UNIT                    ;IF MORE THAN ONE UNIT BEING TESTED
015072  001411                           BEQ 1$
015074                                   PNTF MESSG,D.UNIT(R2),(R5),(R2)          ;PRINT UDA ADDRESS
015074  011246                                                                                 MOV (R2),-(SP)
015076  011546                                                                                 MOV (R5),-(SP)
015100  016246  000002                                                                         MOV D.UNIT(R2),-(SP)
015104  004137  016412                                                                         JSR R1,LPNTF
015110  004035                                                                                 .WORD MESSG
015112  000006                                                                                 .WORD PNT.CT
015114                                           ASSUME C.UADR EQ 0
015114                                           ASSUME D.DRV EQ 0
015114  000407                           BR 2$
015116  005737  003206          1$:      TST KW.CSR                       ;IF NO CLOCK BEING USED
015122  001406                           BEQ 3$                           ;BYPASS RUNTIME MESSAGE
015124                                   PRINT #CR
015124  112700  000015                                                                         MOVB #CR,R0
015130  004737  016240                                                                         CALL CPNT
015134  004737  020402          2$:      CALL RNTIME                      ;PRINT RUNTIME IF A CLOCK IN USE
015140                          3$:      PRINT #CR
015140  112700  000015                                                                         MOVB #CR,R0
015144  004737  016240                                                                         CALL CPNT
015150  000207                           RETURN
```

```
                                        ;OSTRNG
                                        ;
                                        ;FORMAT OF THE ASCIZ STRING IS AS FOLLOWS:
                                        ;
                                        ;CHARACTERS ENCLOSED IN QUOTES ARE TO BE PRINTED AS THEY ARE.
                                        ;
                                        ;OTHERWISE CODE IS A SINGLE LETTER FOLLOWED BY AN OPTIONAL DECIMAL
                                        ;NUMBER:
                                        ;  ON - PRINT OCTAL NUMBER. N REPRESENTS SIZE OF BINARY NUMBER PASSED
                                        ;       IN PARAMETER IN BITS. MAY BE IN RANGE 1 TO 32. IF N>16, TWO PARAMETER
                                        ;       WORDS ARE USED, OTHERWISE ONLY ONE WORD. LEADING ZEROS ARE PRINTED.
                                        ;       N IS ALWAYS SPECIFIED.
                                        ;  DN - PRINT UNSIGNED DECIMAL NUMBER FROM N BIT PARAMETER. LEADING ZEROS
                                        ;       ARE NOT PRINTED. A 16 BIT NUMBER EQUAL TO ZERO WILL PRINT "0".
                                        ;  HN - PRINT HEX NUMBER FROM PARAMETER OF N BITS. IF N>16 TWO PARAMETERS
                                        ;       ARE USED, OTHERWISE ONLY ONE PARAMETER. LEADING ZEROS ARE PRINTED.
                                        ;  SN - PRINT N SPACES. N ASSUMED TO BE 1.
                                        ;  NN - START NEW LINE (CR-LF SEQUENCE). N ASSUMED TO BE 1.
                                        ;  AN - PRINT N ASCII CHARACTERS FROM PARAMETERS, N ASSUMED TO BE 1.
                                        ;       N/2 PARAMETER WORDS USED.
                                        ;  RN - EXECUTE ROUTINE #N. N MUST BE GIVEN AND DEFINED IN HOST PROGRAM.
                                        ;
                                        ;A NULL CHARACTER MEANS END OF MESSAGE. A NULL AS FIRST CHARACTER IN STRING
                                        ;MUST BE IGNORED.
                                        ;
                                        ;OUTPUT A MESSAGE ACCORDING TO A FORMAT STRING
                                        ;
                                        ;INPUTS:
                                        ;       R2 - ADDRESS OF START OF FORMAT STRING
                                        ;       R4 - ADDRESS OF PARAMETERS
                                        ;OUTPUTS:
                                        ;       R2 AND R4 UPDATED TO END OF STRING AND PARAMETERS

015152  112201                          OSTRNG: MOVB (R2)+,R1                ;GET CONTROL CHARACTER
015154  001421                                  BEQ OSTRE                    ;EXIT IF NULL CHARACTER
015156  012700  015452                          MOV #ERRC,R0                 ;GET POINTER TO CHARACTER TABLE
015162  120110                          NCONS:  CMPB R1,(R0)                 ;COMPARE CHARACTER WITH TABLE ENTRY
015164  001407                                  BEQ NCONF                    ;BRANCH IF MATCH FOUND
015166  105720                                  TSTB (R0)+                   ;INCREMENT POINTER
015170  001374                                  BNE NCONS                    ;CONTINUE SEARCH IF NOT END OF TABLE
015172                                          PNTF ERRME1                  ;REPORT BAD CONTROL CHARACTER
015172  004137  016412                                                                  JSR R1,LPNTF
015176  003746                                                                          .WORD ERRME1
015200  000000                                                                          .WORD PNT.CT
015202  000406                                  BR OSTRE
015204  162700  015452                  NCONF:  SUB #ERRC,R0                 ;GET INCREMENT INTO TABLE
015210  006300                                  ASL R0                       ;DOUBLE TO WORD COUNT
015212  004770  015464                          CALL @ERRD(R0)               ;DISPATCH TO PRINT ROUTINE
015216  000755                                  BR OSTRNG                    ;GET NEXT
015220  000207                          OSTRE:  RETURN
```

```
                                     ;CONTROL CHARACTER WAS A QUOTE. PRINT ALL CHARACTERS TO THE NEXT QUOTE.

015222  112200                       CON.QU: MOVB (R2)+,R0                   ;GET CHARACTER
015224  120027  000042                       CMPB R0,#'"                     ;CHECK IF ENDING QUOTE
015230  001403                               BEQ CON.QX                      ;IF SO, GO GET NEXT CONTROL CHARACTER
015232                                       PRINT R0                        ;PRINT THE CHARACTER
015232  004737  016240                                                                               CALL CPNT
015236  000771                               BR CON.QU                       ;CONTINUE PRINTING
015240  000207                       CON.QX: RETURN

                                     ;CONTROL CHARACTER WAS AN A. PRINT ASCII CHARACTERS FROM PARAMETERS.

015242  004737  015720               CON.A:  CALL GETCNT                     ;GET COUNT OF CHARACTERS
015246                               CON.A1: PRINT (R4)+                     ;PRINT THE CHARACTER
015246  112400                                                                                       MOVB (R4)+,R0
015250  004737  016240                                                                               CALL CPNT
015254  005301                               DEC R1                          ;COUNT THE CHARACTERS
015256  001373                               BNE CON.A1                      ;PRINT UNTIL COUNT REACHES ZERO
015260  032704  000001                       BIT #1,R4                       ;CHECK IF R4 NOW ODD
015264  001401                               BEQ CON.A2
015266  005204                               INC R4                          ;IF SO, INCREMENT TO NEXT EVEN ADDRESS
015270  000207                       CON.A2: RETURN                          ;NOW GET NEXT CONTROL CHARACTER

                                     ;CONTROL CHARACTER WAS A D. PRINT DECIMAL NUMBER.

015272  012701  000012               CON.D:  MOV #10.,R1                     ;LOAD RADIX
015276  004737  015776                       CALL PNTNUM                     ;PRINT NUMBER
015302  000207                               RETURN                          ;NOW GET NEXT CONTROL CHARACTER

                                     ;CONTROL CHARACTER WAS AN H. PRINT HEX NUMBER.

015304  012701  000020               CON.H:  MOV #16.,R1                     ;LOAD RADIX
015310  004737  015776                       CALL PNTNUM                     ;PRINT NUMBER
015314  000207                               RETURN                          ;NOW GET NEXT CONTROL CHARACTER
```

```
                                ;CONTROL CHARACTER WAS AN O. PRINT OCTAL NUMBER.

015316  012701  000010          CON.O:  MOV #8.,R1                      ;LOAD RADIX
015322  004737  015776                  CALL PNTNUM                     ;PRINT NUMBER
015326  000207                          RETURN                          ;NOW GET NEXT CONTROL CHARACTER

                                ;CONTROL CHARACTER WAS AN N. PRINT NEW LINE SEQUENCE.

015330  004737  015720          CON.N:  CALL GETCNT                     ;GET COUNT
015334                          CON.N1: PRINT #CR                       ;PRINT NEW LINE SEQUENCE
015334  112700  000015                                                                          MOVB #CR,R0
015340  004737  016240                                                                          CALL CPNT
015344  005301                          DEC R1                          ;COUNT THE SEQUENCES
015346  001372                          BNE CON.N1
015350  000207                          RETURN                          ;NOW GET NEXT CONTROL CHARACTER

                                ;CONTROL CHARACTER WAS AN R. CALL A PRE-PROGRAMMED ROUTINE.

015352  004737  015720          CON.R:  CALL GETCNT                     ;GET ROUTINE NUMBER
015356  020127  000010                  CMP R1,#ERRRSZ                  ;CHECK IF DEFINED ROUTINE NUMBER
015362  101004                          BHI CON.R1
015364  060101                          ADD R1,R1                       ;DOUBLE COUNT TO GET WORD INDEX
015366  004771  015430                  CALL @ERRRTB-2(R1)              ;CALL ROUTINE
015372  000207                          RETURN                          ;NOW GET NEXT CONTROL CHARACTER
015374                          CON.R1: PNTF ERRME1                     ;REPORT BAD MESSAGE STRING
015374  004137  016412                                                                          JSR R1,LPNTF
015400  003746                                                                                  .WORD ERRME1
015402  000000                                                                                  .WORD PNT.CT
015404                                  POP R1                          ;FIX THE STACK
015404  012601                                                                                  MOV (SP)+,R1
015406  000207                          RETURN

                                ;CONTROL CHARACTER WAS AN S. PRINT SPACES.

015410  004737  015720          CON.S:  CALL GETCNT                     ;GET COUNT
015414                          CON.S1: PRINT <#' >                     ;PRINT A SPACE
015414  112700  000040                                                                          MOVB #' ,R0
015420  004737  016240                                                                          CALL CPNT
015424  005301                          DEC R1                          ;COUNT THE SPACES
015426  001372                          BNE CON.S1
015430  000207                          RETURN                          ;NOW GET NEXT CONTROL CHARACTER
```

```
                                  ;ERROR ROUTINE DISPATCH TABLE

 015432  015504                   ERRRTB: .WORD CALRF                   ;NOT USED
 015434  015504                           .WORD CALRE                   ;NOT USED
 015436  015504                           .WORD CALRE                   ;NOT USED
 015440  015516                            WORD CALR4                   ;PRINT BASIC LINE WITHOUT UDA ADDRESS
 015442  015572                           .WORD CALR5                   ;PRINT BASIC LINE WITH UDA ADDRESS
 015444  015650                           .WORD CALR6                   ;CALL ALTERNATE PRINT STRING IN PDP-11 MEMORY
 015446  015664                           .WORD CALR7                   ;PRINT  "REPLACE PROCESSOR MODULE'
 015450  015702                           .WORD CALR8                   ;PRINT  "  UDASA CONTAINS  XXXXXX'
         000010                           ERRRSZ=<.-ERRRTB>/2

                                  ;BUILD TWO TABLES
                                  ;       FIRST CONTAINING CONTROL CHARACTERS
                                  ;       SECOND CONTAINING ROUTINE ADDRESSES

                                  .MACRO BUILD
                                          ENTRY ".CON.QU
                                          ENTRY A,CON.A
                                          ENTRY D,CON.D
                                          ENTRY H,CON.H
                                          ENTRY O,CON.O
                                          ENTRY N,CON.N
                                          ENTRY R,CON.R
                                          ENTRY S,CON.S
                                  .ENDM
```

```
                                        ;HERE IS FIRST TABLE

                                        .MACRO ENTRY ARG1,ARG2
                                                .LIST
                                                .BYTE ''ARG1
                                                .NLIST
                                        .ENDM

  015452                                ERRC:   BUILD
  015452        042                             .BYTE '"
  015453        101                             .BYTE 'A
  015454        104                             .BYTE 'D
  015455        110                             .BYTE 'H
  015456        117                             .BYTE 'O
  015457        116                             .BYTE 'N
  015460        122                             .BYTE 'R
  015461        123                             .BYTE 'S
  015462        000                             .BYTE 0                 ;FOLLOW WITH A NULL BYTE
                                                .EVEN

                                        ;HERE IS SECOND TABLE

                                        .MACRO ENTRY ARG1,ARG2
                                                .LIST
                                                .WORD ARG2
                                                .NLIST
                                        .ENDM

  015464                                ERRD:   BUILD
  015464  015222                                .WORD CON.QU
  015466  015242                                .WORD CON.A
  015470  015272                                .WORD CON.D
  015472  015304                                .WORD CON.H
  015474  015316                                .WORD CON.O
  015476  015330                                .WORD CON.N
  015500  015352                                .WORD CON.R
  015502  015410                                .WORD CON.S
```

```
                                 ;PRE-PROGRAMMED ROUTINES 1, 2 AND 3
                                 ;NOT USED - PRINTS ERROR MESSAGE

 015504                          CALRE:  PNTF ERRME1                 ;PRINT ERROR MESSAGE
 015504  004137  016412                                                                     JSR R1,LPNTF
 015510  003746                                                                             .WORD ERRME1
 015512  000000                                                                             .WORD PNT.CT
 015514  000207                          RETURN
```

```
                                        ;PRE-PROGRAMMED ROUTINE 4
                                        ;PRINT BASIC LINE FOR HOST PROGRAM ERROR WITHOUT UDA ADDRESS
                                        ;THEN SWITCH TO EXTENDED FORMAT

  015516                                CALR4:  PNTB BASLN,#BASNO,#BAS,#BAS,#BAS
  015516  012746  004247                                                                        MOV #BAS,-(SP)
  015522  012746  004247                                                                        MOV #BAS,-(SP)
  015526  012746  004247                                                                        MOV #BAS,-(SP)
  015532  012746  004165                                                                        MOV #BASNO,-(SP)
  015536  004137  016422                                                                        JSR R1,LPNTB
  015542  004250                                                                                .WORD BASLN
  015544  000010                                                                                .WORD PNT.CT
  015546  004737  020402                        CALL RNTIME
  015552                                        PRINT #CR
  015552  112700  000015                                                                        MOVB #CR,R0
  015556  004737  016240                                                                        CALL CPNT
  015562  012737  016340  003222                MOV #PX,PTYPE
  015570  000207                                RETURN
```

```
 1                                           ;PRE-PROGRAMMED ROUTINE 5
 2                                           ;PRINT BASIC LINE FOR HOST PROGRAM ERROR WITH UDA ADDRESS
 3                                           ;THEN SWITCH TO EXTENDED FORMAT
 4
 5 015572                                    CALR5:  PNTB BASLN,#BASNO,#BASL2,(R5),#BAS,#BAS
   015572  012746  004247                                                                         MOV #BAS,-(SP)
   015576  012746  004247                                                                         MOV #BAS,-(SP)
   015602  011546                                                                                 MOV (R5),-(SP)
   015604  012746  004204                                                                         MOV #BASL2,-(SP)
   015610  012746  004165                                                                         MOV #BASNO,-(SP)
   015614  004137  016422                                                                         JSR R1,LPNTB
   015620  004250                                                                                 .WORD BASLN
   015622  000012                                                                                 .WORD PNT.CT
 6 015624  004737  020402                            CALL RNTIME
 7 015630                                            PRINT #CR
   015630  112700  000015                                                                         MOVB #CR,R0
   015634  004737  016240                                                                         CALL CPNT
 8 015640  012737  016340  003222                    MOV #PX,PTYPE
 9 015646  000207                                    RETURN
```

```
                                        ;PRE-PROGRAMMED ROUTINE 6
                                        ;CALL ALTERNATE PRINT ROUTINE IN PDP 11 MEMORY

  015650                                CALR6:  PUSH R2                         ;SAVE CURRENT STRING POINTER
                                                                                        MOV R2, (SP)
  015650  010246
  015652  012402                                MOV (R4)+,R2                    ;GET NEW STRING POINTER
  015654  004737  015152                        CALL OSTRNG                     ;OUTPUT USING THIS STRING
  015660                                        POP R2                          ;GET OLD POINTER BACK
                                                                                        MOV (SP)+,R2
  015660  012602
  015662  000207                                RETURN                          ;NOW CONTINUE THE OLD STRING
```

```
                                 ;PRE-PROGRAMMED ROUTINE 7
                                 ;PRINT "REPLACE PROCESSOR MODULE"

  015664                         CALR7:  PUSH R2
  015664  010246                                                              MOV R2,-(SP)
  015666  012702  011532                 MOV #XFRU,R2
  015672  004737  015152                 CALL OSTRNG
  015676                                 POP R2
  015676  012602                                                              MOV (SP)+,R2
  015700  000207                         RETURN
```

```
                                     ;PRE-PROGRAMMED ROUTINE 8
                                     ;PRINT  "  UDASA CONTAINS  XXXXXX"

  015702                             CALR8:  PUSH R2
  015702  010246                                                                      MOV R2, (SP)
  015704  012702  011504                     MOV #XSA,R2
  015710  004737  015152                     CALL OSTRNG
  015714                                     POP R2
  015714  012602                                                                      MOV (SP)+,R2
  015716  000207                             RETURN
  1                                        ;GETCNT
  2                                        ;
  3                                        ;GET COUNT IN NEXT CHARACTERS OF STRING POINTED TO BY R2.
  4                                        ;NUMBER WILL BE IN DECIMAL. IF NO NUMBER, RETURN A
  5                                        ;DEFAULT OF 1.
  6                                        ;
  7                                        ;INPUTS:
  8                                        ;       R2 - POINTER TO ASCII STRING
  9                                        ;OUTPUTS:
 10                                        ;       R1 - NUMBER READ OR A ONE
 11                                        ;       R2 - POINTING TO CHARACTER AFTER NUMBER
 12
 13 015720                                 GETCNT: PUSH R0
    015720  010046                                                                         MOV R0,-(SP)
 14 015722  005001                                 CLR R1                          ;START WITH ZERO COUNT
 15 015724  121227  000060                 GETCNX: CMPB (R2),#'0                   ;CHECK IF CHARACTER A DIGIT
 16 015730  103415                                 BLO GETCDN                      ;BRANCH IF LOWER THAN ZERO
 17 015732  121227  000071                         CMPB (R2),#'9
 18 015736  101012                                 BHI GETCDN                      ;BRANCH IF HIGHER THAN NINE
 19 015740  006301                                 ASL R1                          ;MULTIPLY NUMBER BY 10
 20 015742  010100                                 MOV R1,R0                       ; SAVE 2N
 21 015744  006301                                 ASL R1                          ; COMPUTE 4N
 22 015746  006301                                 ASL R1                          ; COMPUTE 8N
 23 015750  060001                                 ADD R0,R1                       ; 8N + 2N = 10N
 24 015752  112200                                 MOVB (R2)+,R0                   ;GET DIGIT FROM STING
 25 015754  162700  000060                         SUB #'0,R0                      ;GET RID OF ASCII
 26 015760  060001                                 ADD R0,R1                       ;ADD TO NUMBER
 27 015762  000760                                 BR GETCNX                       ;GO TO NEXT CHARACTER
 28 015764  005701                         GETCDN: TST R1                          ;CHECK IF NUMBER IS ZERO
 29 015766  001001                                 BNE GETCXX                      ;IF ZERO, CHANGE
 30 015770  005201                                 INC R1                          ; TO DEFAULT OF ONE
 31 015772                                 GETCXX: POP R0
    015772  012600                                                                         MOV (SP)+,R0
 32 015774  000207                                 RETURN
```

```
                                ;PNTNUM
                                ;
                                ;PRINT A NUMBER
                                ;
                                ;INPUTS:
                                ;       R1 - RADIX OF NUMBER
                                ;       R2 - ASCII STRING TO COUNT OF BITS IN NUMBER
                                ;       R4 - POINTER TO NUMBER (LOW WORD)
                                ;OUTPUTS:
                                        NUMBER IS PRINTED. LEADING ZEROS ARE PRINTED EXCEPT FOR
                                ;               DECIMAL NUMBERS.
                                ;       R0 - CONTENTS DESTROYED

015776  010100                  PNTNUM: MOV R1,R0                       ;SAVE RADIX
016000  004737  015720                  CALL GETCNT                     ;GET COUNT OF BITS
016004                          PNTNUS: PUSH <R2,R3,R5>
016004  010246                                                                          MOV R2,-(SP)
016006  010346                                                                          MOV R3,-(SP)
016010  010546                                                                          MOV R5,-(SP)
016012  012403                          MOV (R4)+,R3                    ;GET ONE PARAMETER WORD
016014  005005                          CLR R5                          ;CLEAR STORAGE FOR OTHER
016016  020127  000020                  CMP R1,#16.                     ;MORE THAN 16 BITS IN NUMBER?
016022  003401                          BLE 1$
016024  012405                          MOV (R4)+,R5                    ;YES, GET SECOND PARAMETER WORD
016026                          1$:     PUSH R4
016026  010446                                                                          MOV R4,-(SP)
016030  010504                          MOV R5,R4                       ;PUT HIGH WORD IN R4
016032  012702  000020                  MOV #16.,R2                     ;COMPUTE BITS NOT WANTED
016036  160102                          SUB R1,R2                       ;BY SUBTRACTING BITS TO USE
016040  002002                          BGE 2$                          ;FROM 16.
016042  062702  000020                  ADD #16.,R2                     ;IF NEGATIVE, ADD 16 FOR FIRST WORD
016046  001414                  2$:     BEQ 6$                          ;IF ZERO, NO BITS NEED BE CLEARED
016050  012705  100000                  MOV #BIT15,R5                   ;START MASK WITH SIGN BIT SET
016054  005302                  3$:     DEC R2                          ;COUNT BITS IN MASK
016056  001402                          BEQ 4$
016060  006205                          ASR R5                          ;SHIFT MORE BITS TO RIGHT
016062  000774                          BR 3$
016064  020127  000020          4$:     CMP R1,#16.                     ;MORE THAN 16 BITS IN NUMBER?
016070  003402                          BLE 5$
016072  040504                          BIC R5,R4                       ;YES, CLEAR IN HIGH WORD
016074  000401                          BR 6$
016076  040503                  5$:     BIC R5,R3                       ;NO, CLEAR IN LOW WORD
016100  004737  016516          6$:     CALL DIVIDE                     ;DIVIDE BY RADIX IN R0
016104                                  PUSH R5                         ;PUSH REMAINDER ON STACK
016104  010546                                                                          MOV R5, (SP)
016106  005202                          INC R2                          ;COUNT DIGITS ON STACK
016110  005703                          TST R3                          ;CHECK IF QUOTIENT IS ZERO
016112  001372                          BNE 6$
016114  005704                          TST R4
016116  001370                          BNE 6$
```

```
016120  020027  000012          CMP R0,#10.             ;IF RADIX IS DECIMAL
016124  001423                  BEQ 10$                 ; JUST GO PRINT DIGITS ON STACK
016126  010103                  MOV R1,R3               ;OTHERWISE COMPUTE NUMBER OF LEADING ZEROS
016130  162700  000014          SUB #12.,R0             ;DIVIDEND IS BITS IN NUMBER
016134  003002                  BGT 7$                  ;DIVISOR IS BITS PER DIGIT PRINTED
016136  012700  000003          MOV #3,R0               ;   (3 OR 4)
016142  004737  016516  7$:     CALL DIVIDE
016146  005705                  TST R5                  ;IF REMAINDER NOT ZERO
016150  001401                  BEQ 8$                  ;INCREMENT QUOTIENT
016152  005203                  INC R3
016154  160203          8$:     SUB R2,R3               ;SUBTRACT DIGITS ON STACK
016156  001406                  BEQ 10$                 ;NO LEADING ZEROS IF ZERO
016160                  9$:     PRINT #'0               ;PRINT A ZERO
016160  112700  000060                                                          MOVB #'0,R0
016164  004737  016240                                                          CALL CPNT
016170  005303                  DEC R3
016172  001372                  BNE 9$                  ;REPEAT UNTIL COUNT REACHES ZERO

016174                  10$:    POP R5                  ;GET CHACACTER FROM STACK
016174  012605                                                                  MOV (SP)+,R5
016176  062705  000060          ADD #'0,R5              ;CNVERT TO ASCII DIGIT
016202  020527  000071          CMP R5,#'9              ;IF GREATER THAN A 9
016206  003402                  BLE 11$                 ; CONVERT TO A OR HIGHER
016210  062705  000007          ADD #<'A-'9-1>,R5       ; FOR HEX DIGIT
016214                  11$:    PRINT R5                ;PRINT THE CHARACTER
016214  110500                                                                  MOVB R5,R0
016216  004737  016240                                                          CALL CPNT
016222  005302                  DEC R2                  ;REPEAT FOR ALL DIGITS
016224  001363                  BNE 10$                 ; ON STACK
016226                          POP <R4,R5,R3,R2>
016226  012604                                                                  MOV (SP)+,R4
016230  012605                                                                  MOV (SP)+,R5
016232  012603                                                                  MOV (SP)+,R3
016234  012602                                                                  MOV (SP)+,R2
016236  000207                  RETURN
```

```
                                         ;PRINT ONE CHARACTER
                                         ;
                                         ;CALL WITH MACRO PRINT

016240  110037  003224          CPNT:    MOVB R0,ERRCHR
016244                                   PUSH R1
016244  010146                                                                   MOV R1, (SP)
016246  012701  003704                   MOV #ERRONE,R1
016252  120027  000015                   CMPB R0,#CR
016256  001002                           BNE 1$
016260  012701  003707                   MOV #ERRNL,R1
016264  000177  164732          1$:      JMP @#TYPE
016270                          PF:      PRINTF R1,#ERRCHR
016270  012746  003224                                                           MOV     #ERRCHR, (SP)
016274  010146                                                                   MOV     R1,-(SP)
016276  012746  000002                                                           MOV     #2,-(SP)
016302  010600                                                                   MOV     SP,R0
016304  104417                                                                   TRAP    C$PNTF
016306  062706  000006                                                           ADD     #6,SP
016312  000435                           BR CPNTX
016314                          PB:      PRINTB R1,#ERRCHR
016314  012746  003224                                                           MOV     #ERRCHR,-(SP)
016320  010146                                                                   MOV     R1,-(SP)
016322  012746  000002                                                           MOV     #2,-(SP)
016326  010600                                                                   MOV     SP,R0
016330  104414                                                                   TRAP    C$PNTB
016332  062706  000006                                                           ADD     #6,SP
016336  000423                           BR CPNTX
016340                          PX:      PRINTX R1,#ERRCHR
016340  012746  003224                                                           MOV     #ERRCHR,-(SP)
016344  010146                                                                   MOV     R1,-(SP)
016346  012746  000002                                                           MOV     #2,-(SP)
016352  010600                                                                   MOV     SP,R0
016354  104415                                                                   TRAP    C$PNTX
016356  062706  000006                                                           ADD     #6,SP
016362  000411                           BR CPNTX
016364                          PS:      PRINTS R1,#ERRCHR
016364  012746  003224                                                           MOV     #ERRCHR,-(SP)
016370  010146                                                                   MOV     R1,-(SP)
016372  012746  000002                                                           MOV     #2,-(SP)
016376  010600                                                                   MOV     SP,R0
016400  104416                                                                   TRAP    C$PNTS
016402  062706  000006                                                           ADD     #6,SP
016406                          CPNTX:   POP R1
016406  012601                                                                   MOV (SP)+,R1
016410  000207                           RETURN
```

```
                                        ;PRINT FORMATTED MESSAGE
                                        ;
                                        ;CALL WITH MACRO PNT, PNTF, PNTB, PNTX, OR PNTS

016412  012737  016270  003222  LPNTF:  MOV #PF,PTYPE
016420  000413                          BR LPNT
016422  012737  016314  003222  LPNTB:  MOV #PB,PTYPE
016430  000407                          BR LPNT
016432  012737  016340  003222  LPNTX:  MOV #PX,PTYPE
016440  000403                          BR LPNT
016442  012737  016364  003222  LPNTS:  MOV #PS,PTYFE
016450                          LPNT:   PUSH <R2,R3,R4,R5>
016450  010246                                                                          MOV R2,-(SP)
016452  010346                                                                          MOV R3,-(SP)
016454  010446                                                                          MOV R4,-(SP)
016456  010546                                                                          MOV R5,-(SP)
016460  012102                          MOV (R1)+,R2                ;GET ADDRESS OF STRING
016462  010604                          MOV SP,R4                   ;COMPUTE ADDRESS OF ARGUMENTS
016464  062704  000012                  ADD #10.,R4                 ;  WHICH ARE NOW ON STACK (IF ANY)
016470                                  PUSH R1                     ;SAVE RETURN ADDRESS
016470  010146                                                                          MOV R1,-(SP)
016472  004737  015152                  CALL OSTRNG                 ;PRINT THE FORMATTED MESSAGE
016476                                  POP <R0,R5,R4,R3,R2,R1>     ;RESTORE ALL REGISTERS
016476  012600                                                                          MOV (SP)+,R0
016500  012605                                                                          MOV (SP)+,R5
016502  012604                                                                          MOV (SP)+,R4
016504  012603                                                                          MOV (SP)+,R3
016506  012602                                                                          MOV (SP)+,R2
016510  012601                                                                          MOV (SP)+,R1
016512  062006                          ADD (R0)+,SP                ;ADJUST STACK POINTER OVER ARGUMENTS
016514  000110                          JMP @R0                     ;RETURN
```

```
                                   ;DIVIDE
                                   ;
                                   ;DIVIDE A 32 BIT UNSIGNED NUMBER BY A 16 BIT UNSIGNED NUMBER
                                   ;REPLACE DIVIDEND WITH QUOTIENT AND RETURN REMAINDER.
                                   ;WILL NOT CHECK FOR DIVIDE BY ZERO.
                                   ;
                                   ;INPUTS:
                                   ;       R3 - LOW 16 BITS OF DIVIDEND
                                   ;       R4 - HIGH 16 BITS OF DIVIDEND
                                   ;       R0 - DIVISOR
                                   ;OUTPUTS:
                                   ;       R3 - LOW 16 BITS OF QUOTIENT
                                   ;       R4 - HIGH 16 BITS OF QUOTIENT
                                   ;       R5 - REMAINDER

 016516                            DIVIDE: PUSH R2
 016516  010246                                                                    MOV R2,-(SP)
 016520  012702  000040                    MOV #32.,R2                   ;SET UP SHIFT COUNT
 016524  005005                            CLR R5                        ;START WITH ZERO REMAINDER
 016526  006303                    1$:     ASL R3                        ;SHIFT LEFT INTO R5
 016530  006104                            ROL R4
 016532  006105                            ROL R5
 016534  020005                            CMP R0,R5                     ;WILL DIVISOR GO INTO REMAINDER
 016536  101002                            BHI 2$                        ;ONLY SUBTRACT IF IT WILL
 016540  160005                            SUB R0,R5                     ;SUBTRACT DIVISOR
 016542  005203                            INC R3                        ;PUT A ONE INTO QUOTIENT
 016544  005302                    2$:     DEC R2                        ;COUNT THE SHIFTS
 016546  001367                            BNE 1$
 016550                                    POP R2
 016550  012602                                                                    MOV (SP)+,R2
 016552  000207                            RETURN
```

```
                                        ;LOADDM
                                        ;
                                        ;LOAD AND START A DM PROGRAM INTO A CONTROLLER
                                        ;
                                        ;INPUTS:
                                        ;       R5 - CONTROLLER TABLE ADDRESS
                                        ;       DMPROG - POINTER TO START OF DM PROGRAM IN MEMORY
                                        ;OUTPUTS:
                                        ;       IF LOAD SUCCEEDS - Z CLEAR
                                        ;                       CONTROLLER TABLE MARKED LOADED
                                        ;       IF ERROR - Z SET

016554  013701  002156                  LOADDM: MOV DMPROG,R1                   ;GET STORAGE ADDRESS OF DM PROGRAM
016560  116165  000021  000042                  MOVB DMTMO(R1),C.TOT(R5)        ;GET TIMEOUT VALUE
016566  105065  000043                          CLRB C.TOT+1(R5)
016572  016504  000004                          MOV C.VEC(R5),R4                ;GET VECTOR OF UDA
016576                                          AND CT.VEC,R4
016576  042704  177000                                                                          BIC #↑C<CT.VEC>,R4
016602  010501                                  MOV R5,R1                       ;GET INTERRUPT SERVICE LINK
016604  062701  000006                          ADD #C.JSR,R1
016610                                          SETVEC R4,R1,#PRI07             ;SET UP INTERRUPT VECTOR
016610  012746  000340                                                                          MOV     #PRI07,(SP)
016614  010146                                                                                  MOV     R1,-(SP)
016616  010446                                                                                  MOV     R4,-(SP)
016620  012746  000003                                                                          MOV     #3,(SP)
016624  104437                                                                                  TRAP    C$SVEC
016626  062706  000010                                                                          ADD     #10,SP
                                                                                ;INITIALIZE UDA WITH SMALLEST
016632  004737  017434                          CALL UDAINT                     ; RING BUFFER AND INTERRUPTS ENABLED
016636  001444                                  BEQ LOADER                      ;BRANCH IF AN ERROR
```

```
016640  012700  000002                  MOV #OP.ESP,R0                  ;BUILD EXECUTE SUPPLIED PROGRAM COMMAND PACKET
016644  004737  016754                  CALL BLDCMD
016650  013764  002156  000124          MOV DMPROG,HC.CPK+P.UADR(R4)    ;LOAD MAIN PROGRAM ADDRESS
016656  017764  163274  000120          MOV @DMPROG,HC.CPK+P.BCNT(R4)   ;  AND SIZE
016664  013764  002156  000140          MOV DMPROG,HC.CPK+P.OVRL(R4)    ;LOAD OVERLAY ADDRESS
016672  067764  163260  000140          ADD @DMPROG,HC.CPK+P.OVRL(R4)
016700  004737  017040                  CALL SNDCMD                     ;SEND COMMAND TO UDA
016704  004737  017160                  CALL WAITMS                     ;WAIT FOR MESSAGE RESPONSE
016710  001417                          BEQ LOADER      ;ABORT IF NO RESPONSE
016712  032764  000037  000032          BIT #ST.MSK,HC.MPK+P.STS(R4)    ;CHECK FOR ERRORS
016720  001007                          BNE LOADE1
016722  042765  000024  000012          BIC #CT.CMD+CT.REQ,C.FLG(R5)    ;CLEAR COMMAND OUTSTANDING FLAG
016730  052765  000002  000012          BIS #CT.RN,C.FLG(R5)            ;SET DM PROGRAM RUNNING FLAG
016736  000207                          RETURN
```

```
                                ;UDA FAILED TO DOWNLINE LOAD DM PROGRAM

  016740                        LOADE1: ERRDF 34,,ERR034
  016740  104455                                                                       TRAP     C$ERDF
  016742  000042                                                                       .WORD    34
  016744  000000                                                                       .WORD    0
  016746  012420                                                                       .WORD    ERR034
  016750  000264                LOADER: SEZ                         ;SET Z TO INDICATE ERROR OCCURRED
  016752  000207                        RETURN
```

```
                                    ;BLDCMD
                                    ;
                                    ;BUILD A COMMAND IN COMMAND PACKET
                                    ;
                                    ;INPUTS:
                                    ;       R5 - CONTROLLER TABLE ADDRESS
                                    ;       R0 - COMMAND CODE
                                    ;OUTPUTS:
                                    ;       R4 - ADDRESS OF HOST COMM AREA
                                    ;       COMMAND PACKET CONTAINING REF NUMBER AND OPCODE. ALL OTHER FIELDS CLEARED.
                                    ;       CMD REFERRENCE NUMBER IN CONTROLLER TABLE INCREMENTED AND RESULT
                                    ;       IN COMMAND PACKET.
                                    ;       R0 - CONTENTS DESTROYED

016754                              BLDCMD: PUSH <R1,R0>
 016754  010146                                                                              MOV R1,-(SP)
 016756  010046                                                                              MOV R0,-(SP)
016760   016504  000014                     MOV C.RING(R5),R4           ;GET ADDRESS OF HOST COMM AREA
016764   010400                             MOV R4,R0                   ;COPY TO R0
016766   062700  000100                     ADD #HC.CEV,R0              ;COMPUTE ADDRESS OF COMMAND ENVELOPE
016772   012720  000060                     MOV #HC.PSZ,(R0)+           ;LOAD PACKET LENGTH
016776   012701  001000                     MOV #DUP,R1                 ;LOAD DIAG CIRCUIT IDENTIFIER
017002   022716  000031                     CMP #OP.MWR,(SP)            ;IF CODE IS MAINTENANCE WRITE
017006   001002                             BNE BLDC0                   ;  GET OTHER CIRCUIT IDENTIFIER
017010   012701  177777                     MOV #DIAG,R1
017014   010120                     BLDC0:  MOV R1,(R0)+                ;PUT IDENTIFIER INTO PACKET
017016   012701  000030                     MOV #<HC.PSZ>/2,R1          ;GET WORDS TO CLEAR
017022   005020                     BLDC1:  CLR (R0)+                   ;CLEAR PACKET
017024   005301                             DEC R1
017026   001375                             BNE BLDC1
017030                                      POP HC.CPK+P.OPCD(R4)       ;PUT OPCODE IN PACKET
 017030  012664  000114                                                               MOV (SP)+,HC.CPK+P.OPCD(R4)
017034                                      POP R1                      ;RESTORE R1
 017034  012601                                                                       MOV (SP)+,R1
017036   000207                             RETURN
```

```
                                         ;SNDCMD
                                         ;
                                         ;SEND A COMMAND TO THE UDA.
                                         ;MARK BOTH PACKETS AVAILABLE TO THE
                                         ;UDA. SET COMMAND ISSUED BIT IN CONTROLLER TABLE AND INITIALIZE
                                         ;TIMEOUT COUNTER.
                                         ;
                                         ;INPUTS:
                                         ;       R5 - CONTROLLER TABLE ADDRESS
                                         ;OUTPUTS:
                                         ;       R4 - ADDRESS OF HOST COMM AREA


 017040                                  SNDCMD: PUSH <R0,R1>
 017040  010046                                                                                MOV R0,-(SP)
 017042  010146                                                                                MOV R1,-(SP)
 017044  016504  000014                          MOV C.RING(R5),R4              ;LOAD R4 WITH HOST COMM AREA ADDRESS
 017050  005265  000050                          INC C.REF(R5)                  ;INCREMENT CMD REFERENCE NUMBER
 017054  016564  000050  000104                  MOV C.REF(R5),HC.CPK+P.CRF(R4) ;PUT IN PACKET
 017062  012764  140000  000006                  MOV #RG.OWN+RG.FLG,HC.MCT(R4)  ;MARK MESSAGE PACKET AVAILABLE
 017070  012764  100000  000012                  MOV #RG.OWN,HC.CCT(R4)         ;MARK COMMAND TO UDA
 017076  005775  000000                          TST @(R5)                      ;TELL UDA COMMAND IS THERE
 017102  052765  000004  000012                  BIS #CT.CMD,C.FLG(R5)          ;MARK COMMAND ISSUED
 017110                                          POP <R1,R0>
 017110  012601                                                                                MOV (SP)+,R1
 017112  012600                                                                                MOV (SP)+,R0
 017114  000207                                  RETURN
```

```
                                        ;CLRBUF
                                        ;
                                        ;CLEAR THE SPECIFIED DATA BUFFER IN THE HOST COMM AREA
                                        ;AND LOAD BUFFER DESCRIPTOR IN COMMAND PACKET TO THE BUFFER
                                        ;
                                        ;INPUTS:
                                        ;       R5 - CONTROLLER TABLE ADDRESS
                                        ;       R4 - ADDRESS OF HOST COMM AREA
                                        ;       R0 - OFFSET INTO HOST COMM AREA TO DATA BUFFER
                                        ;OUTPUTS:
                                        ;       DATA BUFFER CLEARED
                                        ;       COMMAND PACKET POINTING TO BUFFER
                                        ;       BYTE COUNT SET TO SIZE OF BUFFER
                                        ;       R4 - ADDRESS OF DATA BUFFER

017116                                  CLRBUF: PUSH <R0,R1>
017116  010046                                                                                  MOV R0,-(SP)
017120  010146                                                                                  MOV R1,-(SP)
017122  060400                                  ADD R4,R0                       ;ADD START OF HOST COMM AREA TO OFFSET
017124  010064  000124                          MOV R0,HC.CPK+P.UADR(R4)        ;PUT BUFFER ADDRESS IN COMMAND PACKET
017130  012764  000244  000120                  MOV #HC.BSZ,HC.CPK+P.BCNT(R4)   ;PUT SIZE OF BUFFER IN COMMAND PACKET
017136  010004                                  MOV R0,R4                       ;PUT BUFFER ADDRESS IN R4
017140  012701  000122                          MOV #HC.BSZ/2,R1                ;GET SIZE OF BUFFER IN WORDS
017144  005020                          CLRBFL: CLR (R0)+                       ;CLEAR ALL THE WORDS
017146  005301                                  DEC R1
017150  001375                                  BNE CLRBFL
017152                                          POP <R1,R0>
017152  012601                                                                                  MOV (SP)+,R1
017154  012600                                                                                  MOV (SP)+,R0
017156  000207                                  RETURN
```

```
                                        ;WAITMS
                                        ;
                                        ;WAIT FOR UDA TO RESPOND WITH A MESSAGE PACKET
                                        ;
                                        ;INPUTS:
                                        ;       R5 - ADDRESS OF CONTROLLER TABLE
                                        ;OUTPUTS:
                                        ;       Z CLEAR IF NO ERROR
                                        ;       Z SET IF ERROR, MESSAGE PRINTED

017160                                  WAITMS: PUSH <R0,R1>
017160  010046                                                                                  MOV R0,-(SP)
017162  010146                                                                                  MOV R1,-(SP)
017164  012700  000036                          MOV #30.,R0                     ;SET TIME OUT VALUE OF 30 SECONDS
017170  010501                                  MOV R5,R1                       ;POINT TO TIME OUT COUNTER
017172  062701  000036                          ADD #C.TO,R1
017176  004737  017352                          CALL SETTO
017202  011500                          1$:     MOV (R5),R0                     ;GET ADDRESS OF UDAIP REGISTER
017204  032765  000010  000012                  BIT #CT.MSG,C.FLG(R5)           ;LOOK IF INTERRUPT OCCURRED
017212  001030                                  BNE 3$                          ;BRANCH IF SO
017214  016001  000002                          MOV 2(R0),R1                    ;LOOK AT UDASA REGISTER
017220  001034                                  BNE 4$                          ;BRANCH IF ERROR CODE PRESENT
017222                                          BREAK
017222  104422                                                                                  TRAP    C$BRK
017224  005737  003206                          TST KW.CSR                      ;SEE IF A CLOCK ON SYSTEM
017230  001764                                  BEQ 1$
017232  023765  003220  000040                  CMP KW.EL+2,C.TOH(R5)           ;CHECK IF TIMEOUT HAS HAPPENED
017240  101005                                  BHI 2$
017242  001357                                  BNE 1$
017244  023765  003216  000036                  CMP KW.EL,C.TO(R5)
017252  103753                                  BLO 1$
017254                                  2$:     ERRDF 36.,ERR036
017254  104455                                                                                  TRAP    C$ERDF
017256  000044                                                                                  .WORD   36
017260  000000                                                                                  .WORD   0
017262  012426                                                                                  .WORD   ERR036
017264                                          POP <R1,R0>
017264  012601                                                                                  MOV (SP)+,R1
017266  012600                                                                                  MOV (SP)+,R0
017270  000264                                  SEZ
017272  000207                                  RETURN
```

K9

```
     1 017274   042765  000010  000012  3$:     BIC #CT.MSG,C.FLG(R5)          ;CLEAR MESSAGE RECEIVED FLAG
     2 017302                                   POP <R1,R0>
       017302   012601                                                                  MOV (SP)+,R1
       017304   012600                                                                  MOV (SP)+,R0
     3 017306   000244                          CLZ                            ;GIVE NO ERROR RETURN
     4 017310   000207                          RETURN
     5 017312                           4$:     ERRDF 37,,ERR037
       017312   104455                                                                  TRAP    C$ERDF
       017314   000045                                                                  .WORD   37
       017316   000000                                                                  .WORD   0
       017320   012440                                                                  .WORD   ERR037
     6 017322                                   POP <R1,R0>
       017322   012601                                                                  MOV (SP)+,R1
       017324   012600                                                                  MOV (SP)+,R0
     7 017326   000264                          SEZ
     8 017330   000207                          RETURN
```

```
                                        ;NXMI
                                        ;
                                        ;NON-EXISTANT MEMORY SERVICE ROUTINE
                                        ;
                                        ;INPUTS:
                                        ;       NXMAD SET TO ZERO
                                        ;OUTPUTS:
                                        ;       NXMAD SET TO ONES IF NON-EXISTANT TRAP OCCURED

   017332                               BGNSRV NXMI
   017332                                                                       NXMI::

   017332  012737  177777  002172              MOV #-1,NXMAD

   017340                               ENDSRV
   017340                                                                       L10031:
   017340  000002                                                                       RTI
```

```
                                ;UDASRV
                                ;
                                ;UDA INTERRUPT SERVICE ROUTINE. MARKS UDA CONTROLLER TABLE THAT AN
                                ;INTERRUPT HAS BEEN RECEIVED.
                                ;
                                ;THIS ROUTINE IS CALLED BY A [JSR RO.UDASRV] INSTRUCTION FROM WITHIN
                                ;THE CONTROLLER TABLE. THE PC STORED IN RO IS THE ADDRESS OF THE C.FLG
                                ;WORD IN THE CONTROLLER TABLE. THE STACK CONTAINS THE SAVED CONTENTS
                                ;OF RO FOLLOWED BY THE INTERRUPTED PC AND PS.
                                ;
                                ;INPUTS:
                                ;       RO - ADDRESS OF C.FLG WORD IN CONTROLLER TABLE
                                ;       STACK - SAVED CONTENTS OF RO
                                ;OUTPUTS:
                                ;       CT.CMD CLEARED AND CT.MSG SET IN C.FLG WORD OF CONTROLLER TABLE
                                ;       RO - RESTORED FROM STACK

017342                          BGNSRV UDASRV
017342                                                                                  UDASRV::
017342  052710  000010                  BIS #CT.MSG,(RO)                ;SET CT.MSG
017346                                  POP RO                          ;RESTORE RO
017346  012600                                                                                  MOV (SP)+,RO
017350                          ENDSRV
017350                                                                                  L10032:
017350  000002                                                                                  RTI
```

```
                                  ;SETTO
                                  ;
                                  ;SET TIMEOUT COUNTER TO SOME NUMBER OF SECONDS FROM CURRENT TIME.
                                  ;
                                  ;INPUTS:
                                  ;       R0 - NUMBER OF SECONDS FOR TIMEOUT
                                  ;       R1 - ADDRESS WHERE TWO WORD TIME TO BE PUT
                                  ;OUTPUTS:
                                  ;       R0 - CONTENTS DESTROYED
                                  ;       R1 - INCREMENTED BY 2

                                  ;COMPUTE CLOCK TICKS TIL TIMEOUT

017352                            SETTO:  PUSH <R2,R3>
017352  010246                                                                      MOV R2,-(SP)
017354  010346                                                                      MOV R3,-(SP)
017356  005002                            CLR R2                        ;CLEAR PRODUCT
017360  013703  003214                    MOV KW.HZ,R3                  ;GET MULTIPLICAND
017364  006200                    SET00:  ASR R0                        ;SHIFT MULTIPLIER TO RIGHT
017366  103001                            BCC SET01                     ;IF A ONE BIT SHIFTED OUT
017370  060302                            ADD R3,R2                     ;  ADD MULTIPLICAND TO PRODUCT
017372  006303                    SET01:  ASL R3                        ;DOUBLE THE MULTIPLICAND
017374  005700                            TST R0
017376  001372                            BNE SET00                     ;CONTINUE UNTIL MULTIPLIER IS ZERO

                                  ;GET CURRENT TIME

017400  013700  003216            SET02:  MOV KW.EL,R0                  ;GET TIME
017404  013703  003220                    MOV KW.EL+2,R3
017410  020037  003216                    CMP R0,KW.EL                  ;IF CHANGED DURING RETRIEVAL
017414  001371                            BNE SET02                     ;  GET IT AGAIN

                                  ;ADD TIME TIL TIMEOUT

017416  060200                            ADD R2,R0                     ;ADD
017420  005503                            ADC R3

                                  ;PUT RESULT IN STORAGE

017422  010021                            MOV R0,(R1)+
017424  010311                            MOV R3,(R1)

017426                                    POP <R3,R2>
017426  012603                                                                      MOV (SP)+,R3
017430  012602                                                                      MOV (SP)+,R2
017432  000207                            RETURN
```

```
                                 ;UDAINT
                                 ;
                                 ;FUNCTIONAL DESCRIPTION:
                                 ;       SUBROUTINE TO INITIALIZE A UDA AND BRING IT ON-LINE.
                                 ;       ALL STEPS ARE CHECKED. AN ERROR MESSAGE IS REPORTED IF ANY ERROR
                                 ;       DETECTED.
                                 ;
                                 ;INPUTS:
                                 ;       R5 - ADDRESS OF CONTROLLER TABLE.
                                 ;IMPLICIT INPUTS:
                                 ;       C.RING(R5) - ADDRESS GIVEN TO UDA AS START OF RING BUFFER.
                                 ;       LENGTH OF RING STRUCTURE IS ONE ENTRY EACH.
                                 ;OUTPUTS:
                                 ;       CONDITION Z - SET IF ANY ERROR REPORTED. CLEAR IF NO ERROR.
                                 ;       R4 - ADDRESS OF UDAIP REGISTER IN UDA
                                 ;       R5 - UNCHANGED.

                                 ;FILL HOST COMMUNICATION AREA WITH ALL ONES

017434  016502  000014           UDAINT: MOV C.RING(R5),R2                      ;GET FIRST ADDRESS OF RING BUFFER
017440  012703  000006                   MOV #<HC.RSZ*2+HC.ISZ>/2,R3                   ;GET SIZE OF RING BUFFER
017444  012722  177777           UDAI1L: MOV #-1,(R2)+                  ;WRITE ONES TO BUFFER
017450  005303                           DEC R3                         ;COUNT THE WORDS IN BUFFER
017452  003374                           BGT UDAI1L                     ;LOOP UNTIL ENTIRE BUFFER WRITTEN

                                 ;DO THE INITIALIZATION

017454  004737  017702                   CALL UDAIST                    ;DO FIRST THREE STEPS
017460  103506                           BCS UDAIEX                     ;GET OUT IF UDA MICROCODE REPORTED FAILURE
017462  012364  000002                   MOV (R3)+,2(R4)                ;WRITE NEXT WORD TO UDASA REGISTER
017466  012703  000310                   MOV #200.,R3                   ;GET TRY COUNTER
017472  016402  000002           UDAI1A: MOV 2(R4),R2                   ;LOOK AT UDASA
017476  001407                           BEQ UDAI1C
017500  005303                           DEC R3
017502  001373                           BNE UDAI1A
017504                                   ERRDF 24,,ERR024
017504  104455                                                                          TRAP    C$ERDF
017506  000030                                                                          .WORD   24
017510  000000                                                                          .WORD   0
017512  012314                                                                          .WORD   ERR024
017514  000470                           BR UDAIEX
017516  010264  000002           UDAI1C: MOV R2,2(R4)                   ;WRITE 0 TO UDASA (PURGE)
017522  011402                           MOV (R4),R2                    ;READ FROM UDAIP (POLL)
017524  004737  020220                   CALL UDARSP                    ;WAIT FOR STEP OR ERROR BIT
017530  103462                           BCS UDAIEX                     ;GET OUT IF UDA MICROCODE REPORTED FAILURE
017532  042702  174017                   BIC #^C<SA.CNT>,R2             ;CLEAR OTHER BITS
017536  006202                           ASR R2                         ;MOVE TO RIGHT OF REGISTER
017540  006202                           ASR R2
017542  006202                           ASR R2
017544  006202                           ASR R2
017546  020227  000006                   CMP R2,#6                      ;CONTROLLER MODEL MUST BE 6
017552  001410                           BEQ UDAI2
017554  020227  000015                   CMP R2,#13.                    ;  OR 13
017560  001405                           BEQ UDAI2
017562                                   ERRDF 14,,ERR014               ;REPORT CONTROLLER NEEDS NEW REVISION
017562  104455                                                                          TRAP    C$ERDF
017564  000016                                                                          .WORD   14
```

```
     017566  000000                                                   .WORD   0
     017570  012120                                                   .WORD   ERR014
  52 017572  000441                  BR UDAIEX
```

```
                                        ;CHECK HOST COMMUNICATION AREA FOR ALL ZEROS

017574  016502  000014                  UDAI2:  MOV C.RING(R5),R2               ;GET FIRST ADDRESS OF RING BUFFER
017600  010201                                  MOV R2,R1                       ;SAVE FOR ERROR MESSAGE
017602  012703  000006                          MOV #<HC.RSZ*2+HC.ISZ>/2,R3     ;GET SIZE OF RING BUFFER
017606  005722                          UDAI2L: TST (R2)+                       ;CHECK WORD IN BUFFER
017610  001003                                  BNE UDAI2E                      ;GO TO ERROR REPORTER IF NOT ZERO
017612  005303                                  DEC R3                          ;COUNT THE WORDS IN BUFFER
017614  003374                                  BGT UDAI2L                      ;LOOP UNTIL ALL WORDS CHECKED
017616  000405                                  BR UDAI3

017620                                  UDAI2E: ERRDF 23,,ERR023                ;REPORT BUFFER NOT CLEARED
017620  104455                                                                          TRAP    C$ERDF
017622  000027                                                                          .WORD   23
017624  000000                                                                          .WORD   0
017626  012236                                                                          .WORD   ERR023
017630  000422                                  BR UDAIEX


                                        ;SEND GO BIT TO UDASA REGISTER TO END INITIALIZATION

017632                                  UDAI3:
017632  012700  000001                          MOV #SA.GO,R0
017636  010064  000002                          MOV R0,2(R4)                    ;SEND TO UDA
017642  016501  000014                          MOV C.RING(R5),R1
017646  010161  000004                          MOV R1,HC.MSG(R1)
017652  062761  000020  000004                  ADD #HC.MPK,HC.MSG(R1)
017660  010161  000010                          MOV R1,HC.CMD(R1)
017664  062761  000104  000010                  ADD #HC.CPK,HC.CMD(R1)
017672  000244                                  CLZ                             ;CLEAR Z AS NO ERROR INDICATION
017674  000207                                  RETURN

                                        ;ERROR RETURN

017676  000264                          UDAIEX: SEZ                             ;SET Z TO INDICATE ERROR OCCURRED
017700  000207                                  RETURN
```

```
                                          ;UDAIST
                                          ;
                                          ;START THE INITIALIZATION PROCESS ON THE SELECTED UDA.
                                          ;STOP BEFORE WRITING THE THIRD WORD SO UDA DOES NOT
                                          ;ATTEMPT ANY UNIBUS TRANSFERS.
                                          ;
                                          ;INPUTS:
                                          ;       R5 - ADDRESS OF CONTROLLER TABLE

                                          ;LOAD TABLE OF DATA TO SEND TO UDASA REGISTER

017702                                    UDAIST: BREAK
017702  104422                                                                                    TRAP    C$BRK
017704                                            PUSH R1
017704  010146                                                                                    MOV R1,-(SP)
017706  016504  000004                            MOV C.VEC(R5),R4
017712                                            AND CT.VEC,R4
017712  042704  177000                                                                            BIC #^C<CT.VEC>,R4
017716  006204                                    ASR R4
017720  006204                                    ASR R4
017722  052704  100000                            BIS #SA.STP,R4                   ;SET STEP BIT IN DATA WORD
017726  010437  020120                            MOV R4,UDAID1                    ;LOAD INTERRUPT VECTOR
017732  016537  000014  020124                    MOV C.RING(R5),UDAID2            ;LOAD MEMORY ADDRESS
017740  062737  000004  020124                    ADD #HC.MSG,UDAID2               ;  OF FIRST RESPONSE RING

                                          ;START THE INITIALIZATION BY WRITING TO UDAIP REGISTER

017746  016504  000000                            MOV C.UADR(R5),R4                ;GET ADDRESS OF UDAIP REGISTER
017752  005037  002172                            CLR NXMAD                        ;CLEAR MEMORY ERROR FLAG
017756                                            SETVEC #4,#NXMI,#PRI07           ;SET UP VECTOR 4
017756  012746  000340                                                                            MOV     #PRI07,-(SP)
017762  012746  017332                                                                            MOV     #NXMI,-(SP)
017766  012746  000004                                                                            MOV     #4,-(SP)
0'17772 012746  000003                                                                            MOV     #3,-(SP)
017776  104437                                                                                    TRAP    C$SVEC
020000  062706  000010                                                                            ADD     #10,SP
020004  005764  000002                            TST 2(R4)                        ;ACCESS UDASA REGISTER
020010  005014                                    CLR (R4)                         ;WRITE TO UDAIP
020012                                            CLRVEC #4                        ;GIVE UP THE VECTOR
020012  012700  000004                                                                            MOV     #4,R0
020016  104436                                                                                    TRAP    C$CVEC
020020  005737  002172                            TST NXMAD                        ;SEE IF A MEMORY ERROR OCCURRED
020024  001406                                    BEQ UDAISG
020026                                            ERRDF 20,,ERR020
020026  104455                                                                                    TRAP    C$ERDF
020030  000024                                                                                    .WORD   20
020032  000000                                                                                    .WORD   0
020034  012134                                                                                    .WORD   ERR020
020036  000261                                    SEC
020040  000424                                    BR UDAISE
```

```
                                  ;SET UP LOOP PARAMETERS TO EXECUTE THE FOUR STEPS OF INITIALIZATION

020042  012737  004000  020356    UDAISG: MOV #SA.S1,UDARSD               ;STORE RESPONSE MASK
020050  012703  020116                    MOV #UDAIDT,R3                  ;AND INDEX TO TABLE

                                  ;WAIT FOR AND CHECK RESPONSE DATA

020054  004737  020220            UDAISL: CALL UDARSP                     ;WAIT FOR STEP OR ERROR BITS
020060  103414                            BCS UDAISE                      ;EXIT IF ERROR
020062  004733                            CALL @(R3)+                     ;CALL RESPONSE CHECKER FOR STEP
020064  103412                            BCS UDAISE                      ;GET OUT IF ERROR
020066  006337  020356                    ASL UDARSD                      ;SHIFT TO NEXT STEP BIT
020072  032737  040000  020356            BIT #SA.S4,UDARSD               ;CHECK IF NOW AT STEP 4
020100  001003                            BNE UDAISX                      ;GET OUT IF SO
020102  012364  000002                    MOV (R3)+,2(R4)                 ;WRITE DATA TO UDASA REGISTER
020106  000762                            BR UDAISL                       ;STAY IN LOOP

020110  000241                    UDAISX: CLC                             ;CLEAR CARRY FOR NO ERROR INDICATION
020112                            UDAISE: POP R1
020112  012601                                                                        MOV (SP)+,R1
020114  000207                            RETURN
```

```
                                  ;DATA TO BE SENT AND RECEIVED BY UDA INITIALIZATION

020116  020132                    UDAIDT: .WORD UDAIR1                   ;FIRST WORD RESPONSE CHECK ROUTINE
020120  000000                    UDAID1: .WORD 0                        ;FIRST WORD TO SEND TO UDASA
020122  020144                            .WORD UDAIR2                   ;SECOND WORD RESPONSE CHECK ROUTINE
020124  000000                    UDAID2: .WORD 0                        ;SECOND WORD TO SEND TO UDASA
020126  020164                            .WORD UDAIR3                   ;THIRD WORD RESPONSE CHECK ROUTINE
020130  100000                    UDAID3: .WORD SA.TST                   ;THIRD WORD TO SEND TO UDASA

                                  ;RESPONSE CHECK FOR FIRST WORD FROM UDASA
                                  ;CHECK FOR PROPER CONTROLLER TYPE

020132  012701  004400            UDAIR1: MOV #SA.S1+SA.DI,R1            ;SET STEP ONE BIT
020136  042702  001140                    BIC #<SA.QB+SA.MP+SA.SM>,R2    ;MASK OFF UNWANTED BITS
020142  000416                            BR UDAIRC                      ;NOW COMPARE

                                  ;RESPONSE CHECK FOR SECOND WORD FROM UDASA
                                  ;CHECK FOR ECHO OF INTI AND VECTOR

020144  013701  020120            UDAIR2: MOV UDAID1,R1                  ;GET WORD SENT TO UDASA
020150  000301                            SWAB R1                        ;GET HIGH 8 BITS
020152  042701  177400                    BIC #177400,R1
020156  052701  010000                    BIS #SA.S2,R1                  ;SET STEP 2 BIT
020162  000406                            BR UDAIRC                      ;NOW COMPARE

                                  ;RESPONSE CHECK FOR THIRD WORD FROM UDASA
                                  ;CHECK FOR ECHO OF MESSAGE AND COMMAND RING LENGTHS

020164  013701  020120            UDAIR3: MOV UDAID1,R1                  ;GET WORD SENT TO UDASA
020170  042701  177400                    BIC #177400,R1                 ;JUST LOW 8 BITS
020174  052701  020000                    BIS #SA.S3,R1                  ;SET STEP 3 BIT

                                  ;COMPARE EXPECTED DATA IN R1 WITH ACTUAL DATA IN R2

020200  020102                    UDAIRC: CMP R1,R2                      ;COMPARE THE DATA
020202  001405                            BEQ UDAIRX                     ;EXIT IF COMPARED CORRECTLY
020204                                    ERRDF 25,,ERR025               ;REPORT ERROR
020204  104455                                                                                 TRAP     C$ERDF
020206  000031                                                                                 .WORD    25
020210  000000                                                                                 .WORD    0
020212  012330                                                                                 .WORD    ERR025
020214  000261                            SEC
020216  000207                    UDAIRX: RETURN
```

```
                                        ;UDARSP
                                        ;
                                        ;WAIT FOR UDA TO RESPOND WITH DATA IN UDASA REGISTER.
                                        ;EITHER STEP BIT FROM MASK IN LOCATION UDARSD OR ERROR BIT
                                        ;WILL CAUSE A TERMINATION.
                                        ;AN ERROR MESSAGE WILL BE PRINTED IF THE UDA DOES NOT RESPOND
                                        ;IN 10 SECONDS OR IF ERROR SETS.
                                        ;
                                        ;INPUTS:
                                        ;       UDASRD - MASK OF STEP BIT TO LOOK FOR
                                        ;       R5 - ADDRESS OF CONTROLLER TABLE
                                        ;       R4 - ADDRESS OF UDAIP REGISTER
                                        ;OUTPUTS:
                                        ;       ERROR MESSAGE IF TIME OUT ON RESPONSE OR ERROR BIT SETS
                                        ;       R2 - DATA FROM UDASA REGISTER
                                        ;       CARRY SET IF ERROR BIT SETS OR TIME OUT

020220                                  UDARSP: PUSH R1
020220  010146                                                                            MOV R1,-(SP)
020222  052737  100000  020356                  BIS #SA.ERR,UDARSD              ;SET ERROR BIT IN MASK WORD
020230  012700  000012                          MOV #10.,R0                     ;SET UP FOR 10 SECOND TIMEOUT
020234  010501                                  MOV R5,R1                       ;POINT TO COUNTER IN CONTROLLER TABLE
020236  062701  000036                          ADD #C.TO,R1
020242  004737  017352                          CALL SETTO
020246                                          POP R1
020246  012601                                                                            MOV (SP)+,R1
020250  033764  020356  000002  UDARS1: BIT UDARSD,2(R4)                ;LOOK AT ERROR AND STEP BIT
020256  001024                                  BNE UDARS2                      ;BRANCH IF EITHER SET
020260                                          BREAK
020260  104422                                                                            TRAP    C$BRK
020262  005737  003206                          TST KW.CSR                      ;SEE IF CLOCK ON SYSTEM
020266  001770                                  BEQ UDARS1
020270  023765  003220  000040                  CMP KW.EL+2,C.TOH(R5)           ;CHECK IF TIME OUT OCCURRED
020276  101005                                  BHI 1$
020300  001363                                  BNE UDARS1
020302  023765  003216  000036                  CMP KW.EL,C.TO(R5)
020310  103757                                  BLO UDARS1
020312  016402  000002                  1$:     MOV 2(R4),R2                    ;GET REGISTER CONTENTS
020316                                          ERRDF 22.,ERR022                ;REPORT TIME OUT ERROR
020316  104455                                                                            TRAP    C$ERDF
020320  000026                                                                            .WORD   22
020322  000000                                                                            .WORD   0
020324  012210                                                                            .WORD   ERR022
020326  000407                                  BR UDARSE
```

```
                                  ;CHECK IF ERROR BIT SET

020330  016402  000002            UDARS2: MOV 2(R4),R2           ;GET REGISTER CONTENTS
020334  100006                            BPL UDARSX             ;EXIT IF ERROR NOT SET
020336                                    ERRDF 21,,ERR021       ;REPORT ERROR INFO
020336  104455                                                                           TRAP    C$ERDF
020340  000025                                                                           .WORD   21
020342  000000                                                                           .WORD   0
020344  012146                                                                           .WORD   ERR021
020346  000261                    UDARSE: SEC
020350  000207                            RETURN

                                  ;NORMAL EXIT

020352  000241                    UDARSX: CLC                    ;CLEAR CARRY AS NO ERROR INDICATION
020354  000207                            RETURN

                                  ;LOCATION FOR STEP BIT MASK

020356  000000                    UDARSD: .WORD 0                ;LOAD BY CALLING ROUTINE
```

```
                                ;KW11I
                                ;
                                ;CLOCK INTERRUPT SFRVICE ROU'INE

020360                          BGNSRV KW11I
020360                                                                                  KW11I::
020360  062737  000001  003216          ADD #1,KW.EL                    ;COUNT THE INTERRUPT
020366  005537  003220                  ADC KW.EL+2
020372  012777  000105  162606          MOV #KWOUT.,@KW.CSR             ;RESTART THE CLOCK
020400                          ENDSRV
020400                                                                                  L10033:
020400  000002                                                                                  RTI
```

```
                                ;RNTIME
                                ;
                                ;PRINT RUNTIME
                                ;
                                ;INPUTS:
                                ;       KW.EL - CONTAINS ELAPSED TIME
                                ;       KW.HZ - HERTZ OF CLOCK
                                ;OUTPUTS:
                                ;       IF CLOCK ON SYSTEM:
                                ;         "  RUNTIME HH:MM:SS " PRINTED
                                ;       IF NO CLOCK: ONE SPACE IS PRINTED

020402  005737  003206          RNTIME: TST KW.CSR              ;CHECK IF A CLOCK PRESENT
020406  001465                          BEQ RNTIMX              ;BRANCH IF NOT
020410                                  PUSH <R0,R3,R4,R5>
020410  010046                                                                  MOV R0,-(SP)
020412  010346                                                                  MOV R3,-(SP)
020414  010446                                                                  MOV R4,-(SP)
020416  010546                                                                  MOV R5,-(SP)
020420  013703  003216                  MOV KW.EL,R3            ;GET ELAPSED TIME
020424  013704  003220                  MOV KW.EL+2,R4
020430  013700  003214                  MOV KW.HZ,R0            ;GET SPEED OF CLOCK
020434  004737  016516                  CALL DIVIDE             ;COMPUTE SECONDS OF ELAPSED TIME
020440  012700  000074                  MOV #60.,R0             ;NOW DIVIDE BY 60
020444  004737  016516                  CALL DIVIDE             ; TO COMPUTE MINUTES
020450                                  PUSH R5                 ;SAVE REMAINDER AS SECONDS
020450  010546                                                                  MOV R5,-(SP)
020452  004737  016516                  CALL DIVIDE             ;DIVIDE BY 60 AGAIN
020456                                  PNT RNTIM,R3            ;PRINT HOURS
020456  010346                                                                  MOV R3,-(SP)
020460  004137  016450                                                          JSR R1,LPNT
020464  003712                                                                  .WORD RNTIM
020466  000002                                                                  .WORD PNT.CT
020470  020527  000011                  CMP R5,#9.              ;IF MINUTES 9 OR LESS
020474  003004                          BGT 1$
020476                                  PRINT #'0               ;PRINT A LEADING ZERO
020476  112700  000060                                                          MOVB #'0,R0
020502  004737  016240                                                          CALL CPNT
020506                          1$:     PNT RNTIM1,R5           ;NOW PRINT MINUTES
020506  010546                                                                  MOV R5,-(SP)
020510  004137  016450                                                          JSR R1,LPNT
020514  003735                                                                  .WORD RNTIM1
020516  000002                                                                  .WORD PNT.CT
020520                                  POP R5                  ;GET SECONDS
020520  012605                                                                  MOV (SP)+,R5
020522  020527  000011                  CMP R5,#9.              ;IF 9 OR LESS
020526  003004                          BGT 2$
020530                                  PRINT #'0               ;PRINT A LEADING ZERO
020530  112700  000060                                                          MOVB #'0,R0
020534  004737  016240                                                          CALL CPNT
020540                          2$:     PNT RNTIM2,R5           ;NOW PRINT SECONDS
020540  010546                                                                  MOV R5,-(SP)
020542  004137  016450                                                          JSR R1,LPNT
020546  003743                                                                  .WORD RNTIM2
020550  000002                                                                  .WORD PNT.CT
020552                                  POP <R5,R4,R3,R0>       ;HOURS IN R3
020552  012605                                                                  MOV (SP)+,R5
```

```
      020554  012604                                                                        MOV (SP)+,R4
      020556  012603                                                                        MOV (SP)+,R3
      020560  012600                                                                        MOV (SP)+,R0
   35 020562                          RNTIMX: PRINT <#' >                ;PRINT A SPACE
      020562  112700  000040                                                                MOVB #'  ,R0
      020566  004737  016240                                                                CALL CPNT
   36 020572  000207                          RETURN
```

```
020574                          DATE:   GMANID DATEQ,DATEI,A,-1,1,11,,YES        ;GET DATE
020574  104443                                                                             TRAP     C$GMAN
020376  000406                                                                             BR       10000$
020600  003270                                                                             .WORD    DATEI
020602  000152                                                                             .WORD    T^CODE
020604  003544                                                                             .WORD    DATEQ
020606  177777                                                                             .WORD    -1
020610  000001                                                                             .WORD    T$LOLIM
020612  000013                                                                             .WORD    T$HILIM
020614                                                                            10000$:
020614  012705  003?70                  MOV #DATEI,R5   ;GET POINTER TO ANSWER
020620  121527  000060                  CMPB (R5),#'0
020624  103443                          BLO DERR
020626  122527  000071          DAY:    CMPB (R5)+,#'9
020632  101040                          BHI DERR
020634  121527  000055                  CMPB (R5),#'-
020640  001406                          BEQ DAS1
020642  121527  000060                  CMPB (R5),#'0
020646  103432                          BLO DERR
020650  122527  000071                  CMPB (R5)+,#'9
020654  101027                          BHI DERR
020656  122527  000055          DAS1:   CMPB (R5)+,#'-
020662  001024                          BNE DERR
020664  012704  000014                  MOV #12.,R4     ;GET NUMBER OF MONTH
020670  012703  003345                  MOV #MONTHS,R3  ;GET POINTER TO MONTH NAMES
020674  005000                  MON1:   CLR R0
020676  121523                          CMPB (R5),(R3)+
020700  001401                          BEQ MON2
020702  005200                          INC R0
020704  126523  000001          MON2:   CMPB 1(R5),(R3)+
020710  001401                          BEQ MON3
020712  005200                          INC R0
020714  126523  000002          MON3:   CMPB 2(R5),(R3)+
020720  001401                          BEQ MON4
020722  005200                          INC R0
020724  005700                  MON4:   TST R0
020726  001407                          BEQ MON5
020730  005304                          DEC R4
020732  001360                          BNE MON1
020734                          DERR:   PNTF DATEX
020734  004137  016412                                                                     JSR R1,LPNTF
020740  011671                                                                             .WORD DATEX
020742  000000                                                                             .WORD PNT.CT
020744  000713                          BR DATE
020746  012701  003304          MON5:   MOV #DATEO,R1   ;GET POINTER TO DATE FOR FORMATTER
020752  010403                          MOV R4,R3       ;GET COPY OF MONTH NUMBER
020754  020327  000012                  CMP R3,#10.     ;  IF 10 OR GREATER
020760  103404                          BLO MON6
020762  112721  000061                  MOVB #'1,(R1)+  ;PUT A "1" IN OUTPUT
020766  162703  000012                  SUB #10.,R3
020772  062703  000060          MON6:   ADD #'0,R3      ;CONVERT MONTH NUMBER TO ASCII
020776  110321                          MOVB R3,(R1)+   ;PUT A NUMBER IN OUTPUT
021000  112721  000055                  MOVB #'-,(R1)+  ;PUT A "-" IN OUTPUT
021004  062704  003410                  ADD #DAYS-1,R4  ;GET POINTER TO DAYS IN MONTH
                                                                ;INDEXED BY NUMBER OF MONTH
021010  012703  003270                  MOV #DATEI,R3   ;GET POINTER TO DATE INPUT
021014  005000                          CLR R0
```

```
021016  121327  000055          DAY1:   CMPB (R3),#'
021022  001413                          BEQ DAY2
021024  111321                          MOVB (R3),(R1)+ ;PUT DAY CHARACTER IN OUTPUT
021026  006300                          ASL R0
021030  010002                          MOV R0,R2
021032  006300                          ASL R0
021034  006300                          ASL R0
021036  060200                          ADD R2,R0
021040  112302                          MOVB (R3)+,R2
021042  162702  000060                  SUB #'0,R2
021046  060200                          ADD R2,R0
021050  000762                          BR DAY1
021052  120014                  DAY2:   CMPB R0,(R4)
021054  101327                          BHI DERR
021056  005700                          TST R0  ;SEE IF DATE IS ZERO
021060  001725                          BEQ DERR        ;ERROR IF SO
021062  062705  000003                  ADD #3,R5
021066  121527  000055                  CMPB (R5),#'-   ;CHECK FOR "-" BETWEEN DAY
021072  001320                          BNE DERR        ;  AND YEAR IN OUTPUT
021074  112521                          MOVB (R5)+,(R1)+        ;PUT "-" IN OUTPUT
021076  010504                          MOV R5,R4       ;GET COPY OF INPUT STRING POINTER
021100  005000                          CLR R0
021102  005002                          CLR R2
021104  121427  000060          YER1:   CMPB (R4),#'0
021110  103416                          BLO YER2
021112  121427  000071                  CMPB (R4),#'9
021116  101013                          BHI YER2
021120  006300                          ASL R0
021122  010003                          MOV R0,R3
021124  006300                          ASL R0
021126  006300                          ASL R0
021130  060300                          ADD R3,R0
021132  112403                          MOVB (R4)+,R3
021134  162703  000060                  SUB #'0,R3
021140  060300                          ADD R3,R0
021142  005202                          INC R2
021144  000757                          BR YER1
021146  105714                  YER2:   TSTB (R4)
021150  001271                          BNE DERR
021152  020227  000002                  CMP R2,#2
021156  001407                          BEQ YER3
021160  020227  000004                  CMP R2,#4
021164  001263                          BNE DERR
021166  020027  003554                  CMP R0,#1900.
021172  103660                          BLO DERR
021174  000413                          BR YER5
021176  012702  003425          YER3:   MOV #YEAR19,R2
021202  020027  000106                  CMP R0,#70.
021206  103002                          BHIS YER4
021210  012702  003430                  MOV #YEAR20,R2
021214  105712                  YER4:   TSTB (R2)
021216  001402                          BEQ YER5
021220  112221                          MOVB (R2)+,(R1)+
021222  000774                          BR YER4
021224  112521                  YER5:   MOVB (R5)+,(R1)+
021226  001376                          BNE YER5
021230  000207                          RETURN
```

```
   103
   104 021232  000000                BRSAV:  .WORD   0                        ;DEFAULT BR LEVEL AND VECTOR
   105
   106 021234                                ENDMOD
```

```
                                      .SBTTL  PROTECTION TABLE

021234                                        BGNMOD

                                      ;++
                                      ; THIS TABLE IS USED BY THE RUNTIME SERVICES
                                      ; TO PROTECT THE LOAD MEDIA.
                                      ;-

021234                                        BGNPROT
021234                                                                                  L$PROT::

021234  177777                                -1                            ;OFFSET INTO P-TABLE FOR CSR ADDRESS
021236  177777                                -1                            ;OFFSET INTO P-TABLE FOR MASSBUS ADDRESS
021240  177777                                -1                            ;OFFSET INTO P-TABLE FOR DRIVE NUMBER

021242                                        ENDPROT

```

```
                                        .SBTTL  INITIALIZE SECTION

                                        ;**
                                        ;       THE INITIALIZE SECTION CONTAINS THE CODING THAT IS PERFORMED
                                        ;       AT THE BEGINNING OF EACH PASS. THIS CODE IS EXECUTED UNDER FIVE
                                        ;       CONDITIONS.  THERE
                                        ;       ARE SUPERVISOR EVENT FLAGS THAT ARE USED TO LET THE
                                        ;       DIAGNOSTIC KNOW UNDER WHICH CONDITION THE EXECUTION IS TAKING
                                        ;       PLACE.  THE EVENT FLAGS ARE READ USING THE "READEF" MACRO.
                                        ;       THE CONDITIONS UNDER WHICH THE INIT CODE IS EXECUTED AND THE
                                        ;       CORRRESPONDING EVENT FLAGS ARE:
                                        ;               START COMMAND            EF.START
                                        ;               RESTART COMMAND          EF.RESTART
                                        ;               CONTINUE COMMAND         EF.CONTINUE
                                        ;               POWERDOWN/POWERUP        EF.PWR
                                        ;               NEW PASS                 EF.NEW
                                        ;
                                        ;       IF HERE FROM START COMMAND THEN
                                        ;               SET ISTRT BIT & CLEAR OTHER BITS IN FLAG
                                        ;
                                        ;       IF HERE FROM RESTART COMMAND THEN
                                        ;               SET IREST BIT IN IFLAGS
                                        ;
                                        ;       IF HERE FROM START OR RESTART COMMAND THEN
                                        ;               RESET ALL UNITS
                                        ;               ESTABLISH FREE MEMORY
                                        ;               CLEAR TNUM
                                        ;               INITIALIZE CLOCK
                                        ;               BUILD CONTROLLER & DRIVES TABLES IN MEMORY
                                        ;               EXIT INIT SECTION
                                        ;
                                        ;       IF HERE FROM CONTINUE COMMAND THEN
                                        ;               SET ICONT BIT IN IFLAGS
                                        ;               EXIT INIT SECTION
                                        ;
                                        ;       IF HERE FROM POWER FAIL RESTART THEN
                                        ;               EXIT INIT SECTION
                                        ;
                                        ;       IF HERE FROM NEW PASS OR SUB-PASS THEN
                                        ;               LOOK FOR ANY ADDED OR DROPPED UNITS
                                        ;               EXIT INIT SECTION
                                        ;--

 021242                                         BGNINIT
 021242                                                                                 L$INIT::
                                                                        ;HERE FROM START COMMAND?
 021242                                         READEF  #EF.STA
 021242  012700  000040                                                                          MOV     #EF.STA,R0
 021246  104447                                                                                  TRAP    C$REFG
                                                                        ;BRANCH TO 1$ IF NOT, ELSE
 021250                                         BNCOMPLETE      1$
 021250  103004                                                                                  BCC     1$
 021252  012737  000010  003204                 MOV     #ISTRT,IFLAGS   ;SET START BIT IN FLAG.
 021260  000432                                 BR      INIT1
 021262                                 1$:                             ;HERE FROM RESTART COMMAND?
 02'262                                         READEF  #EF.RES
```

```
021262  012700  000037                                                          MOV     #EF.RES,R0
021266  104447                                                                  TRAP    C$REFG
                                                   ;BRANCH TO 2$ IF NOT, ELSE
021270                           BNCOMPLETE    2$
021270  103004                                                                  BCC     2$
021272  052737  000004  003204   BIS     #IREST,IFLAGS     ;SET RESTART BIT IN FLAG.
021300  000422                   BR      INIT1
C21302                   2$:                               ;HERE FROM CONTINUE COMMAND?
021302                           READEF  #EF.CON
021302  012700  000036                                                          MOV     #EF.CON,R0
021306  104447                                                                  TRAP    C$REFG
                                                   ;BRANCH TO 3$ IF NOT, ELSE
021310                           BNCOMPLETE    3$
021310  103007                                                                  BCC     3$
021312  042737  000020  003204   BIC     #ISTRTH,IFLAGS    ;CLEAR 1ST TIME THRU FLAG AND
021320  052737  000002  003204   BIS     #ICONT,IFLAGS     ;SET CONTINUE BIT IN FLAG.
021326  000405                   BR      INIT0
021330                   3$:                               ;HERE FROM POWER FAIL?
021330                           READEF  #EF.PWR
021330  012700  000034                                                          MOV     #EF.PWR,R0
021334  104447                                                                  TRAP    C$REFG
                                                   ;BRANCH TO INIT0 IF POWER FAIL, ELSE
021336                           BCOMPLETE     INIT0
021336  103401                                                                  BCS     INIT0
021340                   INITQT: DOCLN                     ; ABORT PROGRAM ON NEW PASS
021340  104444                                                                  TRAP    C$DCLN

021342  000137  022126   INIT0:  JMP     INITXX            ; EXIT THE INITIALIZE SECTION.

                         ;
                         ;       INITIALIZE KW11 CLOCK, FREE MEMORY AND IP ADDRESS TABLE
                         ;       DURING START OR RESTART COMMAND ONLY
                         ;

021346  012700  000003   INIT1:  MOV     #SO.FMT,R0        ; GET BITS FOR REFORMAT MODE FLAG
021352  030037  002136           BIT     R0,SFPTBL         ; CHECK IF REFORMAT
021356  001011                   BNE     1$                ; IF SO, CONTINUE
021360  012700  000004           MOV     #SO.CNS,R0        ; GET BIT FOR RECONSTRUCT FLAG
021364  030037  002136           BIT     R0,SFPTBL         ; CHECK IF RECONSTRUCT MODE
021370  001004                   BNE     1$                ; IF SO, CONTINUE
021372  006300                   ASL     R0                ; GET BIT FOR RESTORE MODE
021374  030037  002136           BIT     R0,SFPTBL         ; CHECK IF RESTORE MODE
021400  001757                   BEQ     INITQT            ; IF NONE OF ABOVE, ABORT TEST
021402  010037  003200   1$:     MOV     R0,MODE           ; SAVE MODE FLAGS

        000105                   KWOUT.=105                ; DATA TO START CLOCK

021406  005037  003216           CLR     KW.EL             ;CLEAR ELAPSED TIME
021412  005037  003220           CLR     KW.EL+2
021416                           CLOCK   L,R0              ;SEE IF L-CLOCK PRESENT
021416  012700  000114                                                          MOV     #'L,R0
021422  104462                                                                  TRAP    C$CLCK
021424                           BCOMPLETE     2$
021424  103413                                                                  BCS     2$
021426                           CLOCK   P,R0              ;SEE IF P-CLOCK PRESENT
021426  012700  000120                                                          MOV     #'P,R0
021432  104462                                                                  TRAP    C$CLCK
```

```
021434                                  BCOMPLETE       2$
021434  103407                                                                          BCS     2$
021436  005037  003206                  CLR     KW.CSR                  ;IF NEITHER, CLEAR CSR STORAGE WORD
021442                                  PNTF    NOCLOCK
021442  004137  016412                                                                  JSR R1,LPNTF
021446  004110                                                                          .WORD NOCLOCK
021450  000000                                                                          .WORD PNT.CT
021452  000426                          BR      3$

021454  012037  003206          2$:     MOV     (R0)+,KW.CSR            ;STORE DATA RETURNED
021460  012037  003210                  MOV     (R0)+,KW.BRL
021464  012037  003212                  MOV     (R0)+,KW.VEC
021470  012037  003214                  MOV     (R0)+,KW.HZ
                                                                        ;SETUP KW11 VECTOR ADDRESS
021474                                  SETVEC  KW.VEC,#KW11I,#PRI07
021474  012746  000340                                                                  MOV     #PRI07,-(SP)
021500  012746  020360                                                                  MOV     #KW11I,-(SP)
021504  013746  003212                                                                  MOV     KW.VEC,-(SP)
021510  012746  000003                                                                  MOV     #3,-(SP)
021514  104437                                                                          TRAP    C$SVEC
021516  062706  000010                                                                  ADD     #10,SP
021522  012777  000105  161456          MOV     #KWOUT.,@KW.CSR         ;START THE CLOCK
021530  004737  012750          3$:     CALL    RESET                   ;RESET ALL CONTROLLERS
021534                                  MEMORY  FFREE                   ;RESET START OF FREE MEMORY
021534  104431                                                                          TRAP    C$MEM
021536  010037  002140                                                                  MOV     R0,FFREE
021542  017737  160372  002142          MOV     @FFREE,FSIZE            ;RESET SIZE OF FREE MEMORY


                                ;
                                ;       ALLOCATE DRIVE TABLES TO MEMORY
                                ;

021550  013737  002140  003202  INIT2:  MOV     FFREE,DTABS             ;STORE START OF DRIVE TABLES AND
021556  005077  161420                  CLR     @DTABS                  ;MARK ZERO END.
021562  013700  002012                  MOV     L$UNIT,R0               ;GET NUMBER OF LOGICAL UNITS TO RUN.
021566  012701  000001                  MOV     #1,R1                   ;GET INITIAL SIZE OF DRIVE TABLE AND
021572  062701  000015          1$:     ADD     #<D.SIZE>/2,R1          ;ACCUMULATE DRIVE TABLE SIZE.
021576  005300                          DEC     R0                      ;SEE IF ANY MORE LOGICAL UNITS.
021600  001374                          BNE     1$                      ;BRANCH IF NOT, ELSE
021602  004737  012706                  CALL    ALOCM                   ;ALLOCATE ALL DRIVE TABLES TO MEMORY.
                                                                        ; R1 POINTS TO 1ST WORD IN DRIVE TABLE


                                ;
                                ;       INITIALIZE CONTROLLER TABLE STORAGE WITH A WORD OF ZEROS
                                ;

021606  013737  002140  002150  INIT3:  MOV     FFREE,CTABS             ; STORE START OF CONTROLLER TABLES AND
021614  005077  160330                  CLR     @CTABS                  ; MARK ZEROS END.
021620  005037  002152                  CLR     CTRLRS                  ; CLEAR CONTROLLER COUNT
021624  012701  003434                  MOV     #IPADRS,R1              ; R1 -> IP ADDRESS
021630  012702  000010                  MOV     #8.,R2                  ; GET MAXIMUM # OF CONTROLLERS
021634  005021                  1$:     CLR     (R1)+                   ; CLEAR ENTRY
021636  005302                          DEC     R2                      ; DONE?
021640  001375                          BNE     1$                      ; IF NOT, BRANCH

                                ;
                                ;       BUILD CONTROLLER TABLES
```

```
                                      ;
                                      
 021642  005005                       INIT4:  CLR     R5                      ;CLEAR CUSTOMER DATA FLAG
 021644  005002                               CLR     R2                      ;START WITH LOGICAL UNIT 0
 021646  012737  005160  021232               MOV     #5160,BRSAV             ; SAVE DEFAULT FOR BR LEVEL & VECTOR
 021652                               1$:     GPHARD  R2,R0                   ; GET POINTER TO IT'S P-TABLE
                                                                                              MOV     R2,R0
 021654  010200                                                                               TRAP    C$GPHRD
 021656  104442
 021660                                       BNCOMPLETE      16$             ; BRANCH TO 16$ IF NOT AVAILABLE
                                                                                              BCC     16$
 021660  103104
 021662  013703  002150                       MOV     CTABS,R3                ; GET ADDRESS OF 1ST CONTROLLER TABLE
 021666  005713                       2$:     TST     (R3)                    ; CHECK IF ANY MORE TABLES
 021670  001405                               BEQ     6$                      ; BUILD NEW TABLE IF FOUND ZERO WORD
 021672  021013                               CMP     (R0),(R3)               ; CHECK IF SAME CSR ADDRESS.
 021674                                               ASSUME  C.UADR EQ 0
 021674                                               ASSUME  HO.UBA EQ 0
 021674  001444                               BEQ     11$                     ; BRANCH IF SO


 021676  062703  000052               5$:     ADD     #C.SIZE,R3              ;POINT TO BEGINNING OF NEXT CONTROLLER
 021702  000771                               BR      2$                      ;TABLE IN MEMORY.

                                      ;
                                      ;       BUILD NEW CONTROLLER TABLE
                                      ;

 021704  012704  003434               6$:     MOV     #IPADRS,R4              ;GET BEGINNING OF IP ADDRESS TABLE
 021710  020427  003444               7$:     CMP     R4,#IPADRS+8.           ;SEE IF END OF IP ADDRESS TABLE.
 021714  101004                               BHI     9$                      ;BRANCH IF SO, ELSE
 021716  005724                               TST     (R4)+                   ;DID WE FIND AN OPEN ENTRY ?
 021720  001401                               BEQ     8$                      ;BRANCH IF SO, ELSE
 021722  000772                               BR      7$                      ;LOOK AGAIN.

 021724  011044                       8$:     MOV     (R0),-(R4)              ;TAKE CSR ADDRESS FROM P-TABLE
                                                                              ;AND STORE IT IN THE IP ADDRESS TABLE.
 021726  012701  000025               9$:     MOV     #<C.SIZE>/2,R1          ;GET # OF ENTRIES IN CONTROLLER TABLE
 021732  004737  012706                       CALL    ALOCM                   ;AND ALLOCATE A TABLE TO MEMORY.
                                                                              ; R0 => 1ST WORD P-TABLE
                                                                              ; R1 => 1ST WORD IN CONTROLLER TABLE
 021736  011021                               MOV     (R0),(R1)+              ; STORE CSR ADDRESS AND
 021740  010221                               MOV     R2,(R1)+                ; UNIT NUMBER IN THE CONTROLLER TABLE.
 021742  013704  021232                       MOV     BRSAV,R4                ; GET DEFAULT VECTOR & BR LEVEL
 021746  162704  000004                       SUB     #4,R4                   ; GET NEXT VECTOR
 021752  010437  021232                       MOV     R4,BRSAV                ; SAVE NEXT VECTOR
 021756  010421                               MOV     R4,(R1)+                ;STORE IT IN THE CONTROLLER TABLE.
 021760  012721  004037                       MOV     #4037,(R1)+             ;THE 'JSR R0' INSTRUCION AND
 021764  012721  017342                       MOV     #UDASRV,(R1)+           ;THE ADDRESS OF THE INTERRUPT SERVICE
                                                                              ;ROUTINE IN THE CONTROLLER TABLE.
 021770  012704  000020                       MOV     #<C.SIZE-C.FLG>/2,R4    ;GET # OF ENTRIES TO END OF TABLE.
 021774  005021                       10$:    CLR     (R1)+                   ;CLEAR REST OF TABLE AND
 021776  005304                               DEC     R4                      ;ADD ZERO WORD AT END.
 022000  002375                               BGE     10$                     ;LOOP TIL ALL CLEARED
 022002  005237  002152                       INC     CTRLRS                  ;KEEP TRACK OF CONTROLLER COUNT

                                      ;
                                      ;       BUILD DRIVE TABLES
                                      ;
```

```

022006  013701  003202          11$:    MOV     DTABS,R1                ;GET ADDRESS OF CURRENT DRIVE TABLE
022012  062703  000016                  ADD     #C.DR0,R3               ; INDEX TO 1ST DRIVE IN TABLE
022016  012704  000010                  MOV     #8.,R4                  ; GET # OF DRIVES PER CONTROLLER
022022  005713                  12$:    TST     (R3)                    ;ANY ENTRY TO DRIVE TABLE,
022024  001411                          BEQ     14$                     ;BRANCH IF NOT, ELSE
022026  026033  000002                  CMP     MO.LDR(R0),@(R3)+       ;COMPARE DRIVE NUMBER IN DRIVE TABLE,
022032  001002                          BNE     13$                     ;BRANCH IF DIFFERNENT, ELSE
022034  000137  022140                  JMP     MLDRER                  ;FOUND TWO P-TABLES WITH SAME DRIVE.

022040  005304                  13$:    DEC     R4                      ; COUNT DRIVES
022042  001367                          BNE     12$                     ; IF FOUR DRIVE TABLES ALREADY EXIST,
022044  000137  022156                  JMP     TOOMER                  ;  THEN REPORT ERROR

022050  010113                  14$:    MOV     R1,(R3)                 ;STORE ADDRESS OF DRIVE TABLE IN
                                                                        ;CONTROLLER TABLE.
022052  016021  000002                  MOV     MO.LDR(R0),(R1)+        ;STORE DRIVE NUMBER AND
022056  010221                          MOV     R2,(R1)+                ;LOGICAL UNIT NUMBER IN DRIVE TABLE.

022060  062737  000032  003202          ADD     #D.SIZE,DTABS           ;NEXT DRIVE TABLE ADDRESS AND
022066  005077  161110                  CLR     @DTABS                  ;MARK ZERO END.
022072  005202                  16$:    INC     R2                      ;INCREMENT LOGICAL UNIT NUMBER
022074  020237  002012                  CMP     R2,L$UNIT               ;CHECK IF GOT ALL TABLES
022100  002665                          BLT     1$                      ;IF NOT, GO BACK FOR NEXT, ELSE
022102  012701  000001                  MOV     #1,R1                   ;GET 1 WORD TO TERMINATE ALL CONTROLLER
022106  004737  012706                  CALL    ALOCM                   ;TABLES AND ALLOCATE IT TO MEMORY.

                                ;
                                ;       SAVE CURRENT PARAMETERS TO FREE MEMORY SO EACH TEST CAN USE ALL OF IT
                                ;

022112  013737  002140  002144  INIT6:  MOV     FFREE,FMEM              ;SAVE START ADDRESS
022120  013737  002142  002146          MOV     FSIZE,FMEMS             ;SAVE SIZE

                                ;
                                ;       EXIT INITIALIZE SECTION
                                ;

022126                          INITXX: SETPRI  #PRIO0                  ;SET RUNNING PRIORITY TO ZERO
022126  012700  000000                                                                          MOV     #PRIO0,R0
022132  104441                                                                                  TRAP    C$SPRI

022134                                  EXIT    INIT
022134  104432                                                                                  TRAP    C$EXIT
022136  000036                                                                                  .WORD   L10035-.

                                ;TWO P-TABLES FOR SAME DRIVE
022140  013705  003242          MLDRER: MOV TEMP,R5             ;GET CONTROLLER ADDRESS
022144                                  ERRSF 2,,ERR002
022144  104454                                                                                  TRAP    C$ERSF
022146  000002                                                                                  .WORD   2
022150  000000                                                                                  .WORD   0
022152  012010                                                                                  .WORD   ERR002
022154                                  DOCLN
022154  104444                                                                                  TRAP    C$DCLN

                                ;MORE THAN EIGHT DRIVES SELECTED ON ONE CONTROLLER
```

```
 243
 244 022156  013705  003242          TOOMER: MOV TEMP,R5            ;GET CONTROLLER ADDRESS
 245 022162                                  ERRSF 3,,ERR003
     022162  104454                                                                         TRAP    C$ERSF
     022164  000003                                                                         .WORD   3
     022166  000000                                                                         .WORD   0
     022170  012026                                                                         .WORD   ERR003
 246 022172                                  DOCLN
     022172  104444                                                                         TRAP    C$DCLN
 247
 248
 249 022174                                  ENDINIT
     022174                                                                         L10035:
     022174  104411                                                                         TRAP    C$INIT
```

```
                                   .SBTTL  AUTODROP SECTION

                                   ;++
                                   ; THIS CODE IS EXECUTED IMMEDIATELY AFTER THE INITIALIZE CODE IF
                                   ; THE "ADR" FLAG WAS SET.  THE UNIT(S) UNDER TEST ARE CHECKED TO
                                   ; SEE IF THEY WILL RESPOND.  THOSE THAT DON'T ARE IMMEDIATELY
                                   ; DROPPED FROM TESTING.
                                   ;--

022176                                   BGNAUTO
022176                                                                       L$AUTO::

022176                                   ENDAUTO
022176                                                                       L10036:
022176  104461                                                                       TRAP    C$AUTO
```

```
                                       .SBTTL  CLEANUP CODING SECTION

                                       ;++
                                       ; THE CLEANUP CODING SECTION CONTAINS THE CODING THAT IS PERFORMED
                                       ; AFTER THE HARDWARE TESTS HAVE BEEN PERFORMED.
                                       ;--

      022200                                   BGNCLN
      022200                                                                                   L$CLEAN::

      022200   004737   013206                 CALL CLOSEF                        ;CLOSE DATA FILE
      022204                                   SETVEC #4,#NXMI,#PRI07
      022204   012746   000340                                                                         MOV     #PRI07,-(SP)
      022210   012746   017332                                                                         MOV     #NXMI,-(SP)
      022214   012746   000004                                                                         MOV     #4,-(SP)
      022220   012746   000003                                                                         MOV     #3,-(SP)
      022224   104437                                                                                  TRAP    C$SVEC
      022226   062706   000010                                                                         ADD     #10,SP
      022232   012703   000010                 MOV     #8.,R3            ; R3 = COUNTER OF ENTRIES
      022236   012704   003434                 MOV     #IPADRS,R4        ; R4 -> IP ADDRESS
      022242   005714                  1$:     TST     (R4)              ; IS THERE AN ENTRY?
      022244   001403                          BEQ     2$                ; IF NOT, DONE
      022246   005034                          CLR     @(R4)+            ; INIT UDA
      022250   005303                          DEC     R3                ; MAKE SURE WE DO NOT EXTEND OVER AREA
      022252   001373                          BNE     1$                ; IF NOT DONE, BRANCH
      022254                           2$:     CLRVEC  #4
      022254   012700   000004                                                                         MOV     #4,R0
      022260   104436                                                                                  TRAP    C$CVEC

      022262                                   ENDCLN
      022262                                                                                   L10037:
      022262   104412                                                                                  TRAP    C$CLEAN

      022264                                   ENDMOD
```

```
                                       .SBTTL  TEST 1: DUP PROGRAM DRIVER

022264                                         BGNMOD

022264                                         BGNTST
022264                                                                                T1::
022264                                         PNTX WNSTRT               ;PRINT WARNING MESSAGE
022264  004137  016432                                                                      JSR R1,LPNTX
022270  004565                                                                              .WORD WNSTRT
022272  000000                                                                              .WORD PNT.CT
022274                                         MANUAL                    ;SEE IF MANUAL INTERVENTION ALLOWED
022274  104450                                                                              TRAP     C$MANI
022276                                         BNCOMPLETE T1MODE         ;IF NOT, JUST RUN THE PROGRAM
022276  103020                                                                              BCC      T1MODE
022300  005037  003242                         CLR TEMP                  ;CLEAR WORD FOR ANSWER
022304                                         GMANIL WNQUES,TEMP,1,YES           ;ASK IF STILL WANT TO RUN
022304  104443                                                                              TRAP     C$GMAN
022306  000404                                                                              BR       10000$
022310  003242                                                                              .WORD    TEMP
022312  000130                                                                              .WORD    T$CODE
022314  003630                                                                              .WORD    WNQUES
022316  000001                                                                              .WORD    1
022320                                                                                10000$:
022320  005737  003242                         TST TEMP                           ;LOOK AT ANSWER
022324  001417                                 BEQ T1QUIT                ;IF NO, QUIT NOW
022326  005737  003304                         TST DATEO        ;SEE IF ALREADY ASKED FOR DATE
022332  001002                                 BNE T1MODE
022334  004737  020574                         CALL DATE        ;IF NOT, GET IT NOW

022340  032737  000003  003200         T1MODE: BIT #SO.FMT,MODE
022346  001164                                 BNE T1FMT
022350                                         MANUAL
022350  104450                                                                              TRAP     C$MANI
022352                                         BCOMPLETE T1GO
022352  103406                                                                              BCS      T1GO
022354                                         ERRSF 10.,ERR010
022354  104454                                                                              TRAP     C$ERSF
022356  000012                                                                              .WORD    10
022360  000000                                                                              .WORD    0
022362  012106                                                                              .WORD    ERR010
022364                                 T1QUIT: EXIT TST
022364  104432                                                                              TRAP     C$EXIT
022366  000362                                                                              .WORD    L10040-.
022370  032737  000010  003200         T1GO:   BIT #SO.STR,MODE
022376  001435                                 BEQ T1CNS
022400  023727  002012  000001                 CMP L$UNIT,#1
022406  001406                                 BEQ T1RST
022410                                         ERRSF 9.,ERR009
022410  104454                                                                              TRAP     C$ERSF
022412  000011                                                                              .WORD    9
022414  000000                                                                              .WORD    0
022416  012074                                                                              .WORD    ERR009
022420                                         EXIT TST
022420  104432                                                                              TRAP     C$EXIT
022422  000326                                                                              .WORD    L10040 .

022424                                 T1RST:  PNTF FILNAM
```

M11

```
     022424  004137  016412                                                                     JSR R1,LPNTF
     022430  011710                                                                             .WORD FILNAM
     022432  000000                                                                             .WORD PNT.CT
  31 022434                                    GMANID FILNAQ,FNAME,A,-1,1,10.,NO       ;GET FILE NAME
     022434  104443                                                                             TRAP     C$GMAN
     022436  000406                                                                             BR       10001$
     022440  003230                                                                             .WORD    FNAME
     022442  000142                                                                             .WORD    T$CODE
     022444  003574                                                                             .WORD    FILNAQ
     022446  177777                                                                             .WORD    -1
     022450  000001                                                                             .WORD    T$LOLIM
     022452  000012                                                                             .WORD    T$HILIM
     022454                                                                              10001$:
  32 022454                                    OPEN #FNAME
     022454  012700  003230                                                                     MOV      #FNAME,R0
     022460  104434                                                                             TRAP     C$OPEN
  33 022462  012737  177777  002166            MOV #-1,FILOPN  ;MARK FLAG AS FILE OPEN
  34 022470  000513                            BR T1FMT
  35 022472  013705  002150            T1CNS:  MOV CTABS,R5
  36 022476  010504                    T1SER1: MOV R5,R4
  37 022500  062704  000016                    ADD #C.DR0,R4
  38 022504  012703  000010                    MOV #8.,R3
  39 022510  011402                    T1SER2: MOV (R4),R2      ;GET DRIVE TABLE POINTER
  40 022512  001476                            BEQ T1SERN
  41 022514                                    PNTF SERNUM,D.UNIT(R2),(R5),(R2)
     022514  011246                                                                             MOV (R2),-(SP)
     022516  011546                                                                             MOV (R5),-(SP)
     022520  016246  000002                                                                     MOV D.UNIT(R2),-(SP)
     022524  004137  016412                                                                     JSR R1,LPNTF
     022530  004261                                                                             .WORD SERNUM
     022532  000006                                                                             .WORD PNT.CT
  42 022534                                            ASSUME C.UADR EQ 0
  43 022534                                            ASSUME D.DRV EQ 0
  44 022534                            T1SER3: GMANID SERNQ,TEMP,A,-1,1,20.,NO ;GET SERIAL NUMBER
     022534  104443                                                                             TRAP     C$GMAN
     022536  000406                                                                             BR       10002$
     022540  003242                                                                             .WORD    TEMP
     022542  000142                                                                             .WORD    T$CODE
     022544  003626                                                                             .WORD    SERNQ
     022546  177777                                                                             .WORD    -1
     022550  000001                                                                             .WORD    T$LOLIM
     022552  000024                                                                             .WORD    T$HILIM
     022554                                                                              10002$:
  45 022554  012701  003242                    MOV #TEMP,R1
  46 022560  005000                            CLR R0
  47 022562  105711                    T1SER4: TSTB (R1)
  48 022564  001410                            BEQ T1SER5
  49 022566  005200                            INC R0
  50 022570  121127  000060                    CMPB (R1),#'0
  51 022574  103420                            BLO T1SER7
  52 022576  122127  000071                    CMPB (R1)+,#'9
  53 022602  101767                            BLOS T1SER4
  54 022604  000414                            BR T1SER7
  55 022606  020027  000024            T1SER5: CMP R0,#20.
  56 022612  103424                            BLO T1SER8
  57 022614  012701  003242                    MOV #TEMP,R1
  58 022620  012700  003320                    MOV #HIGHEST,R0
```

```
022624  105710                  T1SER6: TSTB (R0)
022626  001416                          BEQ T1SER8
022630  122120                          CMPB (R1)+,(R0)+
022632  001774                          BEQ T1SER6
022634  103413                          BLO T1SER8
022636                          T1SER7: PRINTF #SERNX,#HIGHEST
022636  012746  003320                                                                      MOV     #HIGHEST,-(SP)
022642  012746  011601                                                                      MOV     #SERNX,-(SP)
022646  012746  000002                                                                      MOV     #2,-(SP)
022652  010600                                                                              MOV     SP,R0
022654  104417                                                                              TRAP    C$PNTF
022656  062706  000006                                                                      ADD     #6,SP
022662  000724                          BR T1SER3
022664  062702  000004          T1SER8: ADD #D.SERN,R2  ;PUT ANSWER INTO DRIVE TABLE
022670  012701  003242                  MOV #TEMP,R1
022674  112122                  T1SER9: MOVB (R1)+,(R2)+
022676  001376                          BNE T1SER9
022700  005303                          DEC R3
022702  001402                          BEQ T1SERN
022704  005724                          TST (R4)+
022706  000700                          BR T1SER2
022710  062705  000052          T1SERN: ADD #C.SIZE,R5
022714  005715                          TST (R5)
022716  001267                          BNE T1SER1
022720  013737  002150  002154  T1FMT:  MOV CTABS,TSTTAB             ;GET FIRST TABLE ADDRESS
022726  013701  002152                  MOV CTRLRS,R1                ;RUN DM PROGRAM ON ALL CONTROLLERS
022732  004737  013074                  CALL RUNDM                   ;  RUN ALL CONTROLLERS OF ONE TYPE AT ONCE
022736  001402                          BEQ 6$
022740  004737  013224                  CALL RESPDM
022744                          6$:     EXIT TST
022744  104432                                                                              TRAP    C$EXIT
022746  000002                                                                              .WORD   L10040 .
022750                                  ENDTST
022750                                                                              L10040:
022750  104401                                                                              TRAP    C$ETST
022752                                  ENDMOD
```

```
                                        .SBTTL  HARDWARE PARAMETER CODING SECTION

   022752                                       BGNMOD

                                        ;++
                                        ; THE HARDWARE PARAMETER CODING SECTION CONTAINS MACROS
                                        ; THAT ARE USED BY THE SUPERVISOR TO BUILD P-TABLES.  THE
                                        ; MACROS ARE NOT EXECUTED AS MACHINE INSTRUCTIONS BUT ARE
                                        ; INTERPRETED BY THE SUPERVISOR AS DATA STRUCTURES.  THE
                                        ; MACROS ALLOW THE SUPERVISOR TO ESTABLISH COMMUNICATIONS
                                        ; WITH THE OPERATOR.
                                        ;--

   022752                                       BGNHRD
   022752  000011                                                                                .WORD L10041-L$HARD/2
   022754                                                                                 L$HARD::

                                        ;FORMAT OF HARDWARE P-TABLE IS AS FOLLOWS:

   022754                               TABLE                               ;START A TEBLE DEFINITION

   022754                               ITEM HO.UBA     2                   ; UNIBUS ADDRESS
   022754                               ITEM HO.LDR     2                   ; DRIVE NUMBER
   022754                               END
```

```
  022754                                  GPRMA   H.UBA,HO.UBA,0,160000,177774,YES       ;BUS ADDRESS
  022754  000031                                                                                      .WORD   T$CODE
  022756  022776                                                                                      .WORD   H.UBA
  022760  160000                                                                                      .WORD   T$LOLIM
  022762  177774                                                                                      .WORD   T$HILIM
  022764                                  GPRMD   H.LDR,HO.LDR,D, 1,0.,255.,YES    ; DRIVE SELECT NUMBER
  022764  001052                                                                                      .WORD   T$CODE
  022766  023012                                                                                      .WORD   H.LDR
  022770  177777                                                                                      .WORD   -1
  022772  000000                                                                                      .WORD   T$LOLIM
  022774  000377                                                                                      .WORD   T$HILIM
  022776                                  ENDHRD
                                                                                                      .EVEN
  022776                                                                                      L10041:

  022776     103     123     122  H.UBA:  .ASCIZ  \CSR ADDRESS\
  023012     104     122     111  H.LDR:  .ASCIZ  \DRIVE NUMBER\
                                          .EVEN
```

```
                                            .SBTTL  SOFTWARE PARAMETER CODING SECTION

                                            ;++
                                            ; THE SOFTWARE PARAMETER CODING SECTION CONTAINS MACROS
                                            ; THAT ARE USED BY THE SUPERVISOR TO BUILD P-TABLES.  THE
                                            ; MACROS ARE NOT EXECUTED AS MACHINE INSTRUCTIONS BUT ARE
                                            ; INTERPRETED BY THE SUPERVISOR AS DATA STRUCTURES.  THE
                                            ; MACROS ALLOW THE SUPERVISOR TO ESTABLISH COMMUNICATIONS
                                            ; WITH THE OPERATOR.
                                            ;--

   023030                                           BGNSFT
   023030  000022                                                                                        .WORD L10042 L$SOFT/2
   023032                                                                                        L$SOFT::

                                            ;FORMAT OF SOFTWARE P-TABLE IS AS FOLLOWS:

   023032                                   TABLE                                 ;START A TABLE DEFINITION

   023032                                   ITEM SO.BIT     2                     ;YES/NO ANSWERS
           000001                                   SO.FM1 = BIT0                 ;  REFORMAT MODE
           000002                                   SO.FM2 = BIT1                 ;  (AGAIN)
           000003                                     SO.FMT = SO.FM1+SO.FM2
           000004                                   SO.CNS = BIT2                 ;  RECONSTRUCT MODE
           000010                                   SO.STR = BIT3                 ;  RESTORE MODE

   023032                                   END
```

SOFTWARE PARAMETER CODING SECTION

```
023032                                       GPRML S.FMT,SO.BIT,SO.FM1,YES    ;REFORMAT?
023032  000130                                                                                      .WORD   T$CODE
023034  023247                                                                                      .WORD   S.FMT
023036  000001                                                                                      .WORD   SO.FM1
023040                                       XFERT SWEND
023040  017024                                                                                      .WORD   T$CODE
023042                                       GPRML S.NRF,SO.BIT,SO.FM2,YES    ;AGAIN - REFORMAT?
023042  000130                                                                                      .WORD   T$CODE
023044  023076                                                                                      .WORD   S.NRF
023046  000002                                                                                      .WORD   SO.FM2
023050                                       XFERT SWEND
023050  013024                                                                                      .WORD   T$CODE
023052                                       GPRML S.CNS,SO.BIT,SO.CNS,YES    ;RECONSTRUCT
023052  000130                                                                                      .WORD   T$CODE
023054  023326                                                                                      .WORD   S.CNS
023056  000004                                                                                      .WORD   SO.CNS
023060                                       XFERT SWEND
023060  007024                                                                                      .WORD   T$CODE
023062                                       GPRML S.RST,SO.BIT,SO.STR,YES    ;RESTORE?
023062  000130                                                                                      .WORD   T$CODE
023064  023371                                                                                      .WORD   S.RST
023066  000010                                                                                      .WORD   SO.STR
023070                                       XFERT SWEND
023070  003024                                                                                      .WORD   T$CODE
023072                                       DISPLAY S.NOF    ;WARNING
023072  000003                                                                                      .WORD   T$CODE
023074  023512                                                                                      .WORD   S.NOF
023076                               SWEND:  ENDSFT
                                                                                                    .EVEN
023076                                                                                      L10042:

023076      015     012              S.NRF:  .BYTE 15,12
023100      116     117     124              .ASCII\NOT USING EXISTING INFORMATION WILL DESTROY THE FACTORY BAD SECTOR\
023202      015     012                      .BYTE 15,12
023204      111     116     106              .ASCII\INFORMATION ON THE DISKS.\
023235      015     012                      .BYTE 15,12
023237      101     107     101              .ASCII\AGAIN - \
023247      122     105     106      S.FMT:  .ASCIZ\REFORMAT USING EXISTING BAD SECTOR INFORMATION\
023326      122     105     103      S.CNS:  .ASCIZ\RECONSTRUCT BAD SECTOR INFORMATION\
023371      104     117     040      S.RST:  .ASCII\DO YOU HAVE A FILE ON THE SYSTEM LOAD DEVICE\
023445      015     012                      .BYTE 15,12
023447      040     103     117              .ASCIZ\ CONTAINING BAD SECTOR INFORMATION\
023512      131     117     125      S.NOF:  .ASCIZ\YOU CANNOT PROCEED WITHOUT SUCH A FILE.\
023562      122     105     123              .ASCIZ\RESTART PROGRAM AND SELECT TO REFORMAT OR RECONSTRUCT DISK.\
023656      000                              .BYTE 0
                                             .EVEN

                                             .DSABL AMA
000000                                       .PSECT END
```

```
                                        .SBTTL  PATCH AREA

000000                          $PATCH::
         000050                         .REPT 40.
                                        .WORD 0
                                        .ENDR

000120                                  LASTAD
                                                                              .EVEN
000120   000134'                                                              .WORD T$FREE
000122   000004                                                               .WORD T$SIZE
000124                          L$LAST::

000124                                  ENDMOD
```

```
      1 000124                              BGNSETUP        1
      2
      3 000124                              BGNPTAB
        000124  000000                                                                          .WORD   0
        000126  000002                                                                          .WORD   L10045-./2 1
        000130                                                                            L10043:
      4
      5 000130  172150                      .WORD   172150                ; UNIBUS ADDRESS
      6 000132  000000                      .WORD   0.                    ; LOGICAL DRIVE NUMBER
      7
      8 000134                              ENDPTAB
        000134                                                                            L10045:
      9
     10 000134                              ENDSETUP
     11
     12
     13
     14
     15
     16
     17
     18         000001                .END
Frrors detected:  0

*** Assembler statistics


Work  file  reads: 589
Work  file writes: 519
Size of work file: 29208 Words  ( 115 Pages)
Size of core pool: 14336 Words  ( 56 Pages)
Operating  system: RT-11 (Under RTEM-11)

Elapsed time: 00:07:56.00
ZUDKA0,ZUDKA0/C=SVC34R.MLB/P:1,ZUDKA0.DOC,ZUDKA0
```

```
$PATCH  124-30#
ADR      30-10#
ALOCM    56-16#    57-14    116-123  116-174  116-220
ASSEMB   26-8      26-8
BAS      50-14#    83-5      83-5     83-5     84-5     84-5
BASL2    50-12#    84-5
BASL3    50-13#
BASLN    50-16#    83-5      84-5
BASNO    50-11#    83-5      84-5
BIT0     30-10#  122-19
BIT00    30-10     30-10#
BIT01    30-10     30-10#
BIT02    30-10     30-10#
BIT03    30-10     30-10#
BIT04    30-10     30-10#
BIT05    30-10     30-10#
BIT06    30-10     30-10#
BIT07    30-10     30-10#
BIT08    30-10     30-10#
BIT09    30-10     30-10#
BIT1     30-10#    33-26     41-22   122-20
BIT10    30-10#
BIT11    30-10#
BIT12    30-10#
BIT13    30-10#
BIT14    30-10#
BIT15    30-10#    41-15     42-12     59-27    62-20    70-28    75-15    89-29
BIT2     30-10#    33-27     41-23   122-22
BIT3     30-10#    33-28     41-24   122-23
BIT4     30-10#    33-29     41-26
BIT5     30-10#    41-29
BIT6     30-10#    41-30
BIT7     30-10#    41-32
BIT8     30-10#
BIT9     30-10#
BLDC0    97-22     97-24#
BLDC1    97-26#    97-28
BLDCMD   61-49     64-14     64-44     95-2     97-15#
BOE      30-10#
BRSAV   114-104# 116-145* 116-179  116-181*
C$AU     26-8#
C$AUTO   26-8#   117-12
C$BRK    26-8#     58-12     61-8    100-21   107-12   110-27
C$BSEG   26-8#
C$BSUB   26-8#
C$CEFG   26-8#
C$CLCK   26-8#   116-93   116-95
C$CLEA   26-8#   118-21
C$CLOS   26-8#     60-12     73-19
C$CLP1   26-8#
C$CVEC   26-8#     58-22   107-30   118-19
C$DCLN   26-8#     55-8      58-30   116-69   116-240  116-246
C$DODU   26-8#
C$DRPT   26-8#
C$DU     26-8#
C$EDIT   26-8#     26-34
```

```
C$ERDF   26-8#    58-28    61-24    62-36    63-21    64-8     68-22    70-32    96-3     100-29   101-5    105-36   105-51   106-12
         107-33   109-37   110-36   111-5
C$ERMR   26-8#
C$ERRO   26-8#
C$ERSF   26-8#    55-7     116-239  116-245  119-21   119-27
C$ERSO   26-8#
C$ESCA   26-8#
C$ESEG   26-8#
C$ESUB   26-8#
C$ETST   26-8#    119-83
C$EXIT   26-8#    116-235  119-22   119-28   119-82
C$GETB   26-8#     73-24
C$GETW   26-8#
C$GMAN   26-8#    114-1    119-10   119-31   119-44
C$GPHR   26-8#    116-146
C$GPLO   26-8#
C$GPRI   26-8#
C$INIT   26-8#    116-249
C$INLP   26-8#
C$MANI   26-8#    119-7    119-19
C$MEM    26-8#    116-109
C$MSG    26-8#     53-16    53-20    53-24    53-28    53-32    53-36    53-40    53-44    53-48    53-60    53-65    53-77    53-81
         53-85     53-89    53-93    53-98    53-102   53-106   53-110   53-114   53-118   53-122
C$OPEN   26-8#     73-20   119-32
C$PNTB   26-8#     91-14
C$PNTF   26-8#     91-12   119-64
C$PNTS   26-8#     91-18
C$PNTX   26-8#     91-16
C$QIO    26-8#
C$RDBU   26-8#
C$REFG   26-8#    116-47   116-53   116-59   116-66
C$RESE   26-8#     26-8#
C$REVI   26-8#     26-34
C$RFLA   26-8#
C$RPT    26-8#
C$SEFG   26-8#
C$SPRI   26-8#    116-233
C$SVEC   26-8#     58-11    94-20   107-27   116-106  118-11
C$TPRI   26-8#
C.DR0    41-34#    62-15    75-12   116-197  119-37
C.DR1    41-35#
C.DR2    41-36#
C.DR3    41-37#
C.DR4    41-38#
C.DR5    41-39#
C.DR6    41-40#
C.DR7    41-41#
C.FLG    41-21#    59-23*   61-10    61-13    61-15    61-38    61-43    61-47*   62-12*   63-6     63-26    64-35*   64-39*   64-40
         64-47*    64-50*   64-62*   64-63    64-69*   64-70    95-12*   95-13*   98-21*   100-17   101-1*   116-186
C.JAD    41-20#
C.JSR    41-19#    94-19
C.PRI    41-45#    64-65    64-67    64-72*   64-73*
C.REF    41-46#    63-19    98-16*   98-17
C.RING   41-33#    53-138   57-15*   61-9     64-29    97-16    98-15    105-20   106-3    106-20   107-20
C.SIZE   41-48#    59-32    62-5     116-157  116-173  116-186  119-74
C.TO     41-42#    61-36    64-55    100-14   100-27   110-22   110-33
```

```
C.TOH    41-43#    61-33     100-24    110-30
C.TOT    41-44#    61-29      64-53     94-14*    94-15*
C.UADR   41-12#    76-16     107-25    116-152   119-42
C.UNIT   41-13#    59-24      59-25     61-12
C.VEC    41-16#    94-16     107-14
CALR4    80-6      83-5#
CALR5    80-7      84-5#
CALR6    80-8      85-4#
CALR7    80-9      86-4#
CALR8    80-10     87-4#
CALRE    80-3      80-4       80-5      82-4#
CF.576   37-39#
CF.ATN   37-34#
CF.MSC   37-35#
CF.OTH   37-36#
CF.SHD   37-38#
CF.THS   37-37#
CLOSEF   60-10#   118-10
CLRSFL   99-22#    99-24
CLRBUF   64-16     64-46      99-16#
CON.A    78-12#    81-21
CON.A1   78-13#    78-15
CON.A2   78-17     78-19#
CON.D    78-23#    81-21
CON.H    78-29#    81-21
CON.N    79-9#     81-21
CON.N1   79-10#    79-12
CON.O    79-3#     81-21
CON.QU   78-3#     78-7       81-21
CON.QX   78-5      78-8#
CON.R    79-17#    81-21
CON.R1   79-19     79-23#
CON.S    79-29#    81-21
CON.S1   79-30#    79-32
CPNT     74-18     74-21      76-21     76-23     78-6      78-13     79-10     79-30     83-7      84-7      90-13     90-22     91-5#    113-27
        113-32    113-35
CPNTX    91-13     91-15      91-17     91-19#
CR       30-12#    74-21      76-21     76-23     79-10     83-7      84-7      91-8
CT.AVL   41-15#    59-27
CT.BRL   41-18#
CT.CMD   41-23#    61-15      95-12     98-21
CT.MSG   41-24#    61-13      64-39     64-62    100-17    101-1     103-19
CT.REQ   41-26#    63-6       63-26     64-35     64-40     64-47     64-50     95-12
CT.RN    41-22#    61-10      95-13
CT.STA   41-29#    61-38      61-46     64-39     64-62
CT.TM1   41-30#    61-42      61-43     64-39     64-70
CT.TM2   41-32#    64-39      64-63     64-69
CT.UNT   41-14#
CT.VEC   41-17#    94-17     107-15
CTABS    46-12#   116-130*  116-131*  116-148   119-35    119-77
CTRLRS   46-13#   116-132*  116-190*  119-78
D.DRV    42-9#     69-36      76-17    119-43
D.SERN   42-13#    68-17     119-66
D.SIZE   42-15#   116-120   116-214
D.UNIT   42-10#    62-19      62-25*    75-14     76-15    119-41
DAS1    114-8     114-13#
```

K12

SFQ 0153

```
CZUDKO UDA50A/KDA50-Q FORMATTER MACRO V05.01b Monday 01-Oct-84 10:07 Page S-4
Cross reference table (CREF V05.01)

DATE     114-1#    114-32    119-15
DATEI     47-2#    114-1     114-2     114-44
DATEO     47-4#     68-26    114-33    119-13
DATEQ     49-3#    114-1
DATEX     52-13#   114-31
DAY      114-5#
DAY1     114-46#   114-57
DAY2     114-47    114-58#
DAYS      47-19#   114-42
DERR     114-4     114-6     114-10    114-12    114-14    114-31#   114-59    114-61    114-64    114-84    114-88    114-90
DF.ACT    40-21#    64-60
DF.LCL    40-24#
DF.NES    40-22#
DF.SA     40-26#
DFPTBL    28-10#
DIAG      34-33#    97-23
DIAGMC    26-8      26-8
DIVIDE    69-38     89-39     90-7      93-16#   113-19    113-21    113-23
DMFRST    40-47#
DMMAIN    40-46#
DMOVRL    40-44#
DMPROG    46-16#    94-13     95-3      95-4      95-5      95-6
DMTMO     40-45#    94-14
DMTRLN    40-43#
DQCONT    69-28     69-61#
DQNO      69-54     69-62#
DQRFMT    69-26     69-53#
DQRSTR    69-27     69-59#
DQUEJP    69-21     69-22#    69-29
DQUEST    65-4      69-16#
DQUESZ    69-18     69-29#
DQUEX     69-19     69-22     69-24     69-25     69-50#    69-57     69-64
DQUNIT    69-23     69-33#
DQUNL1    69-38#    69-42
DQUNL2    69-44#    69-48
DQYES     69-55#    69-60
DSPSIZ    65-9#
DT.AVL    42-12#    62-20     62-25     75-15
DT.UNT    42-11#
DTABS     46-30#   116-116*  116-117*  116-196   116-214*  116-215*
DU.DFL    40-33#
DU.FTL    40-36#
DU.INF    40-34#
DU.QUE    40-32#
DU.SPC    40-37#    64-6
DU.TER    40-35#
DU.TYP    40-39#    64-4      64-19
DUP       34-34#    97-20
E$END     26-8#
E$LOAD    26-8#     26-34
EF.BBR    37-27#
EF.BBU    37-28#
EF.CON    30-10#   116-59
EF.LOG    37-29#
EF.NEW    30-10#
EF.PWR    30-10#   116-66
EF.RES   30-10#   116-53
EF.SEX   37-30#
EF.STA   30-10#   116-47
EOFMSG   53-56     53-59#
ERR001   53-14#
ERR002   53-18#   116-239
ERR003   53-22#   116-245
ERR004   53-26#    55-7
ERR008   53-30#
ERR009   53-34#   119-27
ERR010   53-38#   119-21
ERR014   53-42#   105-51
ERR020   53-46#    58-28    107-33
ERR021   53-50#   111-5
ERR022   53-62#   110-36
ERR023   53-67#   106-12
ERR024   53-79#   105-36
ERR025   53-83#   109-37
ERR030   53-87#    61-24
ERR031   53-91#    62-36
ERR032   53-95#    64-8
ERR033   53-100#   63-21
ERR034   53-104#   96-3
ERR036   53-108#  100-29
ERR037   53-112#  101-5
ERR100   53-116#   68-22
ERR101   53-120#   70-32
ERR21A   53-54     53-57#
ERR23A   53-70#    53-75
ERR23B   53-71     53-73#
ERR23C   53-76#
ERRC     77-36     77-43     81-9#
ERRCHR   46-42#    91-5*     91-12     91-14     91-16     91-18
ERRD     77-45     81-21#
ERRME1   50-8#     77-41     79-23     82-4
ERRNL    50-4#     91-10
ERRONE   50-3#     91-7
ERRRSZ   79-18     80-11#
ERRRTB   79-21     80-3#     80-11
ERRTRM   65-7      72-14#
EVL      30-10#
F$AU     26-8#
F$AUTO   26-8#    117-10    117-12
F$BGN    26-8#     26-26     29-16     30-3      53-14     53-18     53-22     53-26     53-30     53-34     53-38     53-42     53-46     53-50
          53-62     53-67     53-79     53-83     53-87     53-91     53-95     53-100    53-104    53-108    53-112    53-116    53-120   102-10
         103-18    112-5     114-106   115-3     115-10    116-45    116-235   117-10    118-8     118-23    119-3     119-5     119-22    119-28
         119-82    119-83    119-84    120-3     120-14    122-12    123-9     123-9     124-10    125-1     125-3     125-3     125-8     125-10
F$CLEA   26-8#    118-8     118-21
F$DU     26-8#
F$END    26-8      26-8      26-8      26-8      26-8      26-8      26-8      26-8      26-8      26-8      26-8      26-8      26-8      26-8
          26-8      26-8      26-8#     26-26     29-16     30-3      53-16     53-20     53-24     53-28     53-32     53-36     53-40     53-44
          53-48     53-60     53-65     53-77     53-81     53-85     53-89     53-93     53-98     53-102    53-106    53-110    53-114    53-118
          53-122   102-14    103-21    112-9     114-106   115-3     116-235   116-249   117-12    118-21    118-23    119-3     119-5     119-5
         119-5     119-22    119-28    119-82    119-83    119-83    119-84    120-3     121-3     123-10    124-10    125-1     125-3     125-8
         125-10
F$HARD   26-8#    120-14    121-3     123-2     123-4     123-6     123-8
```

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```
F$HW     26-8#     28-10     28-14
F$INIT   26-8#     116-45    116-249
F$JMP    26-8#     116-235   119-22    119-28    119-82
F$MOD    26-8#     26-26     29-16     30-3      114-106   115-3     118-23    119-3     119-84    120-3     124-10
F$MSG    26-8#     53-14     53-16     53-18     53-20     53-22     53-24     53-26     53-28     53-30     53-32     53-34     53-36     53-38
         53-40     53-42     53-44     53-46     53-48     53-50     53-60     53-62     53-65     53-67     53-77     53-79     53-81     53-83
         53-85     53-87     53-89     53-91     53-93     53-95     53-98     53-100    53-102    53-104    53-106    53-108    53-110    53-112
         53-114    53-116    53-118    53-120    53-122
F$PROT   26-8#     115-10    115-16
F$PWR    26-8#
F$RPT    26-8#
F$SEG    26-8#
F$SOFT   26-8#     122-12    123-2     123-4     123-6     123-8     123-10
F$SRV    26-8#     102-10    102-14    103-18    103-21    112-5     112-9
F$SUB    26-8#
F$SW     26-8#     29-10     29-14
F$TEST   26-8#     119-5     119-83
FCTBUF   46-24#    73-23     73-32
FCTNUM   46-25#    59-36*    73-14     73-21*    73-28*
FDATA    46-23#
FFREE    46-8#     56-16     56-20*    116-109*  116-110   116-116   116-130   116-226
FILNAM   52-14#    119-30
FILNAQ   49-4#     119-31
FILOPN   46-20#    60-10     60-13*    119-33*
FMEM     46-10#    116-226*
FMEMS    46-11#    116-227*
FMERR    55-7#     56-18
FNAME    46-44#    73-20     119-31    119-32
FSIZE    46-9#     56-17*    116-110*  116-227
G$CNTO   26-8#
G$DELM   26-8#
G$DISP   26-8#     123-9
G$EXCP   26-8#
G$HILI   26-8#
G$LOLI   26-8#
G$NO     26-8#     119-31    119-44
G$OFFS   26-8#     114-1     119-10    119-31    119-44    121-1     121-2     123-1     123-3     123-5     123-7
G$OFSI   26-8#     114-1     119-10    119-31    119-44    121-1     121-2     123-1     123-3     123-5     123-7
G$PRMA   26-8#     121-1
G$PRMD   26-8#     114-1     119-31    119-44    121-2
G$PRML   26-8#     119-10    123-1     123-3     123-5     123-7
G$RADA   26-8#     114-1     119-31    119-44
G$RADB   26-8#
G$RADD   26-8#     121-2
G$RADL   26-8#     119-10    123-1     123-3     123-5     123-7
G$RADO   26-8#     121-1
G$XFER   26-8#     123-2     123-4     123-6     123-8
G$YES    26-8#     114-1     119-10    121-1     121-2     123-1     123-3     123-5     123-7
GETCDN   88-16     88-18     88-28#
GETCNT   78-12     79-9      79-17     79-29     88-13#    89-15
GETCNX   88-15#    88-27
GETCXX   88-29     88-31#
GTDRVL   75-13#    75-16
GTDRVT   68-16     69-16     70-24     70-36     75-11#
H.LDR    121-2     121-6#
H.UBA    121-1     121-5#
```

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HC.BF1  34-24#    34-25     64-15
HC.BF2  34-25#    34-27     53-139    64-3      64-45
HC.BSZ  34-13#    34-25     34-27     64-18     99-19     99-21
HC.CCT  34-19#    61-40     61-50*    98-19*
HC.CEV  34-22#    34-23     97-18
HC.CMD  34-18#    34-19     34-20     106-23*   106-24*
HC.CPK  34-23#    34-24     53-126    64-33*    95-3*     95-4*     95-5*     95-6*     97-29*    98-17*    99-18*    99-19*   106-24
HC.ESZ  34-11#    34-21     34-23
HC.INT  34-15#    34-16
HC.ISZ  34-9#     34-16     105-21    106-5
HC.MCT  34-17#    64-74*    98-18*
HC.MEV  34-20#    34-21
HC.MPK  34-21#    34-22     53-128    63-9      63-14     63-19     64-11     64-58     64-60     64-65     64-67     64-72     64-73     95-10
       106-22
HC.MSG  34-16#    34-17     34-18     106-21*   106-22*   107-21
HC.PSZ  34-12#    34-22     34-24     97-19     97-25
HC.RSZ  34-10#    34-18     34-20     105-21    106-5
HC.SIZ  34-27#    57-13
HCOMM   57-13#    59-28
HEADER  70-26     70-38     76-13#
HIGHES  47-6#     119-58    119-64
HO.LDR 116-201   116-211   120-21#   121-2     121-2     121-2
HO.UBA 116-153   120-20#   121-1     121-1     121-1
HOE     30-10#
I$AU    26-8#
I$AUTO  26-8#     117-10#   117-12#
I$CLN   26-8#     118-8#    118-21#
I$DU    26-8#
I$HRD  120-14#   121-3#    123-9
I$INIT  26-8#     116-45#   116-235   116-249#
I$MOD   26-8#     26-26     26-26#    29-16     29-16#    30-3      30-3#     114-106   114-106#  115-3     115-3#    118-23    118-23#   119-3
       119-3#    119-84    119-84#   120-3     120-3#    124-10    124-10#
I$MSG   26-8#     53-14#    53-16#    53-18#    53-20#    53-22#    53-24#    53-26#    53-28#    53-30#    53-32#    53-34#    53-36#    53-38#
        53-40#    53-42#    53-44#    53-46#    53-48#    53-50#    53-60#    53-62#    53-65#    53-67#    53-77#    53-79#    53-81#    53-83#
        53-85#    53-87#    53-89#    53-91#    53-93#    53-95#    53-98#    53-100#   53-102#   53-104#   53-106#   53-108#   53-110#   53-112#
        53-114#   53-116#   53-118#   53-120#   53-122#
I$PROT  26-8#     115-10#
I$PTAB  26-8#     125-3     125-3#    125-8     125-8#
I$PWR   26-8#
I$RPT   26-8#
I$SEG   26-8#     119-5
I$SETU  26-8#     125-1     125-1#    125-3     125-10    125-10#
I$SFT  122-12#   123-9     123-10#
I$SRV   26-8#     102-10#   102-14#   103-18#   103-21#   112-5#    112-9#
I$SUB   26-8#     119-5
I$TST   26-8#     119-5     119-5#    119-22    119-28    119-82    119-83    119-83#   119-83#
IBE     30-10#
ICONT   33-26#    116-63
IDU     30-10#
IER     30-10#
IFLAGS  46-31#    116-50*   116-56*   116-62*   116-63*
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INFOB   70-16     70-36#
INFOE   70-18     70-32#
INFOH   70-20     70-24#
INFOP   70-22     70-27#
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INIT1   116-51    116-57    116-78#
INIT2   116-116#
INIT3   116-130#
INIT4   116-143#
INIT6   116-226#
INITQT  116-69#   [illegible]5-86
INITXX  116-71    [illegible]-233#
IPADRS   47-34#    58-14    116-133   116-164   116-165   118-13
IREST    33-27#   116-56
ISR      30-10#
ISTRT    33-28#   116-50
ISTRTM   33-29#   116-62
IXF      30-10#
J$JMP    26-8#
KW.BRL   46-36#   116-102*
KW.CSR   46-35#    61-31     76-19    100-22    110-28    112-8*    113-13    116-97*   116-101*  116-107*
KW.EL    46-39#    61-33     61-36    100-24    100-27    104-26    104-27    104-28    110-30    110-33    112-6*    112-7*    113-16    113 17
        116-91*   116-92*
KW.MZ    46-38#   104-16    113-18    116-104*
KW.VEC   46-37#   116-103*  116-106
KW11I   112-5#    116-106
KWOUT.  112-8     116-89#   116-107
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L$APT    26-34#
L$AUT    26-34#
L$AUTO   26-34    117-10#
L$CCP    26-34#
L$CLEA   26-34    118-8#
L$CO     26-34#
L$DEPO   26-34#
L$DESC   25-34     48-16#
L$DESP   26-34#
L$DEVP   26-34#
L$DISP   26-34     27-9#
L$DLY    26-34#
L$DTP    26-34#
L$DTYP   26-34#
L$DUT    26-34#
L$DVTY   26-34     48-12#
L$EF     26-34#
L$ENVI   26-34#
L$ETP    26-34#
L$EXP1   26-34#
L$EXP4   26-34#
L$EXP5   26-34#
L$HARD   26-34    120-14    120-14#
L$HIME   26-34#
L$HPCP   26-34#
L$HPTP   26-34#
L$HW     26-34     28-10     28-10#
L$ICP    26-34#
L$INIT   26-34    116-45#
L$LADP   26-34#
L$LAST   26-34    124-8#    125 10
```

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L$LOAD  26-34#
L$LUN   26-34#   59-24*   61-12*   75-14*
L$MREV  26-34#
L$NAME  26-34#
L$PRIO  26-34#
L$PROT  26-34   115 10#
L$PRT   26-34#
L$REPP  26-34#
L$REV   26-34#
L$SOFT  26-34   122-12   122-12#
L$SPC   26-34#
L$SPCP  26-34#
L$SPTP  26-34#
L$STA   26-34#
L$SW    26-34    29-10    29-10#
L$TEST  26-34#
L$TIML  26-34#
L$UNIT  26-34#   76-13   116-118  116-217  119-25
L10000  28-10    28-14#
L10001  29-10    29-14#
L10002  53-16#
L10003  53-20#
L10004  53-24#
L10005  53-28#
L10006  53-32#
L10007  53-36#
L10010  53-40#
L10011  53-44#
L10012  53-48#
L10013  53-60#
L10014  53-65#
L10015  53-77#
L10016  53-81#
L10017  53-85#
L10020  53-89#
L10021  53-93#
L10022  53-98#
L10023  53-102#
L10024  53-106#
L10025  53-110#
L10026  53-114#
L10027  53-118#
L10030  53-122#
L10031 102-14#
L10032 103-21#
L10033 112-9#
L10035 116-235  116-249#
L10036 117-12#
L10037 118-21#
L10040 119-22   119-28   119-82   119-83#
L10041 120-14   121-3#
L10042 122-12   123-10#
L10043 125-3#
L10045 125-3    125-8#
LDDM    59-22#   59-34
LDNEXT  59-26    59-30    59-32#
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LOADE1  95-11     96-3#
LOADER  94-23     95-9      96-4#
LOE     30-10#
LOG     34-32#
LOT     30-10#
LPNT    70-40     92-6      92-8      92-10     92-12#   113-24    113-28    113-33
LPNTB   53-15     53-19     53-23     53-27     53-31     53-35     53-39     53-43     53-47     53-55     53-58     53-64     53-68     53-72
        53-76     53-80     53-84     53-88     53-92     53-96     53-109    53-113    53-117    53-121    53-124    53-130    53-137    53-141
        83-5      84-5      92-7#
LPNTF   76-15     77-41     79-23     82-4      92-5#    114-31    116-98    119-30    119-41
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LPNTX   92-9#    119-6
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MD.CWB  37 22#
MD.ERR  37-6#
MD.EXP  37-5#
MD.FEU  37-16#
MD.IMF  37-20#
MD.NXU  37-18#
MD.PRI  37-23#
MD.RIP  37-19#
MD.SCH  37-7#
MD.SCL  37-8#
MD.SEC  37-9#
MD.SEQ  37-14#
MD.SER  37-10#
MD.SPD  37-15#
MD.SSH  37-11#
MD.SWP  37-21#
MD.VOL  37-17#
MD.WBN  37-12#
MD.WBV  37-13#
MESG    70-27     70-39     74-13#
MESSG   50-9#     76-15
MLDRER 116-203   116-238#
MODE    46-26#    69-53     69-59    116-87*   119-17    119-23
MON1   114-17#   114-30
MON2   114-19    114-21#
MON3   114-22    114-24#
MON4   114-25    114-27#
MON5   114-28    114-33#
MON6   114-36    114-39#
MONTHS  47-7#    114-16
MSCP    34-31#
MSGPKL  53-141#   53-144
MSGPKT  53-97     53-137#
NCONF   77-38     77-43#
NCONS   77-37#    77-40
NOCLOC  50-10#   116-98
NULL    46-43#
NXMAD   46-22#    58-10*    58-18    102-12*   107-26*   107-31
NXM1    58-11    102-10#   107-27    118-11
O$APTS  26-8#     26-34
O$AU    26-8#     26-34
O$BGNR  26-8#     26-34
```

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O$BGNS   26-8#    26-32#   26-34
O$DU     26-8#    26-34
O$ERRT   26-8#    26-34
O$GNSW   26-8#    26-32#   26-34
O$POIN   26-8#    26-32    26-32#   26 32#   26-32#   26-34
U$SETU   26-8#    26-32#   26-34   124-8
OP.ABO   36-3#
OP.ACC   36-4#
OP.AVA   36-22#
OP.AVL   36-5#
OP.CCD   36-6#
OP.CMP   36-7#
OP.DUP   36-23#
OP.ELP   36-30#
OP.END   36-20#   63-5     63-8     64-58
OP.ERS   36-8#
OP.ESP   36-29#   95-1
OP.FLU   36-9#
UP.GCS   36-10#
OP.GDS   36-27#   61-48    64-58
OP.GSS   36-28#
OP.GUS   36-11#
OP.MRD   36-18#
OP.MWR   36-19#   97-21
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OP.RD    36-13#
OP.RLC   36-25#
OP.RPL   36-14#
OP.RSD   36-32#   63-8     64-43
OP.SCC   36-15#
OP.SEX   36-21#
OP.SHC   36-24#
OP.SSD   36-31#   63-5     64-13
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OP.WR    36-17#
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OSTRNG   77-34#   77-46    85-6     86-6     87-6     92-17
P.BCNT   38-21#   39-9#    64-11    64-33*   95-4*    99-19*
P.BUFF   38-22#
P.CMST   39-14#
P.CNCL   39-48#
P.CNTF   38-40#   39-46#
P.CNTI   39-49#
P.CPSP   38-34#
P.CRF    38-17#   39-4#    63-19    98-17*
P.CTMO   39-47#
P.CYL    39-26#
P.DEXT   39-52#
P.DFLG   39-53#   64-60
P.DMDT   38-50#
P.DPI    39-54#   64-65    64-67    64-72    64-73
P.DTO    39-55#
P.ELGF   38-32#
P.FBBK   39-10#
P.FLGS   39-7#
P.GRP    39-25#
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P.HTMO   38-41#
P.LBN    38-24#
P.MEDI   39-21#    39 37#
P.MLUN   39-17#    39-33#
P.MOD    38-20#
P.OPCD   38-19#    39-6#     63-9      64-58     97-29*
P.OTRF   38-27#    39-13#
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P.RBN    38-36#
P.RBNS   39-28#
P.RCTC   39-29#
P.RCTS   39-27#
P.RGJD   38-46#
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P.SHST   39-23#    39-39#
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P.UNCL   39-40#
P.UNFL   38-30#    39-18#    39-34#
P.UNIT   38-18#    39-5#
P.UNSZ   39-41#
P.UNTI   39-20#    39-36#
P.USEF   38-42#
P.VRSN   38-39#    39-45#
P.VSER   39-42#
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         53-31     53-31     53-31#    53-31#    53-35     53-35#    53-39     53-39#    53-43     53-43     53-43#    53-43#    53-47     53-47#
         53-55     53-55     53-55#    53-55#    53-58     53-58     53-58#    53-58#    53-64     53-64     53-64     53-64#    53-64#    53-64#
         53-68     53-68     53-68     53-68#    53-68#    53-68#    53-72     53-72     53-72     53-72#    53-72#    53-72#    53-76     53-76#
         53-80     53-80     53-80#    53-80#    53-84     53-84     53-84     53-84#    53-84#    53-84#    53-88     53-88     53-88#    53-88#
         53-92     53-92#    53-96     53-96#    53-109    53-109#   53-113    53-113    53-113#   53-113#   53-117    53-117    53-117#   53-117#
         53-121    53-121#   53-124    53-124#   53-130    53-130    53-130    53-130    53-130    53-130#   53-130#   53-130#   53-130#   53-130#
         53-137    53-137#   53-141    53-141    53-141    53-141    53-141    53-141    53-141    53-141    53-141#   53-141#   53-141#   53-141#
         53-141#   53-141#   53-141#   53-141#   70-40     70-40#    76-15     76-15     76-15     76-15     76-15#    76-15#    76-15#    76-15#
         77-41     77-41#    79-23     79-23#    82-4      82-4#     83-5      83-5      83-5      83-5      83-5      83-5#     83-5#     83-5#
         83-5#     83-5#     84-5      84-5      84-5      84-5      84-5      84-5      84-5#     84-5#     84-5#     84-5#     84-5#     84-5#
        113-24    113-24    113-24#   113-24#   113-28    113-28    113-28#   113-28#   113-33    113-33    113-33#   113-33#   114-31    114-31#
        116-98    116-98#   119-6     119-6#    119-30    119-30#   119-41    119-41    119-41    119-41    119-41#   119-41#   119-41#   119-41#
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PNTNUS   89-16#
PNTPKL   53-130#   53-134
PNTPKT   53-101    53-105    53-124#
PRI      30-10#
PRI00    30-10#   116-233
PRI01    30-10#
PRI02    3C-10#
PRI03    30-10#
PRI04    30-10#
PRI05    30-10#
```

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RNTIM2   50-7#    113-33
RNTIME   76-22     83-6      84-6     113-13#
RNTIMX  113-14    113-35#
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RSPERW   63-15     63-21#    64-59
RSPIN    61-14     63-5#
RSPMWR   63-7      63-9#
RSPNTO   61-30     61-32     61-35     61-37     61-53#
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RSPOU3   64-48     64-51#
RSPOU4   61-52     64-53#
RSPOUT   61-17     63-27     64-34     64-39#
RSPPT2   64-3#
RSPPT3   64-7      64-11#
RSPPTW   63-20     63-26#
RSPTM    61-23     61-29#
RSPTMO   61-34     61-38#
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         53-77#    53-81#    53-85#    53-89#    53-93#    53-98#    53-102#   53-106#   53-110#   53-114#   53-118#   53-122#  102-14#   103-21#
        112-9#    114-1     114-1     114-1     114-1#    116-249#  117-12#   118-21#   119-10    119-10    119-10    119-10#   119-31    119-31
        119-31    119-31#   119-44    119-44    119-44    119-44#   119-83#   121-3#    123-10#
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S.FMT   123-1     123-18#
S.NOF   123-9     123-23#
S.NRF   123-3     123-12#
S.RST   123-7     123-20#
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SA.BST   33-22#
SA.CM1   32-35#
SA.CMD   32-30#
SA.CME   32-40#
SA.CNT   33-16#   105-42
SA.CTP   32-43#
SA.DI    32-22#   109-13
SA.ERC   32-16#
SA.ERR   32-9#     53-63    110-19
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SA.MCV   33-15#
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SA.MSE   32-39#
SA.MSG   32-29#
SA.NV    32-20#
SA.NVE   33-5#
SA.PRG   32-47#
SA.QB    32-10#   109-14
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SA.S2    32-6#    109-23
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SA.S4    32-8#    108-13
SA.SM    32-12#   109-14
SA.STE   32-42#
SA.STP   32-32#   107-18
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SA.VCE   33-3#
SA.VEC   32-27#
SA.WRP   32-31#
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SERNX    52-12#   119-64
SET00   104-17#   104-22
SET01   104-18    104-20#
SET02   104-26#   104-29
SETTO    64-56    100-15   104-14#  110-23
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SO.FM2  122-20#   122-21   123-3
SO.FMT   69-53    116-78   119-17   122-21#
SO.STR   69-59    119-23   122-23#  123-7
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SPECLC   73-18#
SPECLE   73-25     73-31#
SPECLL   73-24#    73-27
SPECLR   73-16     73-22#
SPECLX   73-15     73-32#
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ST.AVL   40-9#
ST.CMD   40-6#
ST.CMP   40-12#
ST.CNT   40-15#
ST.DAT   40-13#
ST.DIA   40-17#
ST.DRV   40-16#
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ST.MFE  40-10#
ST.MSK  40-3#   63-14   95-10
ST.OFL  40-8#
ST.SUB  40-4#
ST.SUC  40-5#
ST.WPR  40-11#
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         103-18   103-18#  112-5    112-5#   115-3    115-3#   115-10   115-10#  116-45   116-45#  117-10   117-10#  118-8    118-8#
         119-3    119-3#   119-5    119-5#   120-3    120-3#   120-14   120-14#  122-12   122-12#
M$PUT    58-11    58-11    58-11    58-11    58-11#   91-12    91-12    91-12    91-12#   91-14    91-14    91-14    91-14#   91-16
         91-16    91-16    91-16#   91-18    91-18    91-18    91-18#   94-20    94-20    94-20    94-20    94-20#   107-27   107-27
         107-27   107-27   107-27#  116-106  116-106  116-106  116-106  116-106# 118-11   118-11   118-11   118-11   118-11#  119-64
         119-64   119-64   119-64#
M$PUT1   58-11    58-11    58-11    58-11    58-11#   58-11#   58-11#   58-11#   91-12    91-12    91-12    91-12#   91-12#   91-12#
         91-14    91-14    91-14    91-14#   91-14#   91-14#   91-16    91-16    91-16    91-16#   91-16#   91-16#   91-18    91-18
         91-18    91-18#   91-18#   91-18#   94-20    94-20    94-20    94-20    94-20#   94-20#   94-20#   94-20#   107-27   107-27
         107-27   107-27   107-27#  107-27#  107-27#  107-27#  116-106  116-106  116-106  116-106  116-106# 116-106# 116-106# 116 106#
         118-11   118-11   118-11   118-11   118-11#  118-11#  118-11#  118-11#  119-64   119-64   119-64   119-64#  119-64#  119-64#
M$RADI   114-1    114-1#   119-10   119-10#  119-31   119-31#  119-44   119-44#  121-1    121-1#   121-2    121-2#   123-1    123-1#
         123-3    123-3#   123-5    123-5#   123-7    123-7#
M$RBRO   73-24    73-24#
M$RNRO   116-93   116-93#  116-95   116-95#  116-109  116-109# 116-146  116-146#
M$SETS   26-26    26-26#   28-10    28-10#   29-10    29-10#   30-3     30-3#    53-14    53-14#   53-18    53-18#   53-22    53-22#
         53-26    53-26#   53-30    53-30#   53-34    53-34#   53-38    53-38#   53-42    53-42#   53-46    53-46#   53-50    53-50#
         53-62    53-62#   53-67    53-67#   53-79    53-79#   53-83    53-83#   53-87    53-87#   53-91    53-91#   53-95    53-95#
         53-100   53-100#  53-104   53-104#  53-108   53-108#  53-112   53-112#  53-116   53-116#  53-120   53-120#  102-10   102-10#
         103-18   103-18#  112-5    112-5#   115-3    115-3#   115-10   115-10#  116-45   116-45#  117-10   117-10#  118-8    118-8#
         119-3    119-3#   119-5    119-5#   120-3    120-3#   120-14   120-14#  122-12   122-12#
M$SVC    53-16    53-16#   53-20    53-20#   53-24    53-24#   53-28    53-28#   53-32    53-32#   53-36    53-36#   53-40    53-40#
         53-44    53-44#   53-48    53-48#   53-60    53-60#   53-65    53-65#   53-77    53-77#   53-81    53-81#   53-85    53-85#
         53-89    53-89#   53-93    53-93#   53-98    53-98#   53-102   53-102#  53-106   53-106#  53-110   53-110#  53-114   53-114#
         53-118   53-118#  53-122   53-122#  55-7     55-8     55-8#    58-11    58-11#   58-12    58-12#   58-22    58-22#   58-28
         58-30    58-30#   60-12    60-12#   61-8     61-8#    61-24    62-36    63-21    64-8     68-22    70-32    73-19    73-19#
         73-20    73-20#   73-24    73-24#   91-12    91-12#   91-14    91-14#   91-16    91-16#   91-18    91-18#   94-20    94-20#
         96-3     100-21   100-21#  100-29   101-5    105-36   105-51   106-12   107-12   107-12#  107-27   107-27#  107-30   107-30#
         107-33   109-37   110-27   110-27#  110-36   111-5    114-1    114-1#   116-47   116-47#  116-53   116-53#  116-59   116-59#
         116-66   116-66#  116-69   116-69#  116-93   116-93#  116-95   116-95#  116-106  116-106# 116-109  116-109# 116-146  116-146#
         116-233  116-233# 116-235  116-235# 116-239  116-240  116-240# 116-245  116 246   116-246# 116-249  116-249# 117-12   117-12#
         118-11   118-11#  118-19   118-19#  118-21   118-21#  119-7    119-7#   119-10   119-10#  119-19   119-19#  119-21   119-22
         119-22#  119-27   119-28   119-28#  119-31   119-31#  119-32   119-32#  119-44   119-44#  119-64   119-64#  119-82   119-82#
         119-83   119-83#
M$TLAB   53-16#   53-20#   53-24#   53-28#   53-32#   53-36#   53-40#   53-44#   53-48#   53-60#   53-65#   53-77#   53-81#   53-85#
         53-89#   53-93#   53-98#   53-102#  53-106#  53-110#  53-114#  53-118#  53-122#  55-7#    55-8#    58-11#   58-12#   58-22#
         58-28#   58-30#   60-12#   61-8#    61-24#   62-36#   63-21#   64-8#    68-22#   70-32#   73-19#   73-20#   73-24#   91-12#
         91-14#   91-16#   91-18#   94-20#   96-3#    100-21#  100-29#  101-5#   105-36#  105-51#  106-12#  107-12#  107-27#  107-30#
         107-33#  109-37#  110-27#  110-36#  111-5#   114-1#   116-47#  116-53#  116-59#  116-66#  116-69#  116-93#  116-95#  116-106#
         116-109# 116-146# 116-233# 116-235# 116-239# 116-240# 116-245# 116-246# 116-249# 117-12#  118-11#  118-19#  118-21#  119-7#
         119-10#  119-19#  119-21#  119-22#  119-27#  119-28#  119-31#  119-32#  119-44#  119-64#  119-82#  119-83#
M$TSTL   53-16    53-16#   53-20    53-20#   53-24    53-24#   53-28    53-28#   53-32    53-32#   53-36    53-36#   53-40    53-40#
         53-44    53-44#   53-48    53-48#   53-60    53-60#   53-65    53-65#   53-77    53-77#   53-81    53-81#   53-85    53-85#
         53-89    53-89#   53-93    53-93#   53-98    53-98#   53-102   53-102#  53-106   53-106#  53-110   53-110#  53-114   53-114#
         53-118   53-118#  53-122   53-122#  55-7     55-7#    55-7#    55-8     55-8#    58-11    58-11#   58-12    58-12#   58-22
         58-22#   58-28    58-28#   58-28#   58-30    58-30#   60-12    60-12#   61-8     61-8#    61-24    61 ?4#   61-24#   62-36
         62-36#   62-36#   63-21    63-21#   63-21#   64-8     64-8#    64-8#    68-22    68-22#   68-22#   70-32    70-32#   70-32#
         73-19    73-19#   73-20    73-20#   73-24    73-24#   91-12    91-12#   91-14    91-14#   91-16    91-16#   91-18    91-18#
         94-20    94-20#   96-3     96-3#    96-3#    100-21   100-21#  100-29   100-29#  100-29#  101-5    101-5#   101-5#   105-36
         105-36#  105-36#  105-51   105-51#  105-51#  106-12   106-12#  106-12#  107-12   107-12#  107-27   107-27#  107-30   107-30#
         107-33   107-33#  107-33#  109-37   109-37#  109-37#  110-27   110-27#  110-36   110-36#  110-36#  111-5    111-5#   111-5#
         114-1    114-1#   116-47   116-47#  116-53   116-53#  116-59   116-59#  116-66   116-66#  116-69   116-69#  116-93   116-93#
         116-95   116-95#  116-106  116-106# 116-109  116-109# 116-146  116-146# 116-233  116-233# 116-235  116-235# 116-239  116-239#
         116-239# 116-240  116-240# 116-245  116-245# 116-245# 116-246  116-246# 116-249  116-249# 117-12   117-12#  118-11   118-11#
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        118-19    118-19#   118-21    118-21#   119-7     119-7#    119-10    119-10#   119-19    119-19#   119-21    119-21#   119-21#   119-22
        119-22#   119-27    119-27#   119-27#   119-28    119-28#   119-31    119-31#   119-32    119-32#   119-44    119-44#   119-64    119-64#
        119-82    119-82#   119-83    119-83#
M$WORD   26-34     26-34#    27-9      27-9      27-9#     55-7      55-7      55-7      55-7#     58-28     58-28     58-28     58-28#    61-24
         61-24     61-24     61-24#    62-36     62-36     62-36     62-36#    63-21     63-21     63-21     63-21#    64-8      64-8      64-8
         64-8#     68-22     68-22     68-22     68-22#    70-32     70-32     70-32     70-32#    96-3      96-3      96-3      96-3#    100-29
        100-29    100-29    100-29#   101-5     101-5     101-5     101-5#    105-36    105-36    105-36    105-36#   105-51    105-51    105-51
        105-51#   106-12    106-12    106-12    106-12#   107-33    107-33    107-33    107-33#   109-37    109-37    109-37    109-37#   110-36
        110-36    110-36    110-36#   111-5     111-5     111-5     111-5#    114-1     114-1     114-1#    114-1#    116-235#  116-239   116-239
        116-239   116-239#  116-245   116-245   116-245   116-245#  119-10    119-10    119-10#   119-10#   119-21    119-21    119-21    119-21#
        119-22#   119-27    119-27    119-27    119-27#   119-28#   119-31    119-31    119-31#   119-31#   119-44    119-44    119-44#   119-44#
        119-82#   121-1     121-1#    121-2     121-2#    123-1     123-1#    123-2     123-2#    123-3     123-3#    123-4     123-4#    123-5
        123-5#    123-6     123-6#    123-7     123-7#    123-8     123-8#    123-9     123-9     123-9#    125-3     125-3#
M$XFER  123-2     123-2#    123-4     123-4#    123-6     123-6#    123-8     123-8#
MANUAL  119-7     119-19
MEMORY  116-109
OPEN     73-20    119-32
OR       43-9#
PNT      45-20#    70-40    113-24    113-28    113-33
PNT...   44-21#    53-15     53-19     53-23     53-27     53-31     53-35     53-39     53-43     53-47     53-55     53-58     53-64     53-68
         53-72     53-76     53-80     53-84     53-88     53-92     53-96     53-109    53-113    53-117    53-121    53-124    53-130    53-137
         53-141    70-40     76-15     77-41     79-23     82-4      83-5      84-5     113-24    113-28    113-33    114-31    116-98    119-6
        119-30    119-41
PNTB     45-11#    53-15     53-19     53-23     53-27     53-31     53-35     53-39     53-43     53-47     53-55     53-58     53-64     53-68
         53-72     53-76     53-80     53-84     53-88     53-92     53-96     53-109    53-113    53-117    53-121    53-124    53-130    53-137
         53-141    83-5      84-5
PNTF     45-8#     76-15     77-41     79-23     82-4     114-31    116-98    119-30    119-41
PNTS     45-17#
PNTX     45-14#   119-6
POINTE   26-32
POP      43-23#    56-21     58-23     69-44     69-49     75-17     79-24     85-7      86-7      87-7      88-31     90-17     90-25     91-19
         92-18     93-28     97-29     97-30     98-22     99-25    100-30    101-2     101-6     103-20    104-41    108-19    110-24    113-29
        113-34
PRINT    44-8#     74-18     74-21     76-21     76-23     78-6      78-13     79-10     79-30     83-7      84-7      90-13     90-22    113-27
        113-32    113-35
PRINTB   91-14
PRINTF   91-12    119-64
PRINTS   91-18
PRINTX   91-16
PUSH     43-15#    56-16     58-9      69-33     69-39     75-11     85-4      86-4      87-4      88-13     89-16     89-22     89-40     91-6
         92-12     92-16     93-16     97-15     98-14     99-16    100-11    104-14    107-13    110-18    113-15    113-22
READEF  116-47    116-53    116-59    116-66
SETPRI  116-233
SETVEC   58-11     94-20    107-27    116-106   118-11
SVC      26-7#     26-8
TABLE    31-20#    41-10     42-7     120-18    122-16
XFER    116-235#  119-22#   119-28#   119-82#
XFERT   123-2     123-4     123-6     123-8
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