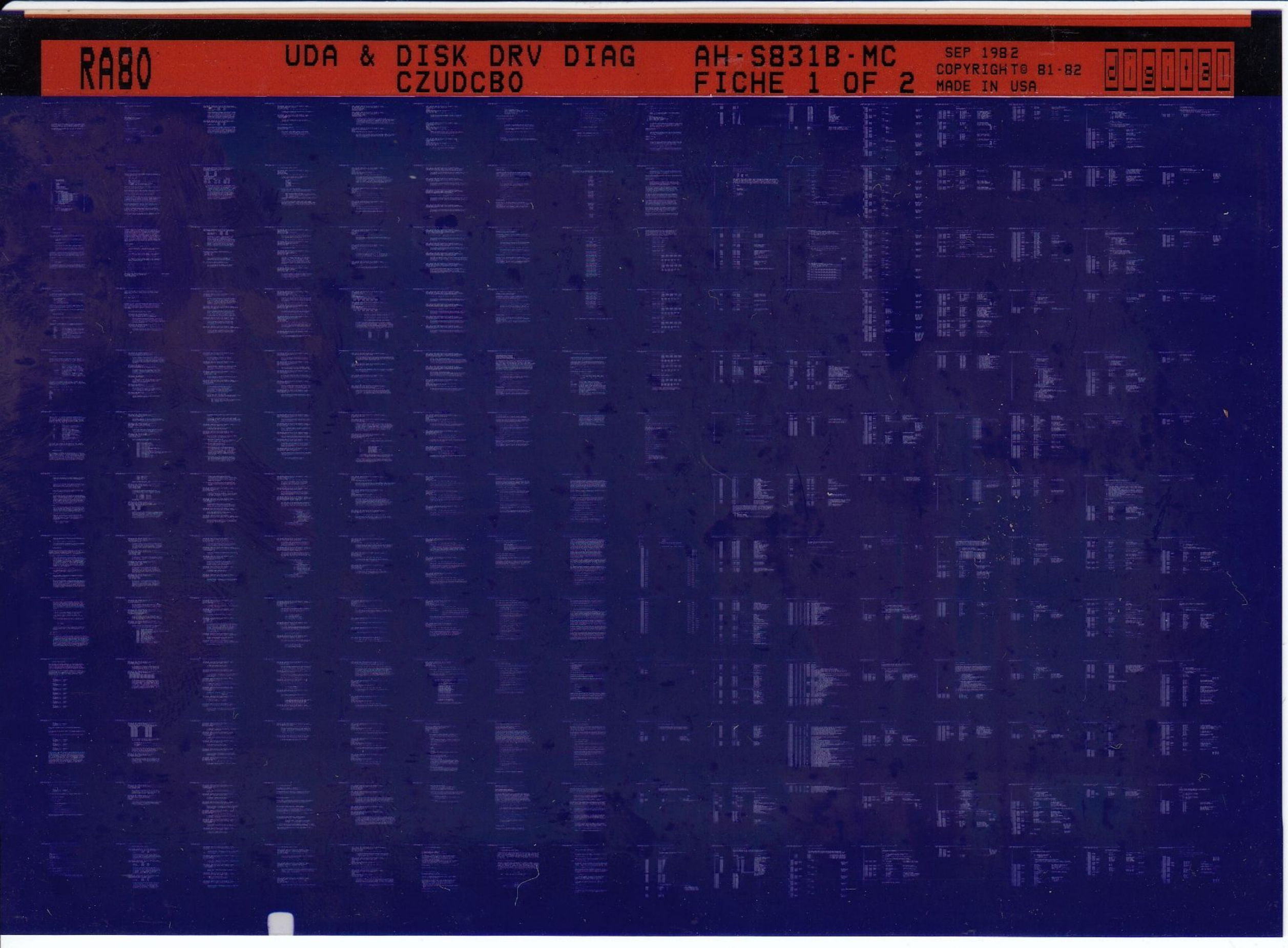
RA80

UDA & DISK DRV DIAG
CZUDCB0

AH-S831B-MC
FICHE 1 OF 2



RA80

UDA & DISK DRV DIAG
CZUDCB0

AH-S831B-MC
FICHE 2 OF 2

digital

```
.REM *
```

IDENTIFICATION

PRODUCT CODE: AC-S830B-MC

PRODUCT NAME: CZUDCB0 UDA50 & DISK DRV DIAG

PRODUCT DATE: 14-APR-82

MAINTAINER: DIAGNOSTIC ENGINEERING

AUTHOR: DALE KECK


```
.REM *
.REM &
```

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1.0 GENERAL INFORMATION

1.1 PROGRAM ABSTRACT

This is the only diagnostic program provided for testing the UDA-50 Unibus Disk Controller and the disk drives connected to it. There are four tests within this diagnostic:

Test # 1 - unibus Addressing Test. Runs the UDA-50 ROM resident diagnostics, then further tests the Unibus address interface.

Test # 2 - Disk Resident Diagnostic Test. Executes the diagnostics in each disk drive.

Test # 3 - Disk Function Test. Functionally tests each disk drive to ensure the disk can seek, read, write and format.

Test # 4 - Disk Exerciser. Exercises the disk drives in a manner similar to normal operating systems. This test should be used to gain confidence in the reliability of the disk drive.

This program is designed to handle all future disk drives that are attached to the UDA-50 without modifying or rereleasing. This is possible because the disk drives are programmed to tell this diagnostic about all their characteristics that make them different from other drives, such as number of cylinders, sectors per cylinder, etc.

Two other PDP-11 diagnostic programs are provided for the UDA-50 disk subsystem:

CZUDEB0 - UDA-50 Disk Drive Fomatter.

DEC/X11 - Unibus Exerciser can be run on the UDA-50 using the UDA-50 module DUBB0.

This diagnostic has been written for use with the Diagnostic Runtime Services Software (Supervisor). These services provide the interface to the operator and to the software environment. For a complete description of the Runtime Services, refer to the XXDP+ User's Manual. There is a brief description of the Runtime Services in section 2 of this document.

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. This program requires the following:

PDP-11 Unibus processor
28K words of memory (minimum)
Console terminal
XXDP+ load media containing this program and the ZUDDB0.PAK data file
One or more UDA-50 subsystems
Line clock - either Type L or P

The line clock is used for all timed loops in the program. The diagnostic will run on a system with no clock but will hang whenever an event for which the program is waiting does not happen (i.e., a time-out error message will not result).

This diagnostic program requires that the data file ZUDDB0.PAK be on the XXDP+ system device. This data file is ordered under the name CZUDDB0.

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 each 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, the 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)
ISR	Inhibit statistical reports
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 a diagnostic 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.

UNIBUS ADDRESS OF UDA (O) 172150 ?

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

BR LEVEL (D) 5 ?

Answer with the interrupt priority used by the UDA. Levels 4 to 7 are accepted. This level must match the level "hard wired" in the UDA by the priority plug.

UNIBUS BURST RATE (D) 63 ?

The UDA allows the ability to control the maximum number of words transferred across the UNIBUS each time the UDA becomes master. The default answer of 63 will allow for the fastest execution of this diagnostic program. You may answer with the value your operating system uses or use zero which will tell the UDA to supply a value that should work on any system. A decimal number in the range of 0 to 63 may be specified and all values should work on any system. A larger value will allow for a faster running program. The value will be passed directly to the UDA during initialization.

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 separate unit to completely test the drive. A maximum of eight logical drives may be tested on one UDA at a time (UDA configuration limit).

EXERCISE ON CUSTOMER DATA AREA IN TEST 4 (L) N ?

Answer "N" to have test 4 (drive exerciser) run on the diagnostic area of the disk. Answer "Y" to run on the customer data area. A "Y" answer will destroy any customer data that may be on the disk. A warning message will be printed before testing begins if this question is answered "Y".

CUSTOMER DATA WILL BE DESTROYED ON:

UNIT	UDA AT	DRIVE
xx	xxxxxx	xxx

Unless the diagnostic is being run in unattended mode (i.e., START/FLAG:UAM command), a confirmation will also be required as follows:

ARE YOU SURE CUSTOMER DATA CAN BE DESTROYED (L) ?

If the above question is answered "N", the entire diagnostic will stop and the Runtime Services prompt will be displayed. No default answer is provided for this question.

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.

ENTER MANUAL INTERVENTION MODE FOR SPECIAL DIAGNOSIS (L) N ?

Tests 2 and 4 have manual intervention modes which allow additional parameters to be input to alter the normal testing of a disk drive. This question should normally be answered "N" when this diagnostic is first run. Then, depending on the errors detected, it may be desirable to change this answer to "Y" and alter the testing to further isolate the problem. If this question is answered "Y", and the UAM (unattended mode operation) flag is set, tests 2 and 4 will print a warning message that the mode cannot be entered and will proceed as if answered "N". See the description of the individual tests in section 5 for more information.

REMAINING SOFTWARE QUESTIONS APPLY TO TEST 4 ONLY

This informational message is printed to describe the use of the remaining questions. If test 4 is not being run, a "CONTROL Z" can be typed to bypass them.

ERROR LIMIT (D) 32 ?

Enter the number of hard errors allowed before a drive is dropped from exercise by test #4. A number in the range of 1 to 65535 will be accepted.

READ TRANSFER LIMIT IN MEGABYTES - 0 FOR NO LIMIT (D) 0 ?

When the specified number of bytes have been read from a drive by test #4, the drive will be dropped from testing. When all drives are dropped, an end of pass will be indicated and the selected tests will be run again. This is the method used to determine how long test #4 is to run. Answer with a zero to prevent test from ending. The only other way test #4 can end is to have all drives dropped because the error limit on each is exceeded. Of course, the operator can always stop test #4 by typing a control-C.

SUPPRESS PRINTING SOFT ERRORS (L) Y?

When test #4 needs to perform retries, soft error reports will be printed to give as much information as possible. These actions are considered normal operation and are not error conditions until the retries fail. When the test is being run only to see how reliable the drive performs, this question should be answered "Y" so they are not confused with hard errors. The number of these soft errors is always reported in the statistical report. Answer "N" to see all the soft error reports.

DO INITIAL WRITE ON START (L) Y ?

If test #4 is to do data compares, the drive will need to be written with data patterns readable by the program.

If the diagnostic area is selected for testing, the initial write is always performed (regardless of how this question is answered).

If the customer data area is selected for testing, the initial write will be performed when all of the following are true:

1. This question is answered "Y".
2. This is the first time test #4 is being run after a START command.
3. The disk is write enabled.

Answering this question "N" when testing on the customer data area will normally result in data comparison errors if the disk was not previously written by this diagnostic or the formatter.

Note that write checks are not performed during the initial write.

ENABLE ERROR LOG (L) N ?

A "Y" answer will cause error messages in test #4 to be stored in a log buffer. Once the log buffer is full, additional error information is lost. The contents of the log buffer will be printed when test #4 is stopped and a statistical report requested. This log feature is intended to allow the Digital Diagnosis Center (DDC) to start test #4 then hang up from the system and let it run for some period of time. DDC can call the system back later, type control-C, then PRINT and see the errors that have occurred (up to the limit of the log buffer). A message will be printed to indicate no errors have occurred if the log buffer is empty. Test #4 will not be allowed to end while the error log is enabled until the error log is printed. The log buffer will hold 30 error messages when one disk unit is being tested. The log buffer will decrease in size as more units are tested.

2.6 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 (O) ?  160000<CR>
SUB-DEVICE # (O) ?  5<CR>
Q-FACTOR (O) 0 ?  <CR>

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

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

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

UNIT 7
CSR ADDRESS (O) ?  160000<CR>
SUB-DEVICE # (O) ?  6,7<CR>
Q-FACTOR (O) 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 because 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-device 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.

2.7 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 ZUDCB0"
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"

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 UDA-50:

```
DR>STA/FLA:PNT

CHANGE HW (L)  ? Y

# UNITS (D)  ? 2

UNIT 0
UNIBUS ADDRESS OF UDA (O)  172150 ?
VECTOR (O)  154 ?
BR LEVEL (D)  5 ?
UNIBUS BURST RATE (D) ?
DRIVE NUMBER (D) 0,1
EXERCISE ON CUSTOMER DATA AREA IN TEST 4 (L) N ?

CHANGE SW (L)  ? N

TST: 001
TESTING INTERRUPT ABILITY OF UDA AT ADR 172150 VEC 154...COMPLETED

TST: 002
TST: 003
TST: 004

UNIT 0 UDA AT 172150 DRIVE 0   RUNTIME 0:02:43
INITIAL WRITE COMPLETE

UNIT 1 UDA AT 172150 DRIVE 1   RUNTIME 0:05:31
INITIAL WRITE COMPLETE

TEST 4 IN PROGRESS.    RUNTIME 0:15:00
```

UNIT	DRIVE	SERIAL-NUMBER	SEEKS X1000	MBYTES READ	MBYTES WRITTEN	HARD ERRORS	SOFT ERRORS	ECC
0	0	0	3	9	6	0	0	0
1	1	1	3	8	6	0	0	0

Sample of terminal dialogue going through software questions to specify transfer limit (one disk being tested).

```
DR>STA/FLA:PNT

CHANGE HW (L)  ? N

CHANGE SW (L)  ? Y

ENTER MANUAL INTERVENTION MODE FOR SPECIAL DIAGNOSIS (L) N ?

REMAINING SOFTWARE QUESTIONS APPLY TO TEST 4 ONLY

ERROR LIMIT (D)  32 ?
READ TRANSFER LIMIT IN MEGABYTES - 0 FOR NO LIMIT (D)  0 ? 5
SUPPRESS PRINTING SOFT ERRORS (L) Y ?
DO INITIAL WRITE ON START (L) Y ?
ENABLE ERROR LOG (L) N ?

TST: 001
TESTING INTERRUPT ABILITY OF UDA AT ADR 172150 VEC 154...COMPLETED

TST: 002
TST: 003
TST: 004

UNIT 0 UDA AT 172150 DRIVE 0   RUNTIME 0:02:43
INITIAL WRITE COMPLETE

UNIT 0 UDA AT 172150 DRIVE 0   RUNTIME 0:09:41
REACHED TRANSFER LIMIT - TESTING STOPPED

TEST 4 IN PROGRESS.    RUNTIME 0:09:41

UNIT DRIVE      SERIAL-NUMBER SEEKS MBYTES  MBYTES  HARD   SOFT    ECC
                              X1000  READ  WRITTEN ERRORS ERRORS
   0     0                  0     2      5       4       0       0     0

CZUDCB EOP     1
    0 CUMULATIVE ERRORS
TST: 001
TESTING INTERRUPT ABILITY OF UDA AT ADR 172150 VEC 154...COMPLETED

TST: 002
.
.
.
```

3.0 ERROR INFORMATION

3.1 TYPES OF ERROR MESSAGES

There are three levels of error messages that may be issued by a diagnostic: 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 = diagnostic name
TYPE = error type (SYS FTL ERR, DEV FTL ERR, HRD ERR or SFT 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 diagnostic program. The diagnostic 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 a UDA-50 or disk drive). Testing stops on that device for the remainder of the current test.

Hard errors (HRD ERR) reports most of the errors detected. Testing will normally continue after the printing of the error.

Soft errors (SFT ERR) are used only in test 4. They present information about an error for which recovery will be attempted. These are printed only if the SUPPRESS PRINTING SOFT ERRORS software question is answered "N" and are used only to provide a greater detail of information. During the error recovery attempt, several soft errors may be printed. Unless the soft errors are followed by a hard error message, the error condition was corrected and testing proceeds.

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 diagnostic are always one line each. The basic message defines what program detected the error, the drive being tested and the time of the error.

The PDP-11 program that is loaded into memory when you give the "R ZUDCB0" command to the XXDP+ monitor is only a small part of this diagnostic. A data file called ZUDDB0.PAK on the system load device (the same device from which the "R" command read the PDP-11 program) contains four programs which are read from the file and loaded into the UDA-50 for execution. These programs are called "diagnostic machine" or DM programs. The "diagnostic machine" is the facility in the UDA-50 which executes a PDP-11 like pogram. The large majority of the testing is done by these four "diagnostic machine" p·ograms. Once the PDP-11 program has loaded and started the "diagnostic machine" program, all it does is respond to requests from that program. These requests include such things as telling the "diagnostic machine" which disks on that UDA-50 are to be tested, printing an error message and updating statistics which are printed in the statistical repr·rt (see section 4.0).

The basic message (the second line of every error message) will be one of the following:

HOST PROGRAM UDA AT xxxxxx RUNTIME hhh mm:ss

The host program (PDP-11) detected the error. UDA AT xxxxx identifies the address of the UDA-50 being tested. It may be omitted if the error is not specific to one UDA-50.

UNIBUS ADDRESSING DM PC:xxxx UDA AT xxxxxx RUNTIME hhh:mm:ss

The "diagnostic machine" program loaded in test 1 detected the error. DM PC xxxx identifies the address in the "diagnostic machine" program where the error message is reported.

DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss

The "diagnostic machine" program loaded in test 2 detected the error. DM PC xxxx identifies the address in the "diagnostic machine" program where the error message is reported. DRIVE xxx identifies the drive number.

DISK FUNCTIONAL DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss

The "diagnostic machine" program loaded in test 3 detected the error.

DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss

The "diagnostic machine" program loaded in test 4 detected the error.

Sample error message:

```
CZUDC DVC FTL ERR  00021 ON UNIT 00 TST 001 SUB 003 PC: xxxxxx      - general message
HOST PROGRAM  UDA AT 172150  RUNTIME 0:00:12                        - basic message
UDA RESIDENT DIAGNOSTICS DETECTED FAILURE                          \
  UDASA CONTAINS 104041                                             :- extended message
REPLACE UDA MODULE M7161                                           /
```

Informational messages are also printed by this program. They are usually one or two lines in length. They are printed as extended messages and are always printed unless the "IER", "IBE" or "IXE" flags are set.

Sample informational message:

```
UNIT 0  UDA AT 172150  DRIVE 0  RUNTIME 0:02:43
INITIAL WRITE COMPLETE
```

3.2 SPECIFIC ERROR MESSAGES

Following is a list of the error messages that may be printed by the diagnostic program. In the list, some of the numbers that may vary with execution or program version are shown as "xxx". These include program counters and runtime. Other numbers, such as unit number, drive number, UDA-50 address and data in registers are filled with sample numbers. Additional information about the error may follow the error message.

3.2.1 HOST PROGRAM ERROR MESSAGES (00001 to 00999)

00001 CZUDC SYS FTL ERR 00001 ON UNIT 00 TST xxx SUB 000 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx:xx
I DON'T LIKE THE ANSWERS YOU GAVE TO THE HARDWARE QUESTIONS
UDA HAS MORE THAN ONE VECTOR, BR LEVEL OR BURST RATE

When the hardware questions were answered, two units were selected with the same UNIBUS address but with a different vector, BR level or burst rate. A single UDA-50 can have only one vector, BR level or burst rate. The program is aborted and returns to the Runtime Services prompt so that you can change the hardware questions.

00002 CZUDC SYS FTL ERR 00002 ON UNIT 00 TST xxx SUB 000 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx:xx
I DON'T LIKE THE ANSWERS YOU GAVE TO THE HARDWARE QUESTIONS
TWO 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 you can change the hardware questions.

00003 CZUDC SYS FTL ERR 00003 ON UNIT 00 TST xxx SUB 000 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx.xx
I DON'T LIKE THE ANSWERS YOU GAVE TO THE HARDWARE QUESTIONS
MORE THAN EIGHT DRIVES SELECTED ON THIS UDA

Up to four physical disk drives can be attached to a UDA-50 at one time. A physical disk drive may be ..om one to four logical disk drives. Each logical disk drive is considered one unit to the diagnostic program. Even though more than eight logical disk drives can be attached to one UDA-50, the UDA-50 only supports eight. The program is aborted and returns to the Runtime Services prompt so that you can change the hardware questions.

00004 CZUDC SYS FTL ERR 00004 ON UNIT 00 TST xxx SUB 000 PC: xxxxxx
HOST PROGRAM RUNTIME x:xx:xx
NOT ENOUGH ROOM IN MEMORY TO TEST THE UNITS SELECTED
PLEASE START PROGRAM OVER AND TEST 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. You have exceeded the number of units that are testable at one time. Start program over and select fewer units.

00005 CZUDC SYS FTL ERR 00005 ON UNIT 00 TST xxx SUB 000 PC: xxxxxx
HOST PROGRAM RUNTIME x:xx:xx
CHECKSUM ERROR IN DM PROGRAM FILE

As a DM program is read from the load media, a checksum is calculated. If the checksum contained in the file does not match what is calculated, an error reading the data file is declared. Restore the data file ZUDDB0.PAK to your load media.

00006 CZUDC SYS FTL ERR 00006 ON UNIT 00 TST xxx SUB 000 PC: xxxxxx
HOST PROGRAM RUNTIME x:xx:xx
TABLE INCONSISTANCY ERROR. PLEASE RE-LOAD PROGRAM

When the host program is started, controller tables are set according to the P-tables. Error 00006 will occur if the tables were corrupted after restarting the diagnostic. Load and start your program again.

00007 CZUDC SYS FTL ERR 00007 ON UNIT 00 TST xxx SUB 000 PC: xxxxxx
HOST PROGRAM RUNTIME x:xx:xx
ERROR IN DM PROGRAM FILE. DM PROGRAM NOT FOUND

The host program was not able to read the DM program from the load media properly. Restore the data file ZUDDB0.PAK to your load media.

00008 CZUDC SYS FTL ERR 00008 ON UNIT 00 TST xxx SUB 000 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx:xx
I DON'T LIKE THE ANSWERS YOU GAVE TO THE HARDWARE QUESTIONS
TWO UDA'S USE THE SAME VECTOR

The hardware questions for two units specified different UDA-50 Unibus addresses but identical vector addresses. The program is aborted and returns to the Runtime Services prompt so tha you can change the hardware questions.

00020 CZUDC DVC FTL ERR 00020 ON UNIT 00 TST xxx SUB 000 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx:xx
MEMORY ERROR TRYING TO READ UDA REGISTERS
CHECK UNIBUS SELECTION SWITCHES ON UDA MODULE M7161
OR UNIBUS
OR REPLACE UDA MODULE M7161

A non-existant memory error occurred when the host program tried to access the UDAIP and UDASA registers. The UDA is at another address (check the UNIBUS selection switches) or module M7161 is broken or the UNIBUS is broken.

00021 CZUDC DVC FTL ERR 00021 ON UNIT 00 TST 001 SUB 003 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx:xx
UDA RESIDENT DIAGNOSTICS DETECTED FAILURE
UDASA CONTAINS 105154
REPLACE UDA MODULE M7162

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

104000 - Fatal sequncer 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. M7161 is the Unibus interface board. M7162 is the SDI interface board.

00022 CZUDC DVC FTL ERR 00022 ON UNIT 00 TST 001 SUB 003 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx:xx
STEP BIT DID NOT SET IN UDASA REGISTER DURING INITIALIZATION
STEP BIT EXPECTED 004000
UDASA CONTAINS 000000
REPLACE UDA MODULE M7161

The UDA did not respond as expected during the initialization sequence which communicates using data in the UDASA register. A normal response from the UDA 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

The expected step bit nor the error bit set within the expected time.

00023 CZUDC DVC FTL ERR 00023 ON UNIT 00 TST 001 SUB 005 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx:xx
UDA 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 UDA MODULE M7161

The UDA is to clear the ring structure (a communications area used by the UDA to talk to the host) in host memory before Step 4 of initialization. If the UDA 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 UDA to clear each word indicates a fault in the address interface to the Unibus.

00024 CZUDC DVC FTL ERR 00024 ON UNIT 00 TST 001 SUB 006 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx:xx
UDASA REGISTER DID NOT GO TO ZERO AFTER STEP 3 WRITE OF INITIALIZATION
PURGE/POLE DIAGNOSTICS WERE REQUESTED
UDASA CONTENTS 004400

For better testing, the host can test the PURGE and POLE mechanism of the UDA. To do so the host sets bit15 of the step 3 data and sends the data to the UDA. The UDA must go to zero and wait for the purge and pole. If the UDA never went to zero, then error message 00024 is displayed. The UDA may have a bad M7161 module or the UNIBUS may be broken.

00025 CZUDC DVC FTL ERR 00025 ON UNIT 00 TST xxx SUB 000 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx:xx
UDA DID NOT RETURN CORRECT DATA IN UDASA REGISTER DURING INITIALIZATION
UDASA EXPECTED 004400
UDASA CONTAINS 004000
REPLACE UDA MODULE M7161

For each step of initialization, specific data is expected to be displayed in the UDASA. If the UDASA does not match the expected data, then error message 00025 is displayed. Replace UDA module M7161.

00026 CZUDC DVC FTL ERR 00026 ON UNIT 00 TST xxx SUB 000 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx:xx
DATA COMPARISON ERROR DURING DIAGNOSTIC PORT LOOP TEST
DATA SENT TO UDASA 000001
RECEIVED FROM UDASA 000000
REPLACE UDA MODULE M7161

The UDA can be put into a mode where the UDASA acts as a wrap port. While the UDA is in this mode, any data being sent to the UDASA will be displayed in the UDASA within a small period of time. If the data in the UDASA does not match the data that was sent to the UDASA, then error message 00026 is displayed. Replace UDA module M7161.

00027 CZUDC DVC FTL ERR 00027 ON UNIT 00 TST xxx SUB 000 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx:xx
UDASA REGISTER DID NOT CHANGE AFTER WRITING TO IT
IN PORT LOOP DIAGNOSTIC
UDASA CONTAINS 004400
REPLACE UDA MODULE M7161

The UDA can be put into a mode where the UDASA acts as a wrap port. While the UDA is in this mode, any data being sent to the UDASA will be displayed in the UDASA within a small period of time. After the host program sent data to it while it was in diagnostic wrap mode, the UDA did not change the contents of the UDASA. Error message 00027 is displayed. Replace UDA module M7161.

00028 CZUDC DVC FTL ERR 00028 ON UNIT 00 TST 001 SUB 004 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx:xx
UDA DID NOT INTERRUPT THE PDP-11
REPLACE UDA MODULE M7161

The host program timed out while waiting for an interrupt that had to occur. The UDA was told to use interrupts during the initialization process. The UDA then waited for the interrupt but it did not occur. Replace the UDA module M7161.

00029 CZUDC DVC FTL ERR 00029 ON UNIT 00 TST 001 SUB 004 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx:xx
UDA INTERRUPTED AT DIFFERENT BR LEVEL THAN SPECIFIED IN HARDWARE QUESTIONS. INTERRUPT WAS AT BR LEVEL 5
CHECK PRIORITY PLUG ON UDA MODULE M7161
OR CHANGE HARDWARE QUESTIONS

The priority plug on the UDA and the BR LEVEL specified during the hardware questions do not match. Either change the plug number or reanswer the hardware question. If all these have been done and there is still a problem replace UDA module M7161.

00030 CZUDC DVC FTL ERR 00030 ON UNIT 00 TST xxx SUB 000 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx:xx
UDA REPORTED FATAL ERROR IN UDASA REGISTER WHILE RUNNING DM PROGRAM
UDASA CONTAINS 100004

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

004400 - UDA has been inited by either a bus init or by writing into the UDAIP.
100001 - UNIBUS envelope/packet read error (parity or timeout)
100002 - UNIBUS envelope/packet write error (parity or timeout)
100003 - UDA ROM and RAM parity error
100004 - UDA RAM parity error
100005 - UDA ROM parity error
100006 - UNIBUS ring read error
100007 - UNIBUS ring write error
100010 - UNIBUS interrupt master failure
100011 - Host access timeout error
100012 - Host exceeded credit limit
100013 - UDA 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 UNIBUS

00031 CZUDC DVC FTL ERR 00031 ON UNIT 00 TST xxx SUB 000 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx:xx
NO INTERRUPT RECEIVED FROM DM PROGRAM FOR 3 MINUTES
ASSUME PROGRAM 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 CZUDC DVC FTL ERR 00032 ON UNIT 00 TST xxx SUB 000 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx:xx
MESSAGE BUFFER RECEIVED FROM DM PROGRAM 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 UNIBUS or either one of the UDA 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 CZUDC DVC FTL ERR 00033 ON UNIT 00 TST xxx SUB 000 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx:xx
RESPONSE PACKET FROM UDA DOES NOT CONTAIN EXPECTED DATA
EITHER UDA 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 to UDA. 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 UDA and the host program. If 2 occurred, check the error code in the MSCP specification for further information. The packets are displayed two words per line, low order word and byte to the right (corresponding to the MSCP long-word entity).

00036 CZUDC DVC FTL ERR 00036 ON UNIT 00 TST xxx SUB 000 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx:xx
NO INTERRUPT RECEIVED FROM UDA FOR 30 SECONDS
WHILE LOADING DM PROGRAM

After a DM program has been sent to the UDA, 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 CZUDC DVC FTL ERR 00037 ON UNIT 00 TST xxx SUB 000 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx:xx
UDA REPORTED FATAL ERROR IN UDASA REGISTER WHILE LOADING DM PROGRAM
UDASA CONTAINS 100004
REPLACE UDA MODULE M7161

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

00038 CZUDC DVC FTL ERR 00038 ON UNIT 00 TST 001 SUB 002 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx:xx
MEMORY ERROR TRYING TO READ UDA REGISTERS
CHECK UNIBUS SELECTION SWITCHES ON UDA MODULE M7161
OR UNIBUS
OR REPLACE UDA MODULE M7161

A non-existant memory error occurred when the host program tried to access the UDAIP and UDASA registers while in subtest 2 of test 1. The UDA is at another address (check the UNIBUS selection switches) or module M7161 is broken or the UNIBUS is broken.

3.2.2 TEST 1 ERROR MESSAGES (01000 TO 01999)

01000 CZUDC HRD ERR 01000 ON UNIT 00 TST 001 SUB 007 PC: xxxxxx
UNIBUS ADDRESSING DM PC:xxxx UDA AT xxxxxx RUNTIME hhh:mm:ss
NON-EXISTANT MEMORY ERROR TRYING TO READ FROM UNIBUS.

	OCTAL	HEX
ADDRESS	000000	00000

The host has given the DM routine the range of accessible host memory. While reading one location within the range, it appeared non-existant to the UDA. Since everything within the bounds were believed to be accessible this error message will be printed. The message prints the address in octal and hex.

01001 CZUDC HRD ERR 01001 ON UNIT 00 TST 001 SUB 007 PC: xxxxxx
UNIBUS ADDRESSING DM PC:xxxx UDA AT xxxxxx RUNTIME hhh:mm:ss
PARITY ERROR ON READ FROM UNIBUS.

	OCTAL	HEX
ADDRESS	000000	00000
DATA READ	000000	0000
DATA EXPECTED	000000	0000

The host has given the DM routine the range of accessible host memory. While reading one location within the range, the DM routine has found a location with bad parity. Every location was accessed by the host program. The host program filled a location with its address. The message prints the address, the data it actually received, and the expected data it should have received in octal and hex.

01002 CZUDC HRD ERR 01002 ON UNIT 00 TST 001 SUB 007 PC: xxxxxx
UNIBUS ADDRESSING DM PC:xxxx UDA AT xxxxxx RUNTIME hhh:mm:ss
UNIBUS ADDRESSING ERROR - INCORRECT DATA READ.
MEMORY LOCATION SHOULD CONTAIN OWN ADDRESS.

	OCTAL	HEX
DATA READ	000000	0000
DATA EXPECTED	000000	0000

The host has given the DM routine the locations of accessible host memory. Every location was accessed by the host program. The host program filled a location with its address. The DM program read from one location and found that the data it read was not equal to its address. The message prints the address, the data it actualy received, and the expected data it should have received in octal and hex.

01003 CZUDC HRD ERR 01003 ON UNIT 00 TST 001 SUB 007 PC: xxxxxx
UNIBUS ADDRESSING DM PC:xxxx UDA AT xxxxxx RUNTIME hhh:mm:ss
NON-EXISTANT MEMORY ERROR TRYING TO READ FROM UNIBUS WITHIN BUFFER.

	OCTAL	HEX
STARTING ADDESS OF BUFFER	123456	0A72E
BUFFER SIZE	001234	029C

After reading every accessible location of host memory, the DM routine breaks up memory into buffers. The DM routine writes and reads data patterns from each host buffer into its DM buffer. While reading one of these buffers, a non-existant memory error occurred. The message prints out the starting address of the buffer and the size of the buffer in octal(for PDP-11 users) and in hex(for VAX users) so the user can determine about where the non-existant memory location occurred.

01004 CZUDC HRD ERR 01004 ON UNIT 00 TST 001 SUB 007 PC: xxxxxx
UNIBUS ADDRESSING DM PC:xxxx UDA AT xxxxxx RUNTIME hhh:mm:ss
PARITY ERROR ON READ FROM UNIBUS WITHIN BUFFER.

	OCTAL	HEX
STARTING ADDESS OF BUFFER	123456	0A72E
BUFFER SIZE	001234	029C

After reading every accessible location of host memory, the DM routine breaks up memory into buffers. The DM routine writes and reads data patterns from each host buffer into its DM buffer. While reading one of these buffers, a parity error occurred. The message prints out the starting address of the buffer and the size of the buffer in octal(for PDP-11 users) and in hex(for VAX users) so the user can determine about where the non-existant memory location occurred.

```
01005   CZUDC HRD ERR  01005 ON UNIT 00 TST 001 SUB 007 PC: xxxxxx
        UNIBUS ADDRESSING DM PC:xxxx  UDA AT xxxxxx  RUNTIME hhh:mm:ss
        DATA COMPARE FAILED AFTER WRITE THEN READ FROM UNIBUS.
         BUFFER SIZE = 005302(O)     0AC2(X)     2754.(D)
         STARTING ADDRESSES OF BUFFERS
              OCTAL          HEX
             044232         0489A
             057056         05E2E
             071676         0738E
             104512         0894A
         CURRENT DATA PATTERN READ                    0
         LAST PATTERN WRITTEN                         0
         STARTING ADDRESS OF LAST BUFFER WRITTEN   104512(O)   0894A(X)
         NUMBER OF ERRORS FOUND                    2754.(D)
            LOCATION        DATA EXPECTED      DATA RECEIVED
          OCTAL   HEX         OCTAL   HEX       OCTAL   HEX
         057056  05E2E        111111  9249      002472  053A
         057060  05E30        044444  4924      005302  0AC2
         057062  05E32        022222  2492      000000  0000
```

After reading an entire buffer, the DM program checks each location. If any or all of the locations did not contain the expected data, this message appears. It contains the buffer size in octal, hex and decimal. The reason it appears in decimal is so the user can correlate this value with the number of errors which is printed in decimal. The starting addresses of the buffers are printed in octal and hex. There will always be at least two buffers and up to four buffers printed. The current data pattern read is printed. DM program will be testing the buffer with this data pattern. The last data pattern written by the DM program is printed. The address of the last buffer written is printed in octal and hex. As many as three errors are presented in the message. This portion presents the location of the error, the expected data and the actual data all in octal and hex.

01006 CZUDC HRD ERR 01006 ON UNIT 00 TST 001 SUB 007 PC: xxxxxx
UNIBUS ADDRESSING DM PC:xxxx UDA AT xxxxxx RUNTIME hhh:mm:ss
UNIBUS ADDRESSING ERROR. TWO ADDRESSES READ SAME LOCATION.

	OCTAL	HEX
KNOWN GOOD ADDRESS	625252	32AAA
ERROR ADDRESS	425252	22AAA
ADDRESS BIT IN ERROR	200000	10000

The UDA can only write to a small portion of memory because there is a PDP-11 program running in the memory. To verify it can address all of memory, it uses one location that it is permitted to write which it calls a "known good address". By changing only one bit in the address of this location it selects a "test address". Different patterns are written to the "known good address", each followed by a read of the "test address". If the data read from the "test address" matches the data written to the "known good address" each time, the address line is determined to be stuck. The "test address" is printed as the error address.

3.2.3 TEST 2 INFORMATIONAL MESSAGES

UNIT x UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
INFORMATION SENT BACK FROM THE DRIVE IS BEING PRESENTED.
TEST NUMBER 0000
DRIVE TYPE 00
ERROR NUMBER 0000
data

There is not error, but it is a message. The disk drive wanted the let the host know what had happened when the drive's internal diagnostic was run. The format follows that of hard error 2021.

UNIT x UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
FOLLOWING REPORT HAS BEEN TRUNCATED DUE TO SIZE

This is a message that may appear if the disk drive gave too much data for the DM program to handle. This message may preceed the previous message and hard error 2021.

3.2.4 TEST 2 ERROR MESSAGES (02000 TO 02999)

02000 CZUDC HRD ERR 02000 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
HOST SPECIFIED UNIT #0 THAT CAN'T BE FOUND.
TEST2 RESTARING

When test 2 starts executing out of the DM, it doesn't know if it had been started to execute drive diagnostics or restarted to down line load a diagnostic into the drive. If it had been restarted for the latter reason, the host must tell Test 2 which drive was to receive the diagnostic. If the drive specified by the host is not attached to the UDA or could not be located by Test 2, this error message will be printed.

02001 CZUDC HRD ERR 02001 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
CANNOT RECEIVE VALID DRIVE STATE FROM DRIVE AFTER DRIVE WAS INITED
CHECK IF DRIVE IS POWERED ON.

This error message is presented if valid drive state was not received from the drive after the drive was inited. There are two types of invalid states: no clocks or 'hard' errors. If after getting state and no clocks occur, error 2001 is reported. There may be a bad transmitter on the drive side or a bad receiver on the UDA side or the SDI cable may have taken a hit.

02002 CZUDC HRD ERR 02002 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
DRIVE STATE RECEIVED HAS BAD PARITY AFTER DRIVE WAS INITED

This error message is presented if bad parity was received from the drive after the drive was inited. There may be a bad transmitter on the drive side or a bad receiver on the UDA side or the SDI cable may have taken a hit.

02003 CZUDC HRD ERR 02003 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
DRIVE IS NOT ASSERTING RECEIVER READY IN DRIVE STATE AFTER DRIVE WAS INITED

This error message is presented if receiver ready was not received from the drive after the drive was inited. There may be a bad transmitter on the drive side or a bad receiver on the UDA side or the SDI cable may have taken a hit.

02004 CZUDC HRD ERR 02004 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
TIME-OUT ON SEND OF ECHO COMMAND TO DRIVE
ECHO DATA FF

This error message is presented if a send of the ECHO commard timed out. This may be caused by receiver ready being deasserted. The echo data is presented in hex.

02005 CZUDC HRD ERR 02005 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
ERROR DURING RECEIVE OF ECHO RESPONSE FROM DRIVE
ECHO DATA FF

This error message is presented if a receive of an ECHO command was in error. The echo data is presented in hex. There may be a bad transmitter on the drive side or a bad receiver on the UDA side or the SDI cable may have taken a hit.

02006 CZUDC HRD ERR 02006 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
ECHO COMMAND RESPONDED WITH DIFFERENT DATA
ECHO DATA SENT 00FE
ECHO DATA RECEIVED 00FF

This error message is presented if the data returning from an ECHO command did not match the data it was suppose to. The data presented is in hex.

02007 CZUDC HRD ERR 02007 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
ERROR BIT SET IN GET STATUS RESPONSE AFTER DRIVE CLEAR COMMAND
GET STATUS RESPONSE
REAL TIME STATE state
STATUS (FROM R TO L): word6 word5 word4 word3 word2 word1 word0:

This error message is presented when an error bit is set in the status of a drive after the drive was cleared of all errors. The data displayed is the responce from a GET STATUS command. The error bits in the responce are in bit position 3, 5 and 6 of word2. For further description of the GET STATUS responce, refer to the SDI Functional Spec v3.6 and the drive's functional spec.

REAL TIME STATE state: REAL TIME STATE 0003
The real time state is the real time drive state <<AFTER>> Test 2 detected the error. <<THIS VALUE IS DISPLAYED IN HEX>>. In this example, receiver ready and attention are both asserted.

The bit positions are defined as follows:
0001 - Receiver ready (Test 2 able to transmit to drive)
0002 - Attention (error occurred or online timeout expired)
0040 - Available (drive offline and usuable)
1000 - Read/Write ready

The complete meaning of these bits is beyond the scope of this text, please refer to the operator documentation for the drive you are working on.

STATUS (R TO L): word6 word5 word4 word3 word2 word1 word0:
The status is the response to the SDI GET STATUS command. These words are printed in HEX. <<NOTE THAT THE STATUS IS PRINTED OUT FROM RIGHT TO LEFT!!>>. The status' meaning is beyond the scope of this text, please refer to the operator documentation for the drive you are working on.

02008 CZUDC HRD ERR 02008 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
TIME-OUT ON SEND OF ONLINE COMMAND TO DRIVE

The ONLINE command timed out while it was sent to the drive. The drive did not assert the RECEIVER READY signal over the SDI.

02009 CZUDC HRD ERR 02009 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
ERROR DURING RECEIVE OF ONLINE RESPONSE FROM DRIVE
explanation

This error message is presented if a receive of an ONLINE command was in error. An explanation of what the error was is also presented. These explanations are:

TIMEOUT ERROR OCCURED DURING RECEIVE XFC
- This error is a failure of the drive to respond to an SDI level 2 command (see the SDI specification) before the drive-supplied command timeout expires.

1ST WORD NOT START FRAME DURING RECEIVE XFC
- The first word received by the UDA from the drive was not a valid message start frame.

FRAMING ERROR OCCURED ON SDI LEVEL 0 READ DURING RECEIVE XFC
- This is caused by one of the following conditions: 1) Illegal frame code -- the frame is not a message start, continue, or end frame. 2) Illegal sequence of frames -- such as a message start frame without ever receiving a message end frame. This can be caused by the drive sending a response before the UDA asserts receiver ready, or a random hit on the SDI cable that garbles a frame or a bad drive transmitter or UDA receiver.

CHECKSUM ERROR OCCURED ON SDI LEVEL 0 READ DURING RECEIVE XFC
- The checksum attached to a message end frame did not match the checksum computed over the level 2 command. This could be caused by a bad drive transmitter, bad UDA receiver, incorrectly computed checksum by the drive (unlikely) or a random hit on the SDI cable.

BUFFER SIZE SMALLER THEN RESPONSE DURING RECEIVE XFC
- A buffer size size set aside for the response was not large enough for the response received. This is caused by the drive sending a response that is incorrect for the request sent to the drive, or the drive sending some garbage with the response.

CODE FROM RECEIVE XFC WAS UNINTELLIGIBLE FROM SUBSYSTEM 0000
- The responce from the drive was not anything that was expected. Possible UDA microcode change without test 2 update.

02010 CZUDC HRD ERR 02010 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
ONLINE COMMAND WAS UNSUCCESSFUL
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

The ONLINE command was not successful. The drive's status is displayed. See hard error 2007 for further information on the format of the status. The drive did not assert the RECEIVER READY signal over the SDI.

02011 CZUDC HRD ERR 02011 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
ONLINE COMMAND DID NOT RETURN EXPECTED RESPONSE CODE
EXPECTED RESPONSE 7E
ACTUAL RESPONSE 00

The ONLINE command did not return an expected response code. If there were at least an UNSUCCESSFUL response, test 2 will report the drive state and status. The expected response and actual response are in hex.

02012 CZUDC HRD ERR 02012 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
TIME-OUT ON SEND OF GET UNIT CHARACTERISTICS COMMAND TO DRIVE

The GET UNIT CHARACTERISTICS command timed out while it was sent to the drive. The drive did not assert the RECEIVER READY signal over the SDI.

02013 CZUDC HRD ERR 02013 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
ERROR DURING RECEIVE OF GET UNIT CHARACTERISTICS COMMAND FROM DRIVE
explanation

This error message is presented if a receive of a GET UNIT CHARACTERISTICS command was in error. An explanation of what the error was is also presented. These explanations are described in hard error 2009.

02014 CZUDC HRD ERR 02014 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
GET UNIT CHARACTERISTICS COMMAND WAS UNSUCCESSFUL
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

The GET UNIT CHARACTERISTICS command was not successful. The drive's status is displayed. See hard error 2007 for further information on the format of the status.

02015 CZUDC HRD ERR 02015 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
GET UNIT CHARACTERISTICS COMMAND DID NOT RETURN EXPECTED RESPONSE CODE'N\
EXPECTED RESPONSE 78
ACTUAL RESPONSE 00

The GET UNIT CHARACTERISTICS command did not return an expected response code. The expected response and actual response are in hex.

02016 CZUDC HRD ERR 02016 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
HOST PROGRAM GAVE DM CODE IMPROPER DATA
EXPECTED VALUE SHOULD BE BETWEEN 0 AND 3
ACTUAL VALUE WAS xx

The host tells the DM program what to do after the DM program is done testing the drive's diagnostic. If the value is not within the expected range, this error message is printed. There is no drive problem. The problem is between the host and the UDA.

02017 CZUDC HRD ERR 02017 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
TIME-OUT ON SEND OF DIAGNOSE COMMAND TO DRIVE

The DIAGNOSE command timed out while it was sent to the drive. The drive did not assert the RECEIVER READY signal over the SDI.

02018 CZUDC HRD ERR 02018 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
ERROR DURING RECEIVE OF DIAGNOSE RESPONSE FROM DRIVE
explanation

This error message is presented if a receive of a DIAGNOSE command was in error. An explanation of what the error was is also presented. These explanations are described in hard error 2009.

02019 CZUDC HRD ERR 02019 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
DIAGNOSE COMMAND WAS UNSUCCESSFUL
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

The DIAGNOSE command was not successful. The drive's status is displayed. See hard error 2007 for further information on the format of the status.

02020 CZUDC HRD ERR 02020 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
DIAGNOSE COMMAND DID NOT RETURN EXPECTED RESPONSE CODE
EXPECTED RESPONSE FC
ACTUAL RESPONSE 00

The DIAGNOSE command did not return an expected response code. The expected response and actual response are in hex.

02021 CZUDC HRD ERR 02021 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
DRIVE DIAGNOSTIC REPORTS A HARD ERROR
TEST NUMBER 0000
DRIVE TYPE 00
ERROR NUMBER 0000
data

The drive diagnostic found an error and is reporting the error back to the host. All values are in hex. TEST NUMBER shows what test was run. DRIVE TYPE shows what type of drive was being tested. ERROR NUMBER shows the result of the test. The drive may pass back data to the host. This data will be presented in a 32 bit hex format following the error message. More data may follow the 32 bit hex values. This data is printed in ascii format. For definitions of what these values mean, refer to the drive functional spec.

02022 CZUDC HRD ERR 02022 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
HOST PROGRAM DOWN LINE LOADED A DIAGNOSTIC WITH A ZERO BYTE COUNT

The host program was attempting to down line load a diagnostic of zero length. The DM program must have the byte count specified by the host.

02023 CZUDC HRD ERR 02023 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
DIAGNOSTIC filnam REQUESTED BY THE DRIVE COULD NOT BE SUPPLIED BY HOST.

The host program could not supply the diagnostic 'filnam' to down line load to the drive.

02024 CZUDC HRD ERR 02024 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
TIME-OUT ON SEND OF MEMORY READ COMMAND TO DRIVE

The MEMORY READ command timed out while it was sent to the drive. The drive did not assert the RECEIVER READY signal over the SDI.

02025 CZUDC HRD ERR 02025 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
ERROR DURING RECEIVE OF MEMORY READ RESPONSE FROM DRIVE
explanation

This error message is presented if a receive of a MEMORY READ command was in error. An explanation of what the error was is also presented. These explanations are described in hard error 2009.

02026 CZUDC HRD ERR 02026 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
MEMORY READ COMMAND WAS UNSUCCESSFUL
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

The MEMORY READ command was not successful. The drive's status is displayed. See hard error 2007 for further information on the format of the status.

02027 CZUDC HRD ERR 02027 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
MEMORY READ COMMAND DID NOT RETURN EXPECTED RESPONSE CODE
EXPECTED RESPONSE 72
ACTUAL RESPONSE 00

The MEMORY READ command did not return an expected response code. The expected response and actual response are in hex.

02028 CZUDC HRD ERR 02028 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
TIME-OUT ON SEND OF MEMORY WRITE COMMAND TO DRIVE

The MEMORY WRITE command timed out while it was sent to the drive. The drive did not assert the RECEIVER READY signal over the SDI.

02029 CZUDC HRD ERR 02029 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
ERROR DURING RECEIVE OF MEMORY WRITE RESPONSE FROM DRIVE
explanation

This error message is presented if a receive of a MEMORY WRITE command was in error. An explanation of what the error was is also presented. These explanations are described in hard error 2009.

02030 CZUDC HRD ERR 02030 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
MEMORY WRITE COMMAND WAS UNSUCCESSFUL
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

The MEMORY WRITE command was not successful. The drive's status is displayed. See hard error 2007 for further information on the format of the status.

02031 CZUDC HRD ERR 02031 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
MEMORY WRITE COMMAND DID NOT RETURN EXPECTED RESPONSE CODE
EXPECTED RESPONSE 7E
ACTUAL RESPONSE 00

The MEMORY WRITE command did not return an expected response code. The expected response and actual response are in hex.

02032 CZUDC HRD ERR 02032 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
TIME-OUT ON SEND OF RUN COMMAND TO DRIVE

The RUN command timed out while it was sent to the drive. The drive did not assert the RECEIVER READY signal over the SDI.

02033 CZUDC HRD ERR 02033 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
ERROR DURING RECEIVE OF RUN RESPONSE FROM DRIVE
explanation

This error message is presented if a receive of a RUN command was in error. An explanation of what the error was is also presented. These explanations are described in hard error 2009.

02034 CZUDC HRD ERR 02034 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
RUN COMMAND WAS UNSUCCESSFUL
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

The RUN command was not successful. The drive's status is displayed. See hard error 2007 for further information on the format of the status.

02035 CZUDC HRD ERR 02035 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
RUN COMMAND DID NOT RETURN EXPECTED RESPONSE CODE
EXPECTED RESPONSE 7E
ACTUAL RESPONSE 00

The RUN command did not return an expected response code. The expected response and actual response are in hex.

02036 CZUDC HRD ERR 02036 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
TIME-OUT ON SEND OF RECALIBRATE COMMAND TO DRIVE

The RECALIBRATE command timed out while it was sent to the drive. The drive did not assert the RECEIVER READY signal over the SDI.

02037 CZUDC HRD ERR 02037 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
ERROR DURING RECEIVE OF RECALIBRATE RESPONSE FROM DRIVE
explanation

This error message is presented if a receive of a RECALIBRATE command was in error. An explanation of what the error was is also presented. These explanations are described in hard error 2009.

02038 CZUDC HRD ERR 02038 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
RECALIBRATE COMMAND WAS UNSUCCESSFUL
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

The RECALIBRATE command was not successful. The drive's status is displayed. See hard error 2007 for further information on the format of the status.

02039 CZUDC HRD ERR 02039 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
RECALIBRATE COMMAND DID NOT RETURN EXPECTED RESPONSE CODE
EXPECTED RESPONSE 7E
ACTUAL RESPONSE 00

The RECLAIBRATE command did not return an expected response code. The expected response and actual response are in hex.

02040 CZUDC HRD ERR 02040 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
TIME-OUT ON SEND OF GET STATUS COMMAND TO DRIVE

The GET STATUS command timed out while it was sent to the drive. The drive did not assert the RECEIVER READY signal over the SDI.

02041 CZUDC HRD ERR 02041 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
ERROR DURING RECEIVE OF GET STATUS RESPONSE FROM DRIVE
explanation

This error message is presented if a receive of a GET STATUS command was in error. An explanation of what the error was is also presented. These explanations are described in hard error 2009.

02042 CZUDC HRD ERR 02042 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
GET STATUS COMMAND WAS UNSUCCESSFUL
REAL TIME STATE 0003
STATUS (R TO): 1312 1110 0908 0706 0504 0302 0100

The GET STAUTS command was not successful. The drive's status is displayed. See hard error 2007 for further information on the format of the status.

02043 CZUDC HRD ERR 02043 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
GET STATUS COMMAND DID NOT RETURN EXPECTED RESPONSE CODE
EXPECTED RESPONSE F6
ACTUAL RESPONSE 00

The GET STATUS command did not return an expected response code. The expected response and actual response are in hex.

02044 CZUDC HRD ERR 02044 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
TIME-OUT ON SEND OF DRIVE CLEAR COMMAND TO DRIVE

The DRIVE CLEAR command timed out while it was sent to the drive. The drive did not assert the RECEIVER READY signal over the SDI.

02045 CZUDC HRD ERR 02045 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
ERROR DURING RECEIVE OF DRIVE CLEAR RESPONSE FROM DRIVE
explanation

This error message is presented if a receive of a DRIVE CLEAR command was in error. An explanation of what the error was is also presented. These explanations are described in hard error 2009.

02046 CZUDC HRD ERR 02046 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
DRIVE CLEAR COMMAND WAS UNSUCCESSFUL
REAL TIME STATE 0003
STATUS (R TO L). 1312 1110 0908 0706 0504 0302 0100

The DRIVE CLEAR command was not successful. The drive's status is displayed. See hard error 2007 for further information on the format of the status.

02047 CZUDC HRD ERR 02047 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK RESIDENT DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
DRIVE CLEAR COMMAND DID NOT RETURN EXPECTED RESPONSE CODE
EXPECTED RESPONSE 7E
ACTUAL RESPONSE 00

The DRIVE CLEAR command did not return an expected response code. The expected response and actual response are in hex.

3.2.5 TEST 3 INFORMATIONAL MESSAGES

UNIT xx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
LOGGABLE INFORMATION AFTER RECAL
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

After sending a RECALIBRATE command, the ATTENTION bit was set. Test 3 then sent a GET STATUS command and found the LOGGABLE INFORMATION bit was set. This is not an error, it is only some information being sent from the drive. Normal operation continues.

Check 03001 for explanation of 'REAL TIME STATE' and 'STATUS'

3.2.6 TEST 3 ERROR MESSAGES (03000 TO 03999)

03001 CZUDC HRD ERR 03001 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
TIME-OUT ON SEND
COMMAND WAS command
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

If test 3 tries to send a level 2 command to the drive, and receiver ready is deasserted, error 3001 occurs.
Where command is one of the following:

- GET COMMON CHARACTERISTICS
- ONLINE
- DRIVE CLEAR
- DISCONNECT
- GET SUBUNIT CHARACTERISTICS
- GET STATUS
- CHANGE MODE
- INITIATE RECLIBRATE
- SPIN UP

REAL TIME STATE state: REAL TIME STATE 0003
The real time state is the real time drive state <<AFTER>> Test 3 detected the error. <<THIS VALUE IS DISPLAYED IN HEX>>. In this example, receiver ready and attention are both asserted.

The bit positions are defined as follows:
- 0001 - Receiver ready (Test 3 able to transmit to drive)
- 0002 - Attention (error occurred or online timeout expired)
- 0040 - Available (drive offline and usuable)
- 1000 - Read/Write ready

The complete meaning of these bits is beyond the scope of this text, please refer to the operator documentation for the drive you are working on.

STATUS (R TO L): word6 word5 word4 word3 word2 word1 word0:
The status is the response to the SDI GET STATUS command. These words are printed in HEX. <<NOTE THAT THE STATUS IS PRINTED OUT FROM RIGHT TO LEFT!!>>. The status' meaning is beyond the scope of this text, please refer to the operator documentation for the drive you are working on.

03002 CZUDC HRD ERR 03002 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
TIME-OUT OF RECEIVE
COMMAND WAS GET COMMON CHARACTERISTICS
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

This error is a failure of the drive to respond to an SDI level 2 command (see the SDI specification) befor the drive-supplied command timeout expires.

Check 03001 for explanation of 'REAL TIME STATE' and 'STATUS'

03003 CZUDC HRD ERR 03003 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
FIRST WORD RECEIVED WAS NOT A START FRAME
COMMAND WAS GET COMMON CHARACTERISTICS
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

The first word received by the UDA from the drive was not a valid message start frame.

03004 CZUDC HRD ERR 03004 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
FRAMING ERROR ON LEVEL 0 RESPONSE
COMMAND WAS GET COMMON CHARACTERISTICS
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

Error 3004 is caused by one or more of the following conditions: 1) Illegal frame code -- the frame is not a message start, continue, or end frame. 2) Illegal sequence of frames -- such as a message start frame without ever receiving a message end frame. This can be caused by the drive sending a response before the UDA asserts receiver ready, or a random hit on the SDI cable that garbles a frame or a bad drive transmitter or UDA receiver.

Check 03001 for explanation of 'REAL TIME STATE' and 'STATUS'

03005 CZUDC HRD ERR 03005 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
CHECKSUM ERROR ON LEVEL 0 RESPONSE
COMMAND WAS GET COMMON CHARACTERISTICS
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

The checksum attached to a message end frame did not match the checksum computed over the level 2 command. This could be caused by a bad drive transmitter, bad UDA receiver, incorrectly computed checksum by the drive (unlikely) or a random hit on the SDI cable.

Check 03001 for explanation of 'REAL TIME STATE' and 'STATUS'

```
03006   CZUDC HRD ERR  03006 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
        DISK FUNCTION DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hhh:mm:ss
        RESPONSE LONGER THAN EXPECTED
        COMMAND WAS GET COMMON CHARACTERISTICS
        REAL TIME STATE 0003
        STATUS (R TO L): 1312  1110  0908  0706  0504  0302  0100
```

The buffer size set aside for the response was not large enough for the response received. This is caused by the drive sending a response that is incorrect for the request sent to the drive, or the drive sending some garbage with the response.

Check 03001 for explanation of 'REAL TIME STATE' and 'STATUS'

```
03007   CZUDC HRD ERR  03007 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
        DISK FUNCTION DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hhh:mm:ss
        CODE FROM RECEIVE WAS UNINELLIGIBLE FROM SUBSYSTEM = 0000
        COMMAND WAS GET COMMON CHARACTERISTICS
        REAL TIME STATE 0003
        STATUS (R TO L): 1312  1110  0908  0706  0504  0302  0100
```

The unknown error code occurs when the UDA returns an error code from an operation that test 3 does not recognize. Possible UDA microcode change without test 3 update.

Check 03001 for explanation of 'REAL TIME STATE' and 'STATUS'

```
03008   CZUDC HRD ERR  03008 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
        DISK FUNCTION DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hhh:mm:ss
        COMMAND DID NOT RETURN EXPECTED RESPONSE CODE
        COMMAND WAS GET COMMON CHARACTERISTICS
          EXPECED RESPONSE   7E
          ACTUAL RESPONSE    7D
        REAL TIME STATE 0003
        STATUS (R TO L): 1312  1110  0908  0706  0504  0302  0100
```

This is caused by receiving an UNSUCCESSFUL response from the drive, or the drive sending some response other than the correct response for the request sent to the drive. See the contents of status for the unexpected response error (or reason).

Check 03001 for explanation of 'REAL TIME STATE' and 'STATUS'

```
03009   CZUDC HRD ERR  03009 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
        DISK FUNCTION DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hhh:mm:ss
        DRIVE NOT ASSERTING RECEIVER READY IN DRIVE STATE
        REAL TIME STATE 0003
```

Test 3 inits the drive and checks the drive's real time state. If RECEIVER READY was not asserted after a period of time this error message is printed.

03010 CZUDC HRD ERR 03010 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
FAILED TO RECEIVE VALID DRIVE STATE
REAL TIME STATE 0003

There are two types of invalid state: no clocks or 'hard' errors. If after getting state and no clocks occur, error 3010 is reported. Check the drive state for further information.

03011 CZUDC HRD ERR 03011 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
CANNOT RECEIVE DRIVE STATE FROM DRIVE
CHECK IF DRIVE IS POWERED ON.
REAL TIME STATE 0003

After the test 3 sends the drive a DISCONNECT command test 3 should be able to receive state from the drive. The drive may have spun down after the DISCONNECT command.

03012 CZUDC HRD ERR 03012 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
DRIVE STATE RECEIVED HAS BAD PARITY
REAL TIME STATE 0003

As in 3010, we can get two types of invalid state. If parity or pulse errors occur for 1/2 a second, either the transmitter or receiver is bad. This could be caused by a bad transmitter or receiver or by a hit on the SDI cable.

03013 CZUDC DVC FTL 03013 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
NO VALID STATE FROM DRIVE
REAL TIME STATE 0003

The drive recieved either one of the two types of invalid state that are described in 3010 and 3012. Check state for further information. This could be caused by a bad transmitter or receiver or by a hit on the SDI cable.

03014 CZUDC HRD ERR 03014 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
SUBUNIT CHARACTERISICS SAY THERE ARE ZERO READ ONLY GROUPS
IN THE DIAGNOSTIC AREA

After interrogating the subunit characteristics, test 3 finds out that the drive claims there are zero read only groups in the diagnostic area. There must be at least one for the test to run.

03015 CZUDC HRD ERR 03015 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
SUBUNIT CHARACTERISTICS SAY THERE ARE LESS THAN 1 READ/WRITE
GROUPS IN THE DIAGNOSTIC AREA

After interrogating the subunit characteristics, test 3 finds out that the drive claims there are zero read/write groups in the diagnostic area. There must be at least one for the test to run.

03016 CZUDC HRD ERR 03016 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
NEITHER R/W READY NOR ATTENTION SET AFTER RECALIBRATE COMMAND
REAL TIME STATE 0003

After a RECALIBRATE command, R/W READY or ATTENTION did not set. Check the state for further information. This could be cause by a bad transmitter or receiver or by a hit on the SDI cable.

03017 CZUDC HRD ERR 03017 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
SUBUNIT CHARACERISTICS SAY LESS THAN 1 DIAGNOSTIC CYLINDER

After interrogating the subunit characteristics, test 3 finds out that the drive claims there are zero diagnostic cylinders. There must be at least one for the test to run.

03018 CZUDC HRD ERR 03018 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
READ/WRITE READY DROPPED BEFORE FORMAT OPERATION

The R/W READY signal was deasserted by the drive before a format operation was going to be sent by the UDA. The drive may have gone off line or is not transmitting properly or the UDA may not be receiving properly or the SDI cable took a hit.

03019 CZUDC HRD ERR 03019 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
FORMAT OPERATION REPORTED TIME-OUT FAILURE
CYLINDER aaa. GROUP bb. TRACK cc.

The format operation sent by the UDA failed. The command timed out possibly due to receiver ready being dropped or communication problem (bad transmitter or receiver or hit on the SDI cable)

Where:
aaa is the cylinder value in decimal.
bb is the group value in decimal.
cc is the track value in decimal.

03020 CZUDC HRD ERR 03020 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
AFTER RECAL, ERROR BITS WERE SET
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

After sending a RECALIBRATE command, the ATTENTION bit was set. Test 3 then sent a GET STATUS command and found the error bits were set. For further information, check the state and the status.

Check 03001 for explanation of 'REAL TIME STATE' and 'STATUS'

03022 CZUDC HRD ERR 03022 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
READ/WRITE READY DROPPED BEFORE WRITE OPERATION

The R/W READY signal was deasserted by the drive before a write operation was going to be sent by the UDA. The drive may have gone off line or is not transmitting properly or the UDA may not be receiving properly or the SDI cable took a hit.

03023 CZUDC HRD ERR 03023 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
COULD NOT WRITE AND READ ANY BLOCK ON THIS TRACK. ON LAST BLOCK:
WRITE OPERATION REPORTED FAILURE -- ERROR CODE aaa OCTAL.
DBN bbb. CYLINDER ccc. GROUP dd. TRACK ee.

After each track in the diagnostic space is formatted, at least one block must be able to have data written to it and read from it and the data must be correct. Not one block (DBN bbb.) from track (ee) was able to pass. The error code (aaa) gives the reason for the write operation failure.

Where:
aaa is the error code in octal.
It may have one of the following values:
2 = drive failure
3 = requested LBN is a secondary revector.
<<< NOTE >>> We are working with DBN's
4 = header compare failure (desired header not found)
153 = suspected positioner error
213 = read/write ready failure
253 = drive data or state clock timeout (indicates cable/transmitter/receiver broken)
313 = receiver ready timeout
413 = drive state receive error during write
bbb is the DBN in decimal.
ccc is the cylinder value in decimal.
dd is the group value in decimal.
ee is the track value in decimal.

03024 CZUDC HRD ERR 03024 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
READ/WRITE READY DROPPED BEFORE READ OPERATION

The R/W READY signal was deasserted by the drive before a read operation was going to be sent by the UDA. The drive may have gone off line or is not transmitting properly or the UDA may not be receiving properly or the SDI cable took a hit.

03025 CZUDC HRD ERR 03025 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
COULD NOT WRITE AND READ ANY BLOCK ON THIS TRACK. ON LAST BLOCK:
READ OPERATION REPORTED FAILURE -- ERROR CODE aaa OCTAL.
DBN bbb. CYLINDER ccc. GROUP dd. TRACK ee.

After each track in the diagnostic space is formatted, at least one block must be able to have data written to it and read from it and the data must be correct. Not one block (DBN bbb.) from track (ee) was able to pass. The error code (aaa) gives the reason for the read operation failure.

Where:

aaa is the error code in octal.
It may have one of the following values:
2 = drive failure
3 = requested LBN is a secondary revector.
<<< NOTE >>> We are working with DBN's
4 = header compare failure (desired header not found)
52 = SERDES overrun error
150 = data sync timeout on read
153 = suspected positioner error
213 = read/write ready failure
253 = drive data or state clock timeout (indicates cable/transmitter/receiver broken)
313 = receiver ready timeout
413 = drive state receive error during write

bbb is the DBN in decimal.
ccc is the cylinder value in decimal.
dd is the group value in decimal.
ee is the track value in decimal.

03026 CZUDC HRD ERR 03026 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
COULD NOT WRITE AND READ ANY BLOCK ON THIS TRACK. ON LAST BLOCK:
DATA COMPARE FAILURE ON WORD aa.
EXPECTED DATA bbbb
ACTUAL DATA cccc
CYLINDER ddd. GROUP ee. TRACK ff.

After each track in the diagnostic space is formatted, at least one block must be able to have data written to it and read from it and the data must be correct. Not one block (DBN bbb.) from track (ee) was able to pass. The data read did not match the data written.

Where:
aa is the offset in decimal into the buffer where the error occurred.
bbbb is the expected data in hex.
cccc is the actual data in hex.
ddd is the cylinder value in decimal.
ee is the group value in decimal.
ff is the track value in decimal.

03027 CZUDC HRD ERR 03027 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
SEEK COMPLETE TIME-OUT -- READ/WRITE READY DID NOT SET
SEEK WAS TO CYLINDER aaa. GROUP bb.

After a SEEK command has been successfully sent from the UDA to the drive, the signal READ/WRITE READY must be set to indicate that the seek completed. If READ/WRITE READY never is asserted by the drive after the seek, the seek times out and error 3027 is presented.

Where:
aaa is the cylinder in decimal.
bb is the group in decimal.

03028 CZUDC HRD ERR 03028 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
NO BLOCK ON THIS TRACK CAN BE READ. LAST BLOCK TRIED:
aBN bbbb. CYLINDER ccc. GROUP dd. TRACK ee.

After a seek to a track, at least one block must be able to be read to assure that test 3 can read the header. If not one block was successful, error message 3028 appears.

Where:
a is 'L' for LBN, 'D' for DBN, or 'X' for XBN.
bbbb is the block number in decimal.
ccc is the cylinder in decimal.
dd is the group number in decimal.
ee is the track number in decimal.

03029 CZUDC HRD ERR 03029 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
AVAILABLE WAS NOT ASSERTED AFTER DISCONNECT
STATE RECEIVED state

After the DISCONNECT command was sent, the AVAILABLE flag should be asserted after a period of time. It it never was, then error 3029 appears. There maybe a problem with a transmitter or a receiver or the SDI cable at this point.

03030 CZUDC HRD ERR 03030 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
INVALID COMMAND aaaa WAS SUCCESSFUL

Some invalid level 2 commands are sent over the SDI. The drive should find these illegal commands and flag them as such. If the drive doesn't, then error 3030 will appear.

Where aaaa is the invalid command in hex.

03031 CZUDC HRD ERR 03031 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
COMMAND WITH type LENGTH = a WAS SUCCESSFUL

SDI level 2 commands with invalid lengths are sent to the drive to check if the drive can find them.

Where:
type could be 'COMMAND' or 'RESPONSE' for which field was affected
a is the invalid length

03032 CZUDC HRD ERR 03032 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
UNIT DID NOT REPORT TRANSMITTION ERROR
WHEN reason

Invalid level 1 sequences were sent to the drive. Several sequences are tried and the drive should find fault with everyone of them.

Where reason could be one of the following:

AN END FRAME WAS SENT AFTER A START FRAME TIMED OUT
A CONTINUE OR END FRAME DID NOT FOLLOW A START FRAME
AN END FRAME WAS SENT WITH NO START FRAME
AN END FRAME WIH A BAD CHECKSUM WAS SENT
A CONTINUE FRAME WAS SENT WITH NO START FRAME

03033 CZUDC HRD ERR 03033 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
UNIT ACCEPTED AN INVALID GROUP NUMBER FROM GROUP SELECT LEVEL 1

A level 1 select group command with an illegal group number is sent to the drive. If the drive accepted it, then error 3033 will be displayed.

03034 CZUDC DVC FTL ERR 03034 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
UNABLE TO CORRECTLY READ OVERLAY x
THIS UDA AND ALL DRIVES ATTACHED WILL BE REMOVED FROM TESTING

There are two overlays in test 3. For some reason that the overlay cannot be read correctly, error 3034 will be displayed. Since no code can be loaded into the UDA at this point, the UDA and all attached drives will cease to be tested. The reason for this may be bad UNIBUS memory or board 1 may be failing.

<<< NOTE >>> This is -- NOT -- a drive failure.

03035 CZUDC DVC FTL ERR 03035 ON UNIT 00 TST 003 SUB 000 PC: xxxxxx
DISK FUNCTION DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
SUCCESSFULLY WROTE ON DMN AREA WHEN DRIVE WAS WRITE PROTECTED

An attempt was made to write on a write protected drive. It should have resulted in an error response from the disk drive, but it didn't.

3.2.7 TEST 4 INFORMATIONAL MESSAGES

```
UNIT u UDA AT cccccc DRIVE n   RUNTIME hh:mm:ss
A CORRECTABLE ECC ERROR EXISTS IN type bn
SECTORS FROM INDEX sector TRK track GRP group CYL cylinder
```

The above message occurs when Test 4 1) detects an ECC error and 2) is able to correct it, and 3) the corrections are less than the drive ECC threshold, (a SDI DRIVE CHARACTERISTIC) and 4) the EDC computed over the corrected sector matched the EDC read.

```
UNIT unit UDA AT udaadr DRIVE plug   RUNTIME hh:mm:ss
INITIAL WRITE COMPLETE
```

Whenever Test 4 is STArted with initial write enabled, <<OR>> whenever it is STArted or REStarted and the diagnostic area is being tested on a drive not in read only mode, the disk will be initially written. The above message occurs when the initial write completes.

```
UNIT unit UDA AT udaadr DRIVE plug   RUNTIME hh:mm:ss
READ ONLY DRIVE, INITIAL WRITE WILL NOT BE PERFORMED
```

If an initial write is to be performed (see above for conditions) and a unit or subunit is in read only mode, (can be set in the manual intervention questions) an initial write will not be performed, and this message will print to inform the operator.

NOTE: DATA COMPARE ERRORS RESULT IF THE DISK IS NOT INITIALLY WRITTEN!!

```
UNIT unit UDA AT udaadr DRIVE plug   RUNTIME hh:mm:ss
THE PREVIOUS DEVICE FATAL WILL CAUSE THE FOLLOWING DRIVES
TO BE DROPPED: plug,  plug+1,  plug+2,  plug+3
```

plug: drive plug number -- each subunit's plug number is displayed. for a single subunit drive (such as and RA80) only one plug number is displayed.

If a device fatal error occurs and dropping is enabled, <<ALL>> subunits on the unit that the device fatal occurred must be dropped. To inform the operator, this message is printed after the device fatal error message.

NOTE: IF MORE THAN ONE UDA IS ON A SYSTEM, THIS MESSAGE MAY NOT IMMEDIATELY FOLLOW THE DEVICE FATAL IF AN ERROR HAPPENS AT THE SAME TIME ON ANOTHER UDA.

3.2.8 TEST 4 ERROR MESSAGES (04000 TO 04999)

04001 CZUDC SFT ERR 04001 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
ATTN ASSERTED DURING SEEK -- ERROR OR LOGGABLE INFORMATION
SEEK FROM GRP group CYL cylinder TO GRP group CYL cylinder
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

This error occurs when the drive asserts the SDI ATTENTION signal without asserting the READ/WRITE READY signal, indicating the unsuccessful completion of a seek.

See retry/recovery section for recovery details.

04002 CZUDC SFT ERR 04002 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
ATTN ASSERTED UNEXPECTEDLY, ASYN DRIVE ERROR OR LOGGABLE
INFORMATION -- THIS IS AN <<UNCOUNTED>> SOFT ERROR
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

This is an asynchronous drive error. Asynchronous drive errors are those errors reported by the drive which are not related to a level 2 command. These errors are reported by the drive using the SDI ATTENTION signal. The operator must look at the status returned to determine the error that occurred.

See retry/recovery section for recovery details.

04003 CZUDC SFT ERR 04003 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
SEEK DID NOT COMPLETE, NEITHER ATTN OR R/W RDY WAS ASSERTED
BEFORE TIMEOUT
SEEK FROM GRP group CYL cylinder TO GRP group CYL cylinder
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

This error occurs when the drive fails to assert READ/WRITE READY before the seek timeout, which indicates the successful completion of a seek.

See retry/recovery section for recovery details.

04004 CZUDC HRD ERR 04004 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxx, UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
RCT AREA CORRUPTED, COULD NOT FIND REPLACEMENT FOR
LBN THAT WAS REVECTORED
ATTEMPTING TO READ RCT LBN bn
SEARCHING FOR LBN bn

CZUDC HRD ERR 04004 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
RCT AREA CORRUPTED, COULD NOT FIND REPLACEMENT FOR
LBN WITH HEADER NOT FOUND
ATTEMPTING TO READ RCT LBN bn
SEARCHING FOR LBN bn

Error 4004 will occurr only when Test 4 is running in the customer data area. It occurs when 1) A sector is either marked revectored or the header can't be found in two revolutions of the disk (both cases should be revectored) and 2) The replacement for that sector isn't found in the RCT and 3) a NULL entry isn't found at the end of the RCT (see DEC STANDARD 166, Replacement and Caching Table Format). In either case, the subunit should be reformatted, and the cause of the RCT corruption determined.

04005 CZUDC HRD ERR 04005 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
HEADER NOT FOUND DURING WRITE
DBN bn
SECTORS FROM INDEX sector TRK track GRP group CYL cylinder
ORIGIN OF SEEK: GRP group CYL cylinder

Error 4005 occurs only when Test 4 is writing a DBN or RBN. This is because bad blocks in the diagnostic area are not revectored, and RBN's are what LBN's are revectord to, so they should never be bad. Test 4 reports this error if the header being searched for couldn't be found in two revolutions of the disk.

```
04006   CZUDC   SFT ERR  04006 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        SELECT TRACK AND WRITE LEVEL 1 CMD NOT EXECUTED
        ATTEMPT attempt
        type bn
        SECTORS FROM INDEX sector TRK track GRP group CYL cylinder
        ORIGIN OF SEEK: GRP group CYL cylinder
        REAL TIME STATE 0003
        STATUS (R TO L): 1312  1110  0908  0706  0504  0302  0100
```

Select track and read or write not executed occurs when the UDA attempts to send the select track and read/write level 1 cmd, but receiver ready is deasserted or the state is invalid so it cannot send the command (the SERDES could also be broken so it's unable to send the command). The same error is generated if the UDA gets a header sync timeout, and when it looks at the drive's state, it is either invalid or reciever ready is deasserted (header sync timeout is <<NOT>> a error -- it's quite normal on a high-density disk).

See retry/recovery section for recovery details.

```
04007   CZUDC   SFT ERR  04007 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        ECC DETECTED ERROR
        RETRY retry
        ERROR RECOVERY LEVEL level
        type bn
        SECTORS FROM INDEX sector TRK track GRP group CYL cylinder
```

Error 4007 occurs if an ECC error is detected but ECC correction is disabled.

See retry/recovery section for recovery details.

```
04008   CZUDC   SFT ERR  04008 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        ECC DETECTED ERROR, BUT CORRECTION FAILED
        RETRY retry
        ERROR RECOVERY LEVEL level
        type bn
        SECTORS FROM INDEX sector TRK track GRP group CYL cylinder
```

Error 4008 occurs if an ECC error is detected, but the correction algorithm is unable to correct the errors.

NOTE: THIS IS USUALLY (BUT NOT ALWAYS) INDICATIVE OF A BAD SPOT IN THE ECC RESIDUE AREA AFTER THE DATA AREA OF THE SECTOR.

See retry/recovery section for recovery details.

```
04009   CZUDC   SFT ERR  04009 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        ECC CORRECTIONS EXCEED THRESHOLD
        RETRY retry
        ERROR RECOVERY LEVEL level
        type bn
        SECTORS FROM INDEX sector TRK track GRP group CYL cylinder

                Error 4009 occurs if an ECC error is detected, the correction
                algorithm succeeds in correcting the errors, but the number of bits
                that were corrected exceeds the correction threshold (a SDI DRIVE
                CHARACTERISTIC).

                See retry/recovery section for recovery details.


04010   CZUDC   SFT ERR  04010 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        ECC CORRECTION SUCCEEDED, BUT EDC DETECTS ERROR
        RETRY retry
        ERROR RECOVERY LEVEL level
        type bn
        SECTORS FROM INDEX sector TRK track GRP group CYL cylinder

                Error 4010 could be caused by several problems:

                1) A buffer with a few ECC errors that can be corrected, but the EDC
                was incorrectly computed or written, or 2) The ECC algorithm
                incorrectly corrected the buffer and/or the EDC value, (but corrections
                were less than the threshold) or 3) UDA buffer RAM problem.

                See retry/recovery section for recovery details.


04011   CZUDC   HRD ERR  04011 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        ERROR RECOVERY TRIED ALL LEVELS WITHOUT SUCCESS
        type bn
        GRP group CYL cylinder

                Error 4011 occurs when retries are enabled, and Test 4 has tried
                all retries on all levels of error recovery.  See ECC and EDC
                retries in the retry/recovery section.
```

```
04012   CZUDC   HRD ERR  04012 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        DATA COMPARISON FAILED
        ECC OR EDC HAD DETECTED ERROR IN BUFFER
        type bn
        SECTORS FROM INDEX sector TRK track GRP group CYL cylinder
        PATTERN NUMBER pattern
        OFFSET OF ERROR WITHIN BUFFER: buffer_offset
        OFFSET OF ERROR WITHIN DISPLAYED LIST: list_offset (1ST WORD OFFSET 0)
            data0   data1   data2   data3   data4   data5
            data6   data7   data8   data9   data10  data11

        CZUDC   HRD ERR  04012 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        DATA COMPARISON FAILED
        ECC OR EDC HAD <<NOT>> DETECTED ERROR IN BUFFER
        type bn
        SECTORS FROM INDEX sector TRK track GRP group CYL cylinder
        PATTERN NUMBER pattern
        OFFSET OF ERROR WITHIN BUFFER: buffer_offset
        OFFSET OF ERROR WITHIN DISPLAYED LIST: list_offset (1ST WORD OFFSET 0)
            data0   data1   data2   data3   data4   data5
            data6   data7   data8   data9   data10  data11

                pattern:        The pattern number (decimal) that failed the comparison.

                buffer_offset:  The offset of the error (decimal) within the sector read,
                                where the first word in the sector is offset 0

                list_offset:    The offset of the error (decimal) within the displayed list,
                                where the first word in the list is offset 0

                dataX:          Test 4 displays twelve data words read from the sector.
                                They are displayed left to right, top to bottom.

        Error 4012 occurs when a data compare detects a difference between
        the buffer read and a known data pattern.  The operator is informed if
        the error was detected by the ECC or EDC.  The first word of the sector
        which may or may not be printed, depending on the position of the error,
        is the pattern number replicated in each nibble of the word.  If a disk
        is not initally written, it is likely that data comparison failures will
        occur in the fist word of the sector.  The following is the first word
        of the sector for the sixteen different patterns.

              pattern         word 0          pattern         word 0

                1             010421            9             114631
                2             021042           10             125252
                3             031463           11             135673
                4             042104           12             146314
                5             052525           13             156735
                6             063146           14             167356
                7             073567           15             177777
                8             104210           16             000000

        Note that pattern 16 is mapped to pattern 0.
```

04013 CZUDC DEV FTL ERR 04013 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
DRIVE NOT ONLINE TO UDA, AND NOT SPINABLE

If a drive dropps offline while being tested (a normal occurance during Test 4) and some event happens that makes the drive unspinnable (such as the operator popping out the run/stop switch) error 4013 will be printed. If the operator inhibits dropping units, Test 4 will go into error recovery and loop on error 4023, spindle dropped ready.

04014 CZUDC DEV FTL ERR 04014 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
UNABLE TO COMPLETE SEEK -- TRIED 3 TIMES
type bn
GRP group CYL cylinder

Once a seek has been attempted 3 times, and never successfully completed, error 4014 will be printed and the entire unit dropped. If the operator inhibits dropping units, the drive will be recalibrated, and the seek will be attempted again.

04015 CZUDC SFT ERR 04015 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
SEEK REQUIRED retries RETRIES BEFORE COMPLETING
GRP group CYL cylinder

retries: The number of times the seek was re-issued

If a seek required retries, error 4015 would print to notify the operator.

04016 CZUDC DEV FTL ERR 04016 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
ERRORS DURING DRIVE INITIALIZATION AND SETUP
THIS UDA AND ALL DRIVES ATTACHED WILL BE REMOVED FROM TESTING

If any errors occur during drive and test initialization, DRIVES ATTACHED TO THE UDA THAT HAD THE DRIVE INITIALIZATION ERRORS WILL NOT BE TESTED. In this case, error 4016 will be printed to notify the operator. THIS ERROR DOES <<NOT>> REFER TO UDA INITIALIZATION. This error is unaffected by the operator inhibiting the dropping of units.

```
04017   CZUDC   DEV FTL ERR  04017 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        NO VALID STATE FROM DRIVE
        NO DRIVE CLOCKS

        CZUDC   DEV FTL ERR  04017 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        NO VALID STATE FROM DRIVE
        HARD PARITY OR PULSE ERROR FOR 1/2 A SECOND
```

If Test 4 is <<EVER>> unable to get valid drive state, the drive is immediately dropped, and error 4017 is printed. There are two types of invalid state: no clocks or 'hard' errors. If Test 4 <<EVER>> detects no clocks, the driver is dropped IMMEDIATELY. Parity and pulse errors are normal, so Test 4 tolerates them, <<UNLESS THEY HAPPEN CONTINUOUSLY FOR 1/2 A SECOND>>. If they do occur for 1/2 a second, either the transmitter or receiver is bad, and the drive is dropped. If the operator has inhibited the dropping of units, Test 4 will retry the module that the error occurred on.

```
04018   CZUDC   DEV FTL ERR  04018 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        ATTEMPT TO WRITE ON WRITE PROTECTED DRIVE
        ERROR CODE RETURNED FROM UDA: code
        REAL TIME STATE 0003
        STATUS (R TO L): 1312  1110  0908  0706  0504  0302  0100
```

code: The error (in octal) returned to Test 4 from the UDA when Test 4 attempted to write on the write protected drive.

The UDA error codes (in octal) are as follows:

code	error
2	SELECT TRACK AND WRITE LEVEL 1 CMD NOT EXECUTED
3	LBN IS REVECTORED
4	HEADER NOT FOUND
153	SEEK OR HEAD SELECT ERROR
213	R/W RDY DROPPED
253	DATA OR STATE CLOCK TIMEOUT
313	RCVR RDY DROPPED
413	REAL TIME STATE RECEIVE ERROR

If an attempt is made to write on a write protected drive, the drive <<SHOULD>> drop READ/WRITE READY -- this is an error code of 213. If <<ANY>> other code is returned from the drive, the drive is causing the write to fail in an incorrect manner.

If Test 4 attempts to write on a write protected drive, error 4018 is printed. Test 4 requires the drive to detect the attempt to write when write protected and return an error for this error to be printed. If the operator has inhibited the dropping of units, a seek will be issued and the write attempted again.

04019 CZUDC HRD ERR 04019 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
HEADER NOT FOUND DURING READ
type bn
SECTORS FROM INDEX sector TRK track GRP group CYL cylinder
ORIGIN OF SEEK: GRP group CYL cylinder

Error 4019 occurs only when Test 4 is reading a DBN or RBN. This is because bad blocks in the diagnostic area are not revectored, and RBN's are what LBN's are revectord to, so they should never be bad. Test 4 reports this error if the header being searched for couldn't be found in two revolutions of the disk.

04020 CZUDC SFT ERR 04020 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
SELECT TRACK AND READ LEVEL 1 CMD NOT EXECUTED
ATTEMPT attempt
type bn
SECTORS FROM INDEX sector TRK track GRP group CYL cylinder
ORIGIN OF SEEK: GRP group CYL cylinder
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

Select track and read or write not executed occurs when the UDA attempts to send the select track and read/write level 1 cmd, but receiver ready is deasserted or the state is invalid so it cannot send the command (the SERDES could also be broken so it's unable to send the command). The same error is generated if the UDA gets a header sync timeout, and when it looks at the drive's state, it is either invalid or reciever ready is deasserted (header sync timeout is <<NOT>> a error -- it's quite normal on a high-density disk).

See retry/recovery section for recovery details.

04021 CZUDC DEV FTL ERR 04021 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
DRIVE NOT FORMATTED IN 512 BYTE MODE -- UNABLE TO TEST
XBN 0 MODE WORD: mode

mode: The mode word found on the drive's XBN 0

Error 4021 occurs only when Test 4 is going to test in the customer data area, and the mode word found in XBN 0 is not the 512 byte mode word (126736 octal). See DEC STANDARD 166 "FCT Structure". Inhibiting the dropping of units has no effect on this error.

04023 CZUDC DEV FTL ERR 04023 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
UNABLE TO CONTINUE TESTING
PORT SWITCH OUT
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

If, during testing, the operator disables the port that Test 4 is using by popping out the port switch, Test 4 prints error 4023. CHANGING THE STATE OF THE PORT SWITCH FOR THE PORT THAT Test 4 IS <<NOT>> USING HAS NO EFFECT ON THE TEST. If dropping of units is inhibited, Test 4 will loop in error recovery, printing this error, until the error state is corrected (by some external action).

CZUDC DEV FTL ERR 04023 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
UNABLE TO CONTINUE TESTING
RUN/STOP SWITCH OUT
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

If, during testing, the operator pops out the run/stop switch, Test 4 prints error 4023. If dropping of units is inhibited, Test 4 will loop in error recovery, printing this error, until the error state is corrected (by some external action).

CZUDC DEV FTL ERR 04023 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxx·xx DRIVE xxx RUNTIME hh:mm:ss
UNABLE TO CONTINUE TESTING
SPINDLE DROPPED READY
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

If, during testing, the spindle drops from its ready state, error 4023 is printed. If dropping of units is inhibited, Test 4 will loop in error recovery, printing this error, until the error state is corrected (by some external action).

```
04024   CZUDC   SFT ERR  04024 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        EDC DETECTED ERROR BUT ECC DID NOT
        RETRY retry
        ERROR RECOVERY LEVEL level
        type bn
        SECTORS FROM INDEX sector TRK track GRP group CYL cylinder
        EDC COMPUTED edc EDC READ edc

                edc:            The edc computed and read in octal.

                Error 4024 could be caused by several problems.  1) A buffer with no
                ECC errors, but the EDC was incorrectly computed or written, or 2) UDA
                buffer RAM problem, or 3) The error is such that the ECC really doesn't
                detect an error... This is unlikely.

                See retry/recovery section for recovery details.


04025   CZUDC   HRD ERR  04025 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        WRITE ATTEMPTED MAXIMUM TIMES
        type bn

                If three I/O errors occur when attempting to write to the drive
                (one I/O error if retries are disabled) error 4025 is printed
                to inform the operator.


04026   CZUDC   HRD ERR  04026 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        READ ATTEMPTED MAXIMUM TIMES
        type bn

                If three I/O errors occur when attempting to read from the drive
                (one I/O error if retries are disabled) error 4026 is printed
                to inform the operator.


04028   CZUDC   DEV FTL ERR  04028 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        BOTH READ ONLY <AND> WRITE ONLY BITS SET -- HOST ERROR

                Error 4028 prints ONLY IF THERE IS A HOST CODE ERROR -- THIS IS NOT
                AN ERROR FROM A DRIVE.  Inhibiting the dropping of units has no effect
                on this error.
```

```
04033   CZUDC   DEV FTL ERR  04033 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        UNABLE TO CORRECTLY READ OVERLAY overlay_number
        THIS UDA AND ALL DRIVES ATTACHED WILL BE REMOVED FROM TESTING
```

overlay_number: The overlay number in octal that could not be read.

Because of Test 4's size, most of the program is stored in host memory and is overlay driven. If any error is detected during a UNIBUS read of an overlay, Test 4 will retry the read (with no error report). It will attempt to read an overlay three times before error 4033 is printed, and the test immediately halted. This error can have several causes: 1) the UNIBUS died (it's improbable that you even get the message in this case) or 2) the UDA's UNIBUS interface died (also unlikely that you get a message), or 3) the host program wiped out the Test 4 overlays (since they are stored in host memory - most likely) or 4) a host memory problem - also likely. Inhibiting the dropping of units has no effect on this error.

```
04034   CZUDC   SFT ERR  04034 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        SERDES OVERRUN ERROR DURING READ
        ATTEMPT attempt
        type bn
        SECTORS FROM INDEX sector TRK track GRP group CYL cylinder
        ORIGIN OF SEEK: GRP group CYL cylinder
        REAL TIME STATE 0003
        STATUS (R TO L): 1312  1110  0908  0706  0504  0302  0100
```

The SERDES overrun error is detected on a read operation and is indicative of a drive whose transfer rate is greater than 23 MHZ or a broken SERDES.

See retry/recovery section for recovery details.

```
04035   CZUDC   SFT ERR  04035 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        DATA OR STATE CLOCK TIMEOUT DURING READ
        ATTEMPT attempt
        type bn
        SECTORS FROM INDEX sector TRK track GRP group CYL cylinder
        ORIGIN OF SEEK: GRP group CYL cylinder
        REAL TIME STATE 0003
        STATUS (R TO L): 1312  1110  0908  0706  0504  0302  0100
```

The loss of drive clock occurs when the UDA is clocking data to or from the drive through the SERDES. Failure of a word to be clocked in during a 125 millisecond time period triggers a loss of drive clock error.

See retry/recovery section for recovery details.

```
04036   CZUDC   SFT ERR  04036 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        DATA SYNC TIMEOUT DURING READ
        ATTEMPT attempt
        type bn
        SECTORS FROM INDEX sector TRK track GRP group CYL cylinder
        ORIGIN OF SEEK: GRP group CYL cylinder
        REAL TIME STATE 0003
        STATUS (R TO L): 1312  1110  0908  0706  0504  0302  0100

                This error occurs on a read operation after the correct header has
                been found and the UDA times out waiting for the data sync word.

                See retry/recovery section for recovery details.


04037   CZUDC   SFT ERR  04037 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        R/W RDY DROPPED DURING READ
        ATTEMPT attempt
        type bn
        SECTORS FROM INDEX sector TRK track GRP group CYL cylinder
        ORIGIN OF SEEK: GRP group CYL cylinder
        REAL TIME STATE 0003
        STATUS (R TO L): 1312  1110  0908  0706  0504  0302  0100

                The loss of read/write ready error is detected either before an
                I/O has begun when trying to send out the real time command or at
                the end of an I/O operation when checking for errors.

                See retry/recovery section for recovery details.


04038   CZUDC   SFT ERR  04038 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        RCVR RDY DROPPED DURING READ
        ATTEMPT attempt
        type bn
        SECTORS FROM INDEX sector TRK track GRP group CYL cylinder
        ORIGIN OF SEEK: GRP group CYL cylinder
        REAL TIME STATE 0003
        STATUS (R TO L): 1312  1110  0908  0706  0504  0302  0100

                The loss of drive receiver ready is detected when the UDA is trying
                to send out a real-time read or write command.

                See retry/recovery section for recovery details.
```

04040 CZUDC HRD ERR 04040 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
ALL COPIES OF RCT READ WITH ERROR, SEARCHING FOR
LBN THAT WAS REVECTORED
LAST RCT LBN SEARCHED bn
SEARCHING FOR LBN bn

CZUDC HRD ERR 04040 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
ALL COPIES OF RCT READ WITH ERROR, SEARCHING FOR
LBN WITH HEADER NOT FOUND
LAST RCT LBN SEARCHED bn
SEARCHING FOR LBN bn

Error 4040 occurs when Test 4 is trying to find the RBN that replaces a LBN that was revectored or whose header could not be found (both should be revectored). Test 4 was unable to get a valid copy out of the M copies of the RCT due to I/O errors or ECC/EDC errors. M is a SDI DRIVE CHARACTERISTIC and is defined by the drive. This is indicitave of either a bad pack (HDA) or that something wrote over the RCT incorrectly. Try to reformat the subunit.

04041 CZUDC HRD ERR 04041 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
COULD NOT FIND REPLACEMENT FOR
LBN THAT WAS REVECTORED
LBN TO REPLACE bn

CZUDC HRD ERR 04041 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
COULD NOT FIND REPLACEMENT FOR
LBN WITH HEADER NOT FOUND
LBN TO REPLACE bn

Error 4041 only occurs when Test 4 is running in the customer data area, and is trying to find the RBN that replaces a LBN that was revectored (must be in the RCT) or whose header could not be found (should be in the RCT, unless the media under the header has 'grown' a bad spot recently). In either case, Test 4 was unable to find an entry in the RCT for the the sector and the subunit should be reformatted. In the case of the revectored LBN, the cause of the RCT's corruption should be determined (even with the header not found, the RCT may have been corrupted because a header going bad without warning [eg. the formatter not being able to see it as a weak spot] is a very low probibility occurance).

```
04042   CZUDC   DEV FTL ERR  04042 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        TIMEOUT WAITING FOR SECTOR OR INDEX PULSE
        GRP group CYL cylinder
        REAL TIME STATE 0003
        STATUS (R TO L): 1312  1110  0908  0706  0504  0302  0100
```

Error 4042 occurs when the UDA microcode never detects a sector or index pulse from the drive before a read or write operation. If dropping of units is inhibited, a seek will be issued, and the write attempted again.

```
04044   CZUDC   SFT ERR  04044 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        SEEK OR HEAD SELECT ERROR DETECTED DURING WRITE
        ATTEMPT attempt
        LBN bn
        SECTORS FROM INDEX sector TRK track GRP group CYL cylinder
        ORIGIN OF SEEK: GRP group CYL cylinder
        REAL TIME STATE 0003
        STATUS (R TO L): 1312  1110  0908  0706  0504  0302  0100
```

See error 4045 for description.

See retry/recovery section for recovery details.

```
04045   CZUDC   SFT ERR  04045 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        SEEK OR HEAD SELECT ERROR DETECTED DURING READ
        ATTEMPT attempt
        LBN bn
        SECTORS FROM INDEX sector TRK track GRP group CYL cylinder
        ORIGIN OF SEEK: GRP group CYL cylinder
        REAL TIME STATE 0003
        STATUS (R TO L): 1312  1110  0908  0706  0504  0302  0100
```

Errors 4044 and 4045 occur when the header comparison routine determines that the drive is positioned at the wrong physical cylinder, or that the wrong head (which can be cylinders, groups or tracks, or any combination depending on the drive) had been selected. This error only occurs when the drive itself had not detected the misseek or incorrect head selected.

NOTE: These errors will only be detected when the operator is running Test 4 in the customer data area. This error will <<never>> appear when running in the diagnostic area.

See retry/recovery section for recovery details.

```
04047   CZUDC   SFT ERR  04047 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        DATA OR STATE CLOCK TIMEOUT DURING WRITE
        ATTEMPT attempt
        type bn
        SECTORS FROM INDEX sector TRK track GRP group CYL cylinder
        ORIGIN OF SEEK: GRP group CYL cylinder
        REAL TIME STATE 0003
        STATUS (R TO L): 1312  1110  0908  0706  0504  0302  0100

                The loss of drive clock occurs when the UDA is clocking data to or
                from the drive through the SERDES.  Failure of a word to be
                clocked in during a 125 millisecond time period triggers a loss of
                drive clock error.

                See retry/recovery section for recovery details.


04048   CZUDC   SFT ERR  04048 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        R/W RDY DROPPED DURING WRITE
        ATTEMPT attempt
        type bn
        SECTORS FROM INDEX sector TRK track GRP group CYL cylinder
        ORIGIN OF SEEK: GRP group CYL cylinder
        REAL TIME STATE 0003
        STATUS (R TO L): 1312  1110  0908  0706  0504  0302  0100

                The loss of read/write ready error is detected either before an
                I/O has begun when trying to send out the real time command or at
                the end of an I/O operation when checking for errors.

                See retry/recovery section for recovery details.


04049   CZUDC   SFT ERR  04049 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        RCVR RDY DROPPED DURING WRITE
        ATTEMPT attempt
        type bn
        SECTORS FROM INDEX sector TRK track GRP group CYL cylinder
        ORIGIN OF SEEK: GRP group CYL cylinder
        REAL TIME STATE 0003
        STATUS (R TO L): 1312  1110  0908  0706  0504  0302  0100

                The loss of drive receiver ready is detected when the UDA is trying
                to send out a real-time read or write command.

                See retry/recovery section for recovery details.
```

04050 CZUDC DEV FTL ERR 04050 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
OPERATOR ERROR IN ANSWERING MANUAL INTERVENTION QUESTIONS FOR THIS UNIT
BEGIN/END SET STARTING BLOCK NUMBER GREATER THAN ENDING BLOCK NUMBER

This is a Test 4 initialization error due to an operator error. Go back to the manual intervention questions and check the answers to the BEGIN/END set questions. Inhibiting the dropping of units has no effect on this error.

04051 CZUDC DEV FTL ERR 04051 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
OPERATOR ERROR IN ANSWERING MANUAL INTERVENTION QUESTIONS FOR THIS UNIT
THE BEGIN/END SETS OVERLAP

This is a Test 4 initialization error due to an operator error. Go back to the manual intervention questions and check the answers to the BEGIN/END set questions. Inhibiting the dropping of units has no effect on this error.

04052 CZUDC DEV FTL ERR 04052 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
OPERATOR ERROR IN ANSWERING MANUAL INTERVENTION QUESTIONS FOR THIS UNIT
[illegible] IN/END SET ENDING BLOCK NUMBER EXCEEDS MAXIMUM
MAXIMUM BLOCK NUMBER ON DEVICE IS maximum_block_number

maximum_block_number: This is the highest block number the operator can specify.

This is a Test 4 initialization error due to an operator error. Go back to the manual intervention questions and check the answers to the BEGIN/END set questions. Inhibiting the dropping of units has no effect on this error.

04053 CZUDC DEV FTL ERR 04053 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
OPERATOR ERROR IN ANSWERING MANUAL INTERVENTION QUESTIONS FOR THIS UNIT
DUPLICATE BAD BLOCKS

This is a Test 4 initialization error due to an operator error. Go back to the manual intervention questions and check the answers to the BAD BLOCK questions. Inhibiting the dropping of units has no effect on this error.

04054 CZUDC DEV FTL ERR 04054 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
OPERATOR ERROR IN ANSWERING MANUAL INTERVENTION QUESTIONS FOR THIS UNIT
BAD BLOCK NUMBER EXCEEDS MAXIMUM. MAXIMUM BLOCK NUMBER
ON DEVICE IS maximum_block_number

maximum_block_number: This is the highest block number the operator can specify.

This is a Test 4 initialization error due to an operator error. Go back to the manual intervention questions and check the answers to the BAD BLOCK questions. Inhibiting the dropping of units has no effect on this error.

04055 CZUDC DEV FTL ERR 04055 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
OPERATOR ERROR IN ANSWERING MANUAL INTERVENTION QUESTIONS FOR THIS UNIT
STARTING CYLINDER GREATER THAN ENDING CYLINDER

This is a Test 4 initialization error due to an operator error. Go back to the manual intervention questions and check the answers to the STARTING AND ENDING CYLINDER questions. Inhibiting the dropping of units has no effect on this error.

04056 CZUDC DEV FTL ERR 04056 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
OPERATOR ERROR IN ANSWERING MANUAL INTERVENTION QUESTIONS FOR THIS UNIT
RANDOM AND SEQUENTIAL SEEKS CANNOT BE MIXED WITHIN A UNIT

Error 4056 is an operator error. The error occurs on a multiple subunit drive when one subunit is selected to run in random mode, and another is selected to run in sequential mode. This mix is not supported, so the above message is issued. Inhibiting the dropping of units has no effect on this error.

04057 CZUDC DEV FTL ERR 04057 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
OPERATOR ERROR IN ANSWERING MANUAL INTERVENTION QUESTIONS FOR THIS UNIT
OVERFLOW WHEN CALCULATING THE L/DBN FROM THE GIVEN CYLINDER
CYLINDER TOO LARGE

This is a Test 4 initialization error due to an operator error. The operator entered a cylinder number, that when converted to a block number, the block number exceeded (2**28) - 1. Go back to the manual intervention questions and check the answers to the STARTING AND ENDING CYLINDER questions. Inhibiting the dropping of units has no effect on this error.

04058 CZUDC DEV FTL ERR 04058 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
OPERATOR ERROR IN ANSWERING MANUAL INTERVENTION QUESTIONS FOR THIS UNIT
TRACK EXCEEDS MAXIMUM FOR DEVICE. MAXIMUM IS maximum_track

maximum_track: This is the highest track number the operator can specify.

This is a Test 4 initialization error due to an operator error. Go back to the manual intervention questions and check the answers to the TRACK questions. Inhibiting the dropping of units has no effect on this error.

CZUDC DEV FTL ERR 04058 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
OPERATOR ERROR IN ANSWERING MANUAL INTERVENTION QUESTIONS FOR THIS UNIT
GROUP EXCEEDS MAXIMUM FOR DEVICE. MAXIMUM IS maximum_group

maximum_group: This is the highest group number the operator can specify.

This is a Test 4 initialization error due to an operator error. Go back to the manual intervention questions and check the answers to the GROUP questions. Inhibiting the dropping of units has no effect on this error.

04059 CZUDC DEV FTL ERR 04059 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
OPERATOR ERROR IN ANSWERING MANUAL INTERVENTION QUESTIONS FOR THIS UNIT
TWO IDENTICAL TRACKS

This is a Test 4 initialization error due to an operator error. Go back to the manual intervention questions and check the answers to the TRACK questions. Inhibiting the dropping of units has no effect on this error.

CZUDC DEV FTL ERR 04059 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
OPERATOR ERROR IN ANSWERING MANUAL INTERVENTION QUESTIONS FOR THIS UNIT
TWO IDENTICAL GROUPS

This is a Test 4 initialization error due to an operator error. Go back to the manual intervention questions and check the answers to the GROUP questions. Inhibiting the dropping of units has no effect on this error.

```
04062   CZUDC   DEV FTL ERR  04062 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        OPERATOR ERROR IN ANSWERING MANUAL INTERVENTION QUESTIONS FOR THIS UNIT
        DBN COMPUTED FROM END CYLINDER GIVEN EXCEEDS MAXIMUM DBN NUMBER ON
        DEVICE - CYLINDER TOO LARGE

                This is a Test 4 initialization error.
                Note that though there may be writeable DBN's on the 'last' cylinder,
                the read only diagnostic area may start on that same cylinder, and Test 4
                tries to write to the end of the cylinder that the operator specified.
                Therefore, specify the previous cylinder if cylinders must be specified.
                Inhibiting the dropping of units has no effect on this error.


        CZUDC   DEV FTL ERR  04062 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        OPERATOR ERROR IN ANSWERING MANUAL INTERVENTION QUESTIONS FOR THIS UNIT
        LBN COMPUTED FROM END CYLINDER GIVEN EXCEEDS MAXIMUM LBN NUMBER ON
        DEVICE - CYLINDER TOO LARGE

                This is a Test 4 initialization error.
                Note that though there may be writeable LBN's on the 'last' cylinder,
                the RCT area may start on that same cylinder, and Test 4 tries to
                write to the end of the cylinder that the operator specified.  Therefore,
                specify the previous cylinder if cylinders must be specified.
                Inhibiting the dropping of units has no effect on this error.


04063   CZUDC   SFT ERR  04063 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        REAL TIME STATE RECEIVE ERROR DURING WRITE
        ATTEMPT attempt
        type bn
        SECTORS FROM INDEX sector TRK track GRP group CYL cylinder
        ORIGIN OF SEEK: GRP group CYL cylinder
        REAL TIME STATE 0003
        STATUS (R TO L): 1312  1110  0908  0706  0504  0302  0100

                The real time drive state receive error is detected at the end of an
                I/O operation and indicates that there was a pulse or parity error
                in the receipt of the drive's state during the I/O operation.

                See retry/recovery section for recovery details.
```

```
04064   CZUDC   SFT ERR  04064 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        REAL TIME STATE RECEIVE ERROR DURING READ
        ATTEMPT attempt
        type bn
        SECTORS FROM INDEX sector TRK track GRP group CYL cylinder
        ORIGIN OF SEEK: GRP group CYL cylinder
        REAL TIME STATE 0003
        STATUS (R TO L): 1312  1110  0908  0706  0504  0302  0100
```

The real time drive state receive error is detected at the end of an I/O operation and indicates that there was a pulse or parity error in the receipt of the drive's state during the I/O operation.

See retry/recovery section for recovery details.

```
04068   CZUDC   HRD ERR  04068 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        UNKNOWN ERROR CODE DURING WRITE
        ERROR CODE RETURNED error_code
        REAL TIME STATE 0003
        STATUS (R TO L): 1312  1110  0908  0706  0504  0302  0100
```

error_code: This is the error code returned to Test 4 by the UDA that Test 4 does not recognize.

The unknown error code occurs when the UDA returns an error code from an operation that Test 4 does not recognize. Possible UDA microcode change without Test 4 update.

See retry/recovery section for recovery details.

```
04069   CZUDC   HRD ERR  04069 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
        DISK EXERCISER  DM PC:xxxx  UDA AT xxxxxx  DRIVE xxx  RUNTIME hh:mm:ss
        UNKNOWN ERROR CODE DURING READ
        ERROR CODE RETURNED error_code
        REAL TIME STATE 0003
        STATUS (R TO L): 1312  1110  0908  0706  0504  0302  0100
```

error_code: This is the error code returned to Test 4 by the UDA that Test 4 does not recognize.

The unknown error code occurs when the UDA returns an error code from an operation that Test 4 does not recognize. Possible UDA microcode change without Test 4 update.

See retry/recovery section for recovery details.

04070 CZUDC SFT ERR 04070 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
TIMEOUT OF SEND
command_type
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

command_type: See section following error 4078 for a description

If Test 4 tries to send a level 2 command to the drive, and receiver ready is deasserted, error 4070 occurs.

See retry/recovery section for recovery details.

04071 CZUDC SFT ERR 04071 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
TIMEOUT OF RECEIVE
command_type
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

command_type: See section following error 4078 for a description

This error is a failure of the drive to respond to an SDI level 2 command (see the SDI specification) before the drive-supplied command timeout expires.

See retry/recovery section for recovery details.

04072 CZUDC SFT ERR 04072 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
FIRST WORD RECEIVED WAS NOT START FRAME
command_type
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

command_type: See section following error 4078 for a description

The first word received by the UDA from the drive was not a valid message start frame.

See retry/recovery section for recovery details.

04073 CZUDC SFT ERR 04073 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
FRAMING ERROR ON LEVEL 0 RECEIVE
command_type
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

command_type: See section following error 4078 for a description

Error 4073 is caused by one or more of the following conditions: 1) Illegal frame code -- the frame is not a message start, continue, or end frame. 2) Illegal sequence of frames -- such as a message start frame without ever receiving a message end frame. This can be caused by the drive sending a response before the UDA asserts receiver ready, or a random hit on the SDI cable that garbles a frame or a bad drive transmitter or UDA receiver.

See retry/recovery section for recovery details.

04074 CZUDC SFT ERR 04074 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
CHECKSUM ERROR ON LEVEL 0 RECEIVE
command_type
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

command_type: See section following error 4078 for a description

The checksum attached to a message end frame did not match the checksum computed over the level 2 command. This could be caused by a bad drive transmitter, bad UDA receiver, incorrectly computed checksum by the drive (unlikely) or a random hit on the SDI cable.

See retry/recovery section for recovery details.

04075 CZUDC SFT ERR 04075 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
BUFFER SIZE SMALLER THAN RESPONSE
command_type
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

command_type: See section following error 4078 for a description

The buffer size set aside for the response was not large enough for the response received. This is caused by the drive sending a response that is incorrect for the request sent to the drive, or the drive sending some garbage with the response.

See retry/recovery section for recovery details.

04076 CZUDC SFT ERR 04076 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
RESPONSE OF LEVEL 2 CMD NOT AS EXPECTED
command_type
EXPECTED RESPONSE expected_response
RESPONSE RECEIVED response_received
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

command_type: See section following error 4078 for a description

expected_response: This is the correct response (HEX) for the command.

response_received: This is the response received from the drive, (HEX) where a 7D is an unsuccessful response. Any other than a 7D for this value indicates a <<VERY>> sick drive.

This is caused by receiving an UNSUCCESSFUL response from the drive, or the drive sending some response other than the correct response for the request sent to the drive. See the contents of status for the unexpected response error (or reason).

See retry/recovery section for recovery details.

04077 CZUDC HRD ERR 04077 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
DRIVE NEVER DEASSERTED RECEIVER READY AFTER SEND
command_type
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

command_type: See section following error 4078 for a description

This is caused by the drive not seeing a command sent by the UDA. The drive must deassert receiver ready to acknowledge that it did see a command via the SDI. If the drive saw only part of the command, it would have marked the command as unsuccessful. But in this case, the drive did not see any of the command and is now waiting for a command to be sent from the UDA.

04078 CZUDC HRD ERR 04078 ON UNIT 00 TST 04 SUB 000 PC: xxxxxx
DISK EXERCISER DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hh:mm:ss
UNKNOWN ERROR CODE RETURNED FROM LEVEL 2 RECEIVE
command_type
ERROR CODE RETURNED error_code
REAL TIME STATE 0003
STATUS (R TO L): 1312 1110 0908 0706 0504 0302 0100

command_type: See section following error 4078 for a description

error_code: This is the error code returned to Test 4 by the UDA that Test 4 does not recognize.

The unknown error code occurs when the UDA returns an error code from an operation that Test 4 does not recognize. Possible UDA microcode change without Test 4 update.

See retry/recovery section for recovery details.

NOTE: Errors 4070 - 4078 will become device fatals if attempted 3 times. If dropping of units are inhibited, error recovery is the same as if the error was a soft error.

command_type: in errors 4070-4078 command_type is one of the following level 2 commands:

ATTEMPTING TO BRING DRIVE ONLINE
ATTEMPTING TO ISSUE SEEK
ATTEMPTING TO GET STATUS
ATTEMPTING DRIVE CLEAR CMD
ATTEMPTING TO BRING DRIVE ONLINE
ATTEMPTING TO CHANGE MODE
ATTEMPTING ERROR RECOVERY CMD
ATTEMPTING TO ISSUE SEEK
ATTEMPTING TO RECALIBRATE

The following commands types occur only during initialization, and will cause a device fatal if they occur. Inhibiting the dropping of units has no effect on these errors.

ATTEMPTING TO SPIN UP DRIVE
ATTEMPTING TO GET COMMON CHAR
ATTEMPTING TO GET SUBUNIT CHAR

If <<ANY>> error occurs during initialization, <<NO>> testing is done on <<ANY>> drive attached to the UDA that the initialization erorr occured on. See error number 4016.

3.2.9 SPECIAL DEVICE FATAL (05000)

05000 CZUDC DVC FTL 05000 ON UNIT 00 TST 002 SUB 000 PC: xxxxxx
DISK zzzzzzzz DM PC:xxxx UDA AT xxxxxx DRIVE xxx RUNTIME hhh:mm:ss
UNABLE TO FIND REQUESTED DRIVE FOR TESTING
THE FOLLOWING IS VISIBLE ON THE PORTS
UDA PORT 0 -- description
UDA PORT 1 -- description
UDA PORT 2 -- description
UDA PORT 3 -- description

Where zzzzzzzz is either 'RESIDENT', 'FUNCION' or 'EXERCISER'. This message is presented when the specified drive was not found by test 2, test 3 or test 4 on any of the ports. A description of what was each port follows.

NO DRIVE ATTACHED
- There is nothing on the port. If there is suppose to be a drive on this port, make sure there is an odd number of cables between the UDA and the drive and make sure the cables are properly attached.

RCVR RDY NEVER ASSERTED
- The device on the port did not assert RCVR RDY while trying to get state.

TIMEOUT OF SEND
- Sending an SDI command timed out. RCVR RDY is not asserted.

TIMEOUT OF RECEIVE
- Receiving an SDI command timed out. The drive failed to respond to an SDI level 2 command before a timeout expired.

FIRST WORD RECEIVED WAS NOT START FRAME
- The first word received by the UDA from the drive was not a valid message start frame.

FRAMING ERROR ON LEVEL 0 RECEIVE
- The device and the UDA are out of sync or an illegal frame code (the frame is not a message start, continue, or end frame) or illegal sequence of frames. This can be caused by the drive sending a response before the UDA asserts receiver ready, or a random hit on the SDI cable that garbles a frame or a bad drive transmitter or UDA receiver.

CHECKSUM ERROR ON LEVEL 0 RECEIVE
- The checksum attached to a message end frame did not match the checksum computed over the level 2 command. This could be caused by a bad drive transmitter, bad UDA receiver, incorrectly computed checksum by the drive (unlikely) or a random hit on the SDI cable.

RESPONSE LONGER THAN EXPECTED FOR CMD
- The buffer size set aside for the response was not large enough for the response received. This is caused by the drive sending a response that is incorrect for the request sent to the drive, or the drive sending some garbage with the response.

DRIVE n[, consecutive drive numbers if subunited drive] [further explanation]
- A drive was found at the end of the cable. It may be a subunited drive, so all the subunit numbers are printed. A further explanation may be presented. These further explanations are:

DRIVE NOT AVAILABLE TO THIS UDA
- The drive was found but is not available to this UDA. It may be dual ported and the drive is online to another controller.

UNSPINABLE DRIVE
- The drive is unspinable. The drive may be powered up but the RUN/STOP switch may be popped out.

3.3 TEST 4 RETRY/RECOVERY METHODS

ECC Error on Disk Read

ECC DETECTED ERROR, BUT CORRECTION FAILED
ECC CORRECTIONS EXCEED THRESHOLD
ECC DETECTED ERROR (If ECC correction disabled)

Retry/Recovery - The UDA or Test 4 will first re-read the sector with the erroneous ECC N times, then N times for each level of error recovery the drive supports. The value of N is an SDI drive characteristic. This retry mechanism will persist until either the recovery level reaches zero or the operation succeeds. It should be noted that the manual intervention questions can disable retries (in this case the recovery fails the first time) and disable error correction (i.e., no ECC correction will be performed). ECC correction and retries are <<ALWAYS>> enabled when the Test 4 is reading the RCT.

Recovery success - One soft error is counted for the entire operation including retries.

Recovery Failure - Test 4 will issue a hard error for the sector. No soft errors will be counted.

Error Detecting Code (EDC) Error

EDC DETECTED ERROR BUT ECC DID NOT
ECC CORRECTION SUCCEEDED, BUT EDC DETECTS ERROR

This error is indicative of a UDA hardware error, either a SERDES failure or an undetected RAM failure, or a sector that was written with an incorrectly computed EDC.

Retry/Recovery - The UDA or Test 4 will re-read the sector with the erroneous EDC N times, then N times for each level of error recovery the drive supports. The value of N is an SDI drive characteristic. This retry mechanism will persist until either the recovery level reaches zero or the operation succeeds. It should be noted that the manual intervention questions can disable retries (in this case the recovery fails the first time). Retries are <<ALWAYS>> enabled when the Test 4 is reading the RCT.

Recovery success - One soft error is counted for the entire operation including retries.

Recovery Failure - Test 4 will issue a hard error for the sector. No soft errors will be counted.

SDI Level 2 and Asynchronous Errors

The SDI level 2 errors are as follows:

- o Packet acknowledge failure
- o Level 2 command error response, "DE" bit set
- o Level 2 command error response, "PE" or "RE" bit set
- o Receipt of erroneous drive response
- o Seek complete timeout
- o Asynchronous drive errors

Level 2 errors are always retried, even if retries are disabled in the manual intervention questions.

In the following retry/recovery algorithms, the Test 4 'Generic error recovery' is the following steps:

1. Issue online command

2. Get status

   2a. If the port, run or spindle ready (PS, RU or SR) bit is deasserted, an Immediate device fatal error is reported and the unit and all its subunits are dropped from testing.

   2b. If the recalibrate requested (RR) bit is set, Test 4 will issue a RECALIBRATE, then SEEK <<AFTER>> generic error recovery is complete.

   2c. If the drive error (DE) bit is set, Test 4 will issue a SEEK <<AFTER>> generic error recovery is complete.

3. If no drive errors, go to 5

4. Send DRIVE CLEAR command

5. Change mode

NOTE: If the drive's timeout expires once, so the drive asserts attention just to get Test 4 to issue a level 2, Test 4 will go through the above error recovery. However, since the timeout expiring is not an error, no error message is issued.

Packet Acknowledge Failure

TIMEOUT OF SEND
TIMEOUT OF RECEIVE

The timeout of send occurs when the UDA attempts to send a level 2 command to the drive, but the drive's receiver ready is not asserted. Timeout of receive is a failure of the drive to respond to an SDI level 2 command (see the SDI specification) before the drive-supplied command timeout expires. These errors are grouped together because their recoveries are the same.

Retry/Recovery - UDA - The steps listed below are performed.

1. The drive is initialized.

2. An SDI GET STATUS command is issued.

3. If the status obtained in the previous step indicated error conditions, these error conditions are resolved and then cleared by an SDI DRIVE CLEAR command.

4. An SDI SEEK command is issued.

5. The command is retried.

Retry/Recovery - Test 4 - The steps listed below are performed.

1. The drive is initialized

2. Test 4 Generic error recovery is performed

3. An SDI SEEK command is issued.

4. The command is retried.

Recovery success - One soft error is counted for the entire operation including retries.

Recovery Failure - The above sequence will be repeated two times and, if the failure persists, the Test 4 will issue a device fatal error and the drive and all its subunits will be dropped. It should be noted that the retry strategy for SDI level 2 errors involves issuing additional level 2 commands. The retry count is the sum of all retries on all SDI level 2 commands, including those commands issued in recovery attempts.

Level 2 Command Error Response - "DE" Bit Set

RESPONSE OF LEVEL 2 CMD NOT AS EXPECTED
SEEK RECEIVED UNSUCCESSFUL RESPONSE

An UNSUCCESSFUL response to a level 2 command, with the "DE" bit set in the status response, notifies the Test 4 that a drive error was detected (or occurred) in connection with the execution of the SDI command.

Retry/Recovery - UDA - The steps listed below are performed.

1. An SDI GET STATUS command is issued.

2. The drive error is cleared by an SDI DRIVE CLEAR command and a SEEK command is issued for the cylinder where the drive was positioned when the error was reported.

3. The command is retried.

Retry/Recovery - Test 4 - The steps listed below are performed.

1. Test 4 Generic error recovery is performed
Note that because the "DE" bit is set, Test 4 generic error recovery will issue a SEEK (see generic error recovery)

2. The command is retried

Recovery success - One soft error is counted for the entire operation including retries.

Recovery Failure - The above sequence is repeated two times and, if the failure persists, the Test 4 will issue a device fatal error and the drive and all its subunits will be dropped. Note that the
retry strategy for SDI level 2 errors involves issuing additional level 2 commands. The retry count is the sum of all retries on all SDI level 2 commands, including those commands issued in recovery attempts.

Level 2 Command Error Response - "PE" or "RE" Bit Set

RESPONSE OF LEVEL 2 CMD NOT AS EXPECTED
SEEK RECEIVED UNSUCCESSFUL RESPONSE

An UNSUCCESSFUL response to a level 2 command with the "PE" or "RE" bit set in the status response notifies the Test 4 that the command either was not appropriate for the state of the drive, or that the command contained invalid arguments.

Retry/Recovery - UDA - The steps listed below are performed.

1. An SDI GET STATUS command is issued

2. The drive error is cleared by an SDI DRIVE CLEAR command.

3. The controller verifies the state of the drive and, if possible, retries the level 2 command. Otherwise, the UDA notifies the host and bypasses subsequent retries.

Retry/Recovery - Test 4 - The steps listed below are performed.

1. Test 4 Generic error recovery is performed

2. The command is retried

Recovery success - One soft error is counted for the entire operation including retries.

Recovery Failure - The above sequence is repeated two times and, if the failure persists, the Test 4 will issue a device fatal error and the drive and all its subunits will be dropped. Note that the retry strategy for SDI level 2 errors involves issuing additional level 2 commands. The retry count is the sum of all retries on all SDI level 2 commands, including those commands issued in recovery attempts.

Receipt of an Erroneous Drive Response

FIRST WORD RECEIVED WAS NOT START FRAME
FRAMING ERROR ON LEVEL 0 RECEIVE
CHECKSUM ERROR ON LEVEL 0 RECEIVE
BUFFER SIZE SMALLER THAN RESPONSE
UNKNOWN ERROR CODE RETURNED FROM LEVEL 2 RECEIVE (hard error)

The first word not start frame error is caused when the UDA does not see a valid message start frame as the first frame received from the drive. The framing error is caused by the UDA receiving an illegal frame code -- the frame is not a message start, continue, or end frame or Illegal sequence of frames -- such as a message start frame without ever receiving a message end frame. The checksum error occurs when a message end frame checksum did not match the checksum computed over the level 2 command. The buffer size smaller than response error occurs when the buffer set aside for the response was not large enough for the response received. The unknown error code is returned when the UDA returns an error code that the Test 4 does not recognize. These errors are grouped together because their recoveries are the same.

Retry/Recovery - UDA - The steps listed below are performed.

1. An SDI GET STATUS command is issued.

2. If the status obtained in the previous step indicated error conditions, these error conditions are resolved and then cleared by an SDI DRIVE CLEAR command.

3. The command is retried.

Retry/Recovery - Test 4 - The steps listed below are performed.

1. Test 4 Generic error recovery is performed

2. The command is retried

Recovery success - One soft error is counted for the entire operation including retries.

Recovery Failure - The above sequence is repeated two times and, if the failure persists, the Test 4 will issue a device fatal error and the drive and all its subunits will be dropped. Note that the retry strategy for SDI level 2 errors involves issuing additional level 2 commands. The retry count is the sum of all retries on all SDI level 2 commands, including those commands issued in recovery attempts.

Seek Complete Timeout

ATTN ASSERTED DURING SEEK -- ERROR OR LOGGABLE INFORMATION
SEEK DID NOT COMPLETE, NEITHER ATTN OR R/W RDY WAS ASSERTED

This error occurs when the drive fails to assert READ/WRITE READY, indicating the successful completion of a seek, or asserts the SDI ATTENTION signal without asserting the READ/WRITE READY signal, indicating the unsuccessful completion of a seek.

Retry/Recovery - UDA - The steps listed below are performed.

1. An SDI GET STATUS command is issued.

2. If the status obtained in the previous step indicated error conditions, these error conditions are resolved and then cleared by an SDI DRIVE CLEAR command.

3. The SEEK is retried.

Retry/Recovery - Test 4 - The steps listed below are performed.

1. Test 4 Generic error recovery is performed

2. The SEEK is retried

Recovery success - One soft error is counted for the entire operation including retries.

Recovery Failure - The above sequence is repeated two times and, if the failure persists, the Test 4 will issue a device fatal error and the drive and all its subunits will be dropped. Note that the retry strategy for SDI level 2 errors involves issuing additional level 2 commands. The retry count is the sum of all retries on all SDI level 2 commands, including those commands issued in recovery attempts.

Asynchronous Drive Errors

ATTN ASSERTED UNEXPECTEDLY, ASYN DRIVE ERROR OR LOGGABLE INFORMATION -- THIS IS AN <<UNCOUNTED>> SOFT ERROR

Asynchronous drive errors are those errors reported by the drive which are not related to a level 2 or command. These errors are reported by the drive using the SDI ATTENTION signal. Examples are OFF CYLINDER and HDA OVERTEMPERATURE errors. Drive errors are reported to the controller by the "DE" or "WE" bit being set in the error byte in the status response.

Retry/Recovery - UDA - The steps listed below are performed.

1. An SDI GET STATUS command is issued.

2. The drive error is cleared by an SDI DRIVE CLEAR command and, if the error is not "WE", a SEEK command is issued for the cylinder where the drive was last positioned.

Retry/Recovery - Test 4 - The steps listed below are performed.

1. Test 4 Generic error recovery is performed

2. A SEEK is issued

NOTE: A "WE" is a write on a write protected drive; Test 4 detects this in a different manner, so "WE" will never be set.

Recovery Failure -

NOTE: There is a difference between the UDA in controller mode and the Test 4 for this type of error.

The UDA in controller mode will repeat the above sequence two times and, if the drive error persists, the drive would be marked as offline.

Test 4 will <<NOT>> drop the drive after two retries. Instead, the drive will be dropped due to a side affect of such an error: A seek never completing, (causing a device fatal error) or Spindle ready dropping (causing a device fatal error).

Drive I/O Errors

The drive I/O errors occur either during the header compare process (i.e., before I/O actually begins) or during the I/O operation itself. They are as follows:

- Header not found
- Seek or head select error
- Data sync timeout
- Data or state clock timeout during operation (read/write)
- Receiver ready dropped during operation (read/write)
- Read/write ready dropped during operation (read/write)
- SERDES overrun error
- Drive failed to execute select track and (read/write)
- Real time state receive error

Header not found (header compare error)

HEADER NOT FOUND DURING (read/write)

This error occurs when the header compare routine fails to find the desired header (or a revectored version of the desired header) in two disk revolutions.

Retry/Recovery - UDA and Test 4 - Failure to find the desired header in two rotations of the disk will cause the Test 4 to search the Replacement and Caching Table (RCT) to check if the logical block number has been replaced. If a match is found, the Test 4 will perform the desired operation on the revectored block. Enabling/disabling retries has no affect on this operation.

Recovery success - No error is reported or counted.

Recovery Failure - A hard error (header not found) is reported.

Seek or head select error (Positioner Error)

SEEK OR HEAD SELECT ERROR DETECTED DURING (read/write)

This error occurs when the header comparison routine determines that the drive is positioned at the wrong cylinder and that the drive has not detected a seek error.

NOTE: The header comparison routine is active <<ONLY>> in the customer data area. This error will never be detected in the diagnostic area.

Retry/Recovery - UDA - The steps listed below are performed.

1. An SDI GET STATUS command is issued.

2. If the status obtained in the previous step indicated error conditions, these error conditions are resolved and then cleared by an SDI DRIVE CLEAR command.

3. An SDI RECALIBRATE command is issued.

4. An SDI SEEK command is issued.

5. The I/O operation is retried.

Retry/Recovery - Test 4 - The steps listed below are performed.

1. Test 4 Generic error recovery is performed

2. An SDI RECALIBRATE command is issued.

3. An SDI SEEK command is issued.

4. If retries are disabled, Immediate recovery failure. Retries are <<ALWAYS>> enabled when the Test 4 is reading the RCT.

5. The I/O operation is retried.

Recovery success - One soft error is counted for the entire operation including retries.

Recovery Failure - The above sequence is repeated two times and, if a drive I/O error persists, a hard error is reported for the sector. No soft errors are counted.

Data Sync Timeout Error

DATA SYNC TIMEOUT DURING READ

This error occurs on a read operation after the correct header has been found and the UDA times out waiting for the data sync word.

Retry/Recovery - UDA - The steps listed below are performed.

1. An SDI GET STATUS command is issued.

2. If the status obtained in the previous step indicated error conditions, these error conditions are resolved and then cleared by an SDI DRIVE CLEAR COMMAND.

3. An SDI SEEK command is issued.

4. The read operation is retried.

Retry/Recovery - Test 4 - The steps listed below are performed.

1. Test 4 Generic error recovery is performed

2. An SDI SEEK command is issued.

3. If retries are disabled, Immediate recovery failure. Retries are <<ALWAYS>> enabled when the Test 4 is reading the RCT.

4. The read operation is retried.

Recovery success - One soft error is counted for the entire operation including retries.

Recovery Failure - The above sequence is repeated two times and, if a drive I/O error persists, a hard error is reported for the sector. No soft errors are counted.

Data or state clock timeout (Loss of Drive Clock)
Peceiver ready failure (Loss of Drive Receiver Ready)

DATA OR STATE CLOCK TIMEOUT DURING (read/write)
RCVR RDY DROPPED DURING (read/write)
COULD NOT SEND SELECT TRACK AND (read/write) CMD OR
HEADER SYNC TIMEOUT WITH INVALID STATE

The loss of drive clock occurs when the UDA is clocking data to or from the drive through the SERDES. Failure of a word to be clocked in during a 125 millisecond time period triggers a loss of drive clock error. The loss of drive receiver ready is detected when the UDA is trying to send out a real-time read or write command. Unable to select track and read or write occurs when the UDA attempts to send the select track and read/write level 1 cmd, but receiver ready is deasserted or the state is invalid so it cannot send the command (the SERDES could also be broken so it's unable to send the command). The same error is generated if the UDA gets a header sync timeout, and when it looks at the drive's state, it is either invalid or reciever ready is deasserted (header sync timeout is <<NOT>> a error -- it's quite normal on a high-density disk). These errors are grouped together because their recoveries are the same.

Retry/Recovery - UDA - The steps listed below are performed.

1. The drive is initialized.

2. An SDI GET STATUS command is issued.

3. If the status obtained in the previous step indicated error conditions, these error conditions are resolved and then cleared by an SDI DRIVE CLEAR command.

4. An SDI SEEK command is issued.

5. The I/O operation is retried.

Retry/Recovery - Test 4 - The steps listed below are performed.

1. The drive is initialized

2. Test 4 Generic error recovery is performed

3. An SDI SEEK command is issued.

4. If retries are disabled, Immediate recovery failure. Retries are <<ALWAYS>> enabled when the Test 4 is reading the RCT.

5. The I/O operation is retried.

Recovery success - One soft error is counted for the entire operation including retries.

Recovery Failure - The above sequence is repeated two times and, if a drive I/O error persists, a hard error is reported for the sector. No soft errors are counted.

Read/Write ready dropped (Loss of Drive Read/Write Ready)
SERDES Overrun Error
Real Time State Receive Error (Real Time Drive State Receive Error)

R/W RDY DROPPED DURING (read/write)
SERDES OVERRUN ERROR DURING READ
REAL TIME STATE RECEIVE ERROR DURING (read/write)
UNKNOWN ERROR CODE DURING (read/write)

The loss of read/write ready error is detected either before an I/O has begun when trying to send out the real time command or at the end of an I/O operation when checking for errors. The SERDES overrun error is detected on a read operation and is indicative of a drive whose transfer rate is greater than 23 MHZ or a broken SERDES. The real time drive state receive error is detected at the end of an I/O operation and indicates that there was a pulse or parity error in the receipt of the drive's state during the I/O operation. The unknown error code is returned when the UDA returns an error code that the Test 4 does not recognize. They are grouped together because their recoveries are the same.

Retry/Recovery - UDA - The steps listed below are performed.

1. An SDI GET STATUS command is issued.

2. If the status obtained in the previous step indicated error conditions, these error conditions are resolved and then cleared by an SDI DRIVE CLEAR command.

3. An SDI SEEK command is issued.

4. The I/O operation is retried.

Retry/Recovery - Test 4 - The steps listed below are performed.

1. Test 4 Generic error recovery is performed

2. An SDI SEEK command is issued.

3. If retries are disabled, Immediate recovery failure. Retries are <<ALWAYS>> enabled when the test 4 is reading the RCT.

4. The read operation is retried.

Recovery success - One soft error is counted for the entire operation including retries.

Recovery Failure - The above sequence is repeated two times and, if a drive I/O error persists, a hard error is reported for the sector. No soft errors are counted.

3.4 DEC STANDARD 166 EXCERPTS

3.4.1 THE REPLACEMENT AND CACHING TABLES

The Replacement and Caching Tables record the locations of all revectored LBN sectors and the status of each RBN on the unit. Each copy of the table is organized in ascending RBN order, with an entry for each RBN sector on the unit. There are "n" copies of the table on the unit, where "n" is a device characteristic. The tables are stored at the high address end of the LBN area of the unit. Table entries (and RBNs) are allocated via a hash algorithm described later.

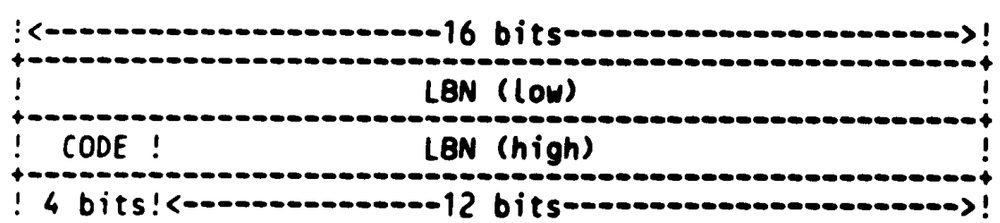
Replacement And Caching Table Format -

Each entry in the Replacement and Caching Table represents an RBN on the unit. The table is ordered in ascending RBN order. Thus the first entry corresponds to the first RBN on the unit, etc. The size of each copy of the table may exceed that required to contain an entry for each RBN on the unit since additional entries may be required to align the table so that adjacent copies can begin on a track boundary. Entries that do not correspond to RBNs on the unit are called "null entries"; there is always at least one null entry at the end of the RCT. All other entries past this last null entry are undefined.

NOTE

The RCT pad area is controller specific and should never be accessed by the host.

The format of a replacement block descriptor in the Replacement and Caching Tables is:



Where:

LBN is the Logical Block Number of a revectored LBN sector.

CODE is one of the following octal values:

00 - Unallocated (empty) replacement block.

02 - Allocated replacement block - primary RBN.

03 - Allocated replacement block - non-primary RBN.

04 - Unusable replacement block.

* 05 - Alternate unusable replacement block

10 - Null entry - no corresponding RBN sector.

For codes 00, 04, and 10 the LBN field is always zero.

NOTE

* This code is reserved. Programs should treat this code as if it were code 04.

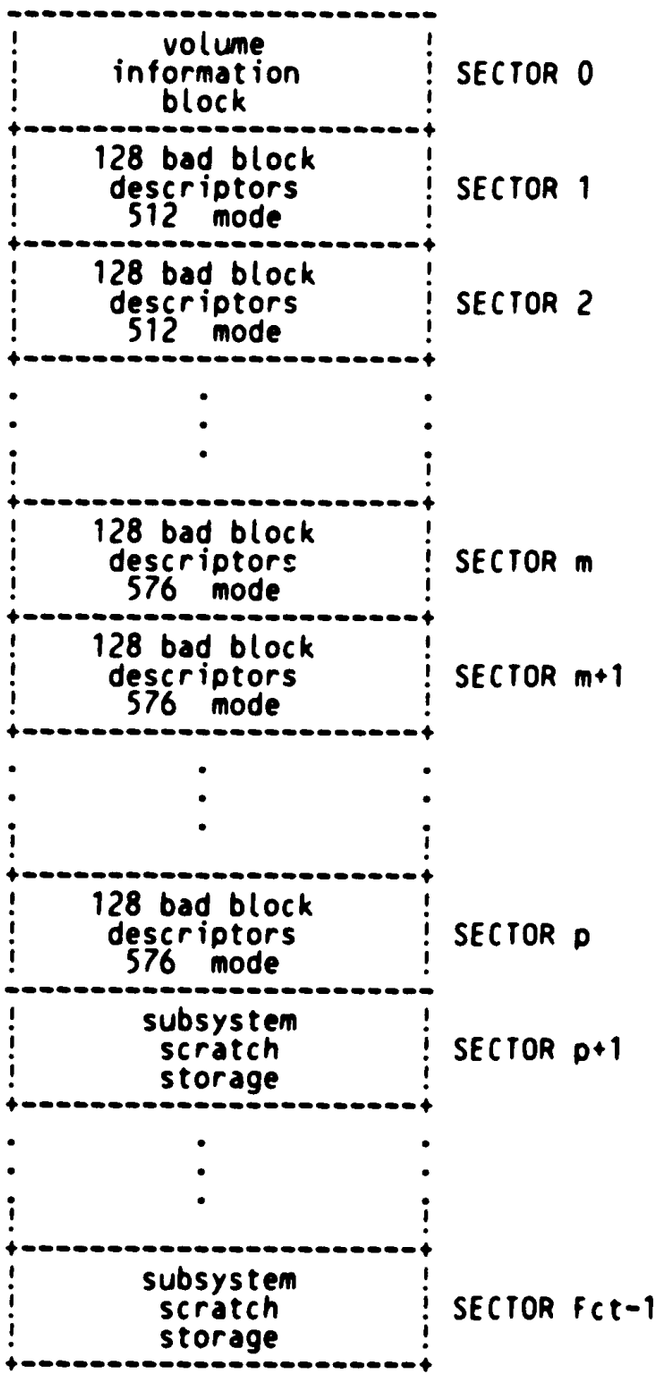
Embedded-controllers with no distinction between primary and secondary RBN's must use:

1. Code 02 if the replacement block can be retrieved with little degradation of performance for all blocks.

2. Code 03 if accessing the replacement block has a large impact on performance for all blocks.

3.4.2 FCT Structure

Each copy of the FCT is composed of one volume information block, one 512 byte format table, one 576 byte format table, and one subsystem temporary storage area (distributed amongst the alignment pads). An FCT copy has the following format:



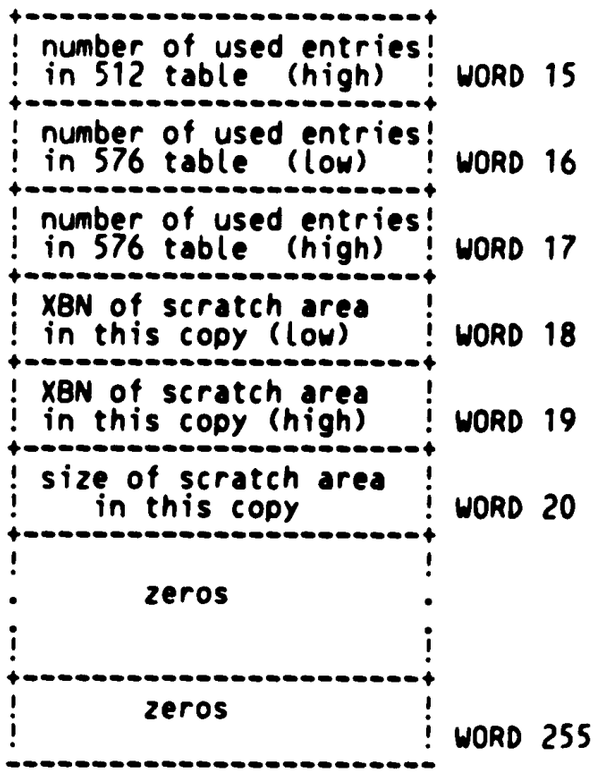
The XBN area itself is always formatted to contain 512 byte sectors. The calculations for m and p are:

m := ((((Lc*g*t*r)+1)/2)+127)/128

p := 2*m

Sector 0 contains various volume identification information. The format is:

media mode	WORD 0
formatting instance number	WORD 1
volume serial number least significant word	WORD 2
volume serial number	WORD 3
volume serial number	WORD 4
volume serial number most significant word	WORD 5
date that volume was first formatted (low)	WORD 6
date that volume was first formatted	WORD 7
date that volume was first formatted	WORD 8
date that volume was first formatted (high)	WORD 9
date of most recent volume formatting (low)	WORD 10
date of most recent volume formatting	WORD 11
date of most recent volume formatting	WORD 12
date of most recent volum formatting (high)	WORD 13
number of used entries in 512 table (low)	WORD 14



Where:

WORD 0: "Media Mode" - is "126736" for a 512 byte format and "074161" for a 576 byte format. During formatting the media mode word is set to zero.

4.0 PERFORMANCE AND PROGRESS REPORTS

At the end of each pass, the pass count is given along with the total number of errors reported since the diagnostic was started. The "EOP" switch can be used to control how often the end of pass message is printed. Section 2.2 describes switches.

A statistical report will automatically be printed periodically (approximately every fifteen minutes) and at the end of test #4. It can be suppressed by setting the Inhibit Statistical Report flag (e.g. START/FLAGS:ISR). This is the same report that can be printed on demand with the PRINT command.

During tests 1, 2, and 3, the report will look like the following example:

```
TEST 1 IN PROGRESS    RUN TIME 2:24:10
```

During test #4, the report will contain statistics on each drive for the current pass of the test; for example:

```
TEST 4 IN PROGRESS    RUN TIME 2:24:10

UNIT DRIVE     SERIAL-NUMBER SEEKS MBYTES  MBYTES  HARD   SOFT     ECC
                             X1000  READ  WRITTEN ERRORS ERRORS
   0     0            1002     12     36       22      0      0       1
   1     4      7342102112     14     42       29      0      2       0
```

Explanation of each column:

UNIT	The unit number (number of HW P-table).
DRIVE	The drive number (the number which appears on the "unit plug" on the front of the disk drive).
SERIAL-NUMBER	The decimal serial number of the disk drive.
SEEKS X1000	The decimal number of seeks performed by this drive during this pass of test 4. Multiply value by 1000.
MBYTES READ	The number of mega-bytes (million bytes) read by this drive during this pass of test 4. It is this value that is used to optionally drop a drive by the READ TRANSFER LIMIT software question.
MBYTES WRITTEN	The number of mega-bytes written by this drive during this pass of test 4.
HARD ERRORS	The number of hard error reports printed for this drive during this pass of test 4. It is this value that is used to optionally drop a drive by the ERROR LIMIT software question.

SOFT ERRORS	The number of soft errors reported for the drive during this pass of test 4. A soft error is any error condition that resulted in a retry operation that eventually succeeded in recovering from the error condition. One soft error is counted even though several retry attempts may be made and does not correspond to the number of soft error reports printed. To see the soft error reports, you must change the default answer to the SUPPRESS PRINTING SOFT ERRORS software question.
ECC	The number of times data read from the drive was modified using the error correction code (ECC) and resulted in a matching error detection code (EDC).

5.0 TEST SUMMARIES

The UDA Host Resident Diagnostic consists of one PDP-11 diagnostic supervisor program that runs in the PDP-11 processor and four programs that run in the UDA's buffer memory through an interpreter called the "diagnostic machine" which resides in the UDA. The PDP-11 program mainly is responsible for downline loading the "diagnostic machine" programs into the UDA and starting their execution. The "diagnostic machine" program controls the testing from that point by requesting the PDP-11 processor to supply information, print error messages and update statistics. The "diagnostic machine" program informs the PDP-11 processor when a test is complete.

The four "diagnostic machine" programs are in the ZUDDB0.PAK data file which is read from the XXDP+ system device by the PDP-11 program. The data file comes with listings of each program.

5.1 TEST # 1 - UNIBUS ADDRESSING TEST

The purpose of test #1 is to complete the testing of the Unibus interface in the UDA. The UDA resident diagnostic is not able to completely test the Unibus interface because communication with the PDP-11 processor is necessary. Specifically, this test will:

1. Check that every address line on the Unibus can be driven to both one and zero states.

2. Check that the UDA can interrupt the PDP-11 processor at the proper priority level and vector.

3. Exercise the Unibus interface by transferring blocks of data to and from Unibus memory.

This test assumes that the following are being tested by the UDA Resident Diagnostic:

1. All data bits can be written and read correctly.

2. NPR cycles can be executed correctly.

Test 1 is divided into six subtests. One at a time, each UDA selected for testing will run each subtest.

Subtest 1 makes sure that the UDAIP and UDASA registers are existant and runs the first part of the UDA's resident diagnostics.

Subtest 2 initializies the UDA into diagnostic loop mode. In this mode any value written into the UDASA is echoed in the UDASA.

In subtest 3, the UDA is initialized with interrupts enabled. The vector address and priority level will be determined solely from the answers to the hardware questions. If the hardware vectors to the wrong address, it is impossible to determine the res lt. A descriptive error message of the problem will not occur (the program or processor may hang or an unrela.ed message may occur). Therefore, the message "TESTING INTERRUPT ABILITY OF UDA AT ADR xxxxxx VEC xxx..." isprinted just before the UDA is requested to cause an interrupt and the word "COMPLETED" is printed (on the same line) when the interrupt test is completed. If the word "COMPLETED" does not follow the first message, it should be apparent that the interrupt caused the diagnostic or processor to go astray. The priority level of the interrupt request is also verified.

Subtest 4 and 5 initializes the UDA using different sizes of the host communications area. The different sizes of the host communications area are supplied to allow the UDA Resident Diagr.ostic to do the most Unibus address testing possible. Interrupts are disabled. Any UDA Resident Diagnostic errors will be reported. Subtest 4 initializes the UDA with tne smallest ring buffer size possible. Subtest 5 initializes the UDA with a large ring buffer area.

Subtest 6 downline loads a "diagnostic machine" program into the UDA. The "diagnostic machine" program is downline loaded from the memory space included in the host communications area when the UDA was first initialized. The UDA Resident Diagnostic has already verified that it can access these memory addresses, so the downline load command should perform properly. The "diagnostic machine" program is then started.

The "diagnostic machine" program asks the PDP-11 program to fill free memory (that memory available to the PDP-11 program that is not being used by the program or the Runtime Services) with an addressing pattern and report the location and size of the free memory. Every location of free memory is read and the data checked. Then, one by one, each address line is tested as follows:

1. Determine a test address by taking the first address of free memory and complimenting the address bit to be tested.

2. Read from the test address.

3. If a non-existant memory error occurs, the test is complete.

4. Write all ones to the first address of free memory then read from the test address. If data read is not all ones, then test is complete.

5. Write zeros to the first address of free memory then read from the test address. If data read is not zeros, then test is complete.

6. Report Unibus addressing error.

When all address bits have been tested, then block transfers to and from memory are tested with different data patterns. This data is transferred at the rate disk data is transferred to and from memory during normal UDA operation.

The next UDA selected for testing is then be tested in the same manner. When all UDAs have been tested, test #1 ends.

5.2 TEST # 2 - DISK RESIDENT DIAGNOSTIC TEST

The purpose of test #2 is to execute the diagnostics that run in each disk drive. These diagnostic programs may be resident in the disk drive or require downline loading from the ZUDDB0.PAK data file. (There currently are no disk drives that require downline loading and no such files exist in the ZUDDB0.PAK file. This program is designed such that they can be easily added in a future release.) This UDA diagnostic program only knows the procedure to execute the disk resident diagnostics and how to determine whether a test passed or failed.

One at a time, each UDA selected for testing is initialized and a "diagnostic machine" program downline loaded. The "diagnostic machine" program asks what drives are to be tested, then issues several commands to the disk drive and check for the correct response from the drive. This should serve as a good indicator that the UDA and disk drive can communicate.

A DIAGNOSE command is then issued to the drive to request the drive run all of its diagnostics. If the disk drive requests a downline load of a drive diagnostic, the diagnostic program is read from the XXDP+ load device, downline loaded into the disk drive and started. There is no limit to the number of downline loads that can be requested by a drive.

If the "Manual Intervention Mode" software question was answered "N" (default) testing proceeds to the next drive. When all drives on the UDA have been tested, the next UDA selected for testing is tested in the same manner. When all UDA's have been tested, test #2 ends.

If the "Manual Intervention Mode" software question was answered "Y", an interactive mode is entered to allow the operator to perform diagnostic activities on the disk drive as desired. The Service Manual for the disk drive must be used to determine what diagnostic capabilities are available.

First, a brief description of available commands is printed as follows:

```
TEST #2 MANUAL INTERVENTION ON UNIT xx UDA AT xxxxxx DRIVE xxx
TO WRITE AND READ MEMORY:
  W DATA REGION OFFSET
  R REGION OFFSET
TO RUN A DIAGNOSTIC:
  D REGION
TO EXIT QUESTIONING:
  E
DATA, REGION AND OFFSET ARE HEX VALUES.
 ?
```

Commands may be typed after the question mark prompt. Each command is processed as entered and results displayed immediately. The exit command will allow the diagnostic to proceed.

Read and write commands remember the region and offset values. Successive read and successive write commands automatically increment to the next offset if the region and offset values are not typed. If a region is typed but not an offset, offset zero is used.

Examples:

```
1.      W FF FFFC 4
2.      W 02
3.      R FFFC 4
          FFFC 0004/ FF
4.      R
          FFFC 0005/ 02
5.      W 21 FFFC
6.      R
          FFFC 0000/ 21
```

Command 1 writes one byte (FF) into region FFFC, offset 4. Command 2 writes one byte (02) into the next byte - region FFFC, offset 0005. Commands 3 and 4 read the bytes back. Command 5 writes one byte (21) into the first byte of region FFFC. Command 6 reads back that byte.

The diagnose command remembers the region from previous diagnose commands only, because the region containing the diagnostic is generally not the same region used to write parameters or read results. If the diagnostic returns any data, the data is printed immediately.

5.3 TEST # 3 - DISK FUNCTION TEST

The purpose of test #3 is to functionally test the disk drive. On a drive that is well diagnosed by its disk resident diagnostics (executed by test #2) these functional tests will have little value. On a drive that has no or minimal resident diagnostics, these functional tests will have more value.

Test #3 starts by initializing each UDA selected for testing and then downline loading a "diagnostic machine" program into each UDA. Once all UDAs have been started, the PDP-11 program responds to requests from all UDAs. When all the UDAs have indicated the end of testing, test #3 ends.

The "diagnostic machine" program performs the following functions on each drive:

1. Issue a DRIVE CLEAR command.
2. Issue RECALIBRATE command.
3. Issue a CHANGE MODE command to enable diagnostic cylinder access, set the drive to 512 byte sector size, and write protect.
4. Issue INITIATE SEEK command to last diagnostic cylinder.
5. Read all factory formatted sector headers. If no headers on a track can be read, report the error, otherwise continue.
6. Starting with cylinder 0, group 0 and incrementing through every cylinder on the disk, seek to a group, read a header on track 0 and then seek to the factory formatted diagnostic cylinder. Read from the diagnostic cylinder to verify disk positioned correctly.
7. Attempt to write on the first diagnostic cylinder while write protected.
8. Issue a CHANGE MODE command to enable formatting operations and disable write protect.
9. Format all writable DBNs in 512 byte format.
10. Write and read several data patterns to each writable DBN. Report an error if all DBNs on one track have an error.
11. Send invalid SDI level 2 and level 1 commands and check the results.
12. Issue a DISCONNECT command.

5.4 TEST # 4 - DISK EXERCISER

The purpose of test #4 is to exercise the disk drives in a manner similar to normal usage under standard operating systems. Execution of this test should give an indication of the performance of the disk drive. This test may be run for long or short periods of time, depending on how the software questions are answered.

These are two modes of operation for test #4:

1. Default operation on the entire area selected (customer or diagnostic) with all parameters selected for random operation as shown by default answers below.

2. Manual intervention mode where a number of questions are asked and operation is controlled by their answers.

Which mode is entirely determined by the answer to the first software question asking, "Enter manual intervention mode for special diagnosis?" This question would normally have been answered "N" (default) and testing will begin immediately. If answered "Y", the following series of questions will be asked for each unit selected for testing:

THE FOLLOWING QUESTIONS REFER TO UNIT xx UDA AT xxxxxx DRIVE xxx

This message will identify to which drive the questions are being asked. The entire series of questions will be asked for each drive, there is no short way to answer like in the hardware questions.

NUMBER OF BAD BLOCKS (D) 0 ?

An answer in the range of 1 to 16 will allow that many bad block numbers to be entered. The program will allow writes and reads to these blocks but no error messages will be printed for these blocks. Errors encountered on these blocks will not appear in the statistics. Answer zero to bypass entering bad blocks.

BAD BLOCK (A) ?

This question will be asked the number of times requested by the previous answer. Any decimal number that can be converted into a 28-bit binary value will be accepted. No other error checking will be made at this time to determine if the block number actually exists on the disk.

DO YOU WANT TO CHANGE TESTING PARAMETERS FOR THIS DRIVE (L) N ?

Answer "N" to bypass all further questioning on this drive.
Answer "Y" to be asked the following questions.

READ ONLY (L) N ?

Answer "Y" to dictate read only and prevent test #4 from performing any writes to the disk.

WRITE ONLY (L) N ?

This question will only be asked if the previous question was answered 'N'. Answer "Y" to dictate write only.

CHECK ALL WRITES BY READING (L) N ?

Answer "Y" to cause all writes to be checked by reading the data immediately after the write operation.

RANDOMLY CHECK WRITES BY READING (L) Y ?

This question will only be asked if the previous question was answered 'N'. Answer 'Y' for the write check to be performed randomly. Answer 'N' if write checks are not desired. This question is asked no matter how previous questions were asked.

DATA PATTERN - 0 FOR RANDOM SELECTION (D) 0 ?

There are 16 data patterns available, selected as 1 to 16. Pattern number 0 will cause patterns 1 to 15 to be randomly selected for each write. If pattern number 16 is selected, the following set of questions will be asked for a pattern to be input.

ENABLE ECC DATA CORRECTION (L) Y ?

A "Y" answer will enable the use of ECC to correct data errors. If the number of corrections is within the drive's threshold, an informational message will be printed identifying the block number. These ECC corrections will also appear in the statistical report for the drive.

An 'N" answer will prevent the use of ECC. All ECC errors will cause an error message to be printed and retries to be attempted.

COMPARE ALL DATA READ (L) N ?

Answer "Y" to cause a data compare after every read.

RANDOMLY COMPARE DATA READ (L) Y ?

This question will only be asked if the previous question was answered 'N'. Answer "Y" for the data compare to be performed on random records. Answer 'N" if data compares are not desired.

```
ENABLE RETRIES (L) Y
```

A "Y" answer will enable retries to be performed on disk errors.

```
RANDOM ACCESS MODE (L) Y ?
```

Answer "Y" to cause block numbers to be chosen randomly. Answer "N" to cause block numbers to be selected sequentially up and down the disk surface.

```
DO YOU WISH TO:
   0 - TEST ENTIRE AREA SELECTED
   1 - SPECIFY BEGIN/END SETS TO TEST
   2 - SPECIFY TRACKS AND CYLINDERS TO TEST
   3 - SPECIFY GROUPS AND CYLINDERS TO TEST
   4 - SPECIFY CYLINDERS TO TEST
(D) 0 ?
```

This question specifies the options available to limit testing to a portion of the selected area (customer or diagnostic) of the disk. A zero answer is the default which specifies to use the entire area for the test. Other answers will cause additional questions to be asked.

```
NUMBER OF BEGIN/END SETS (D) 1 ?
BEGIN BLOCK (A) 0 ?
END BLOCK (A) 0 ?
```

These questions are asked if begin/end sets were selected to limit the testing area (Answer 1). One to four sets may be specified. The BEGIN BLOCK and END BLOCK questions are asked as many times as needed.

```
NUMBER OF TRACKS TO TEST (D) 1 ?
TRACK (D) 0 ?

NUMBER OF GROUPS TO TEST (D) 1 ?
GROUP (D) 0 ?
```

One of these sets of questions is asked if either tracks and cylinders or groups and cylinders was specified to limit the testing area (Answers 2 or 3). Up to seven tracks or groups may be specified on which testing will be limited.

```
DO YOU WISH TO LIMIT THE CYLINDERS TESTED (L) N ?
```

This question is asked only after the tracks or groups have been specified above. If testing is to be further limited to a set of cylinders, answer "Y" and the following two questions will be asked:

```
STARTING CYLINDER (A) 0 ?
ENDING CYLINDER (A) 0 ?
```

These questions are asked if the question immediately above was answered "Y" or if cylinders were selected to limit the testing area (Answer 4). One set of cylinder numbers may be specified to limit the testing area.

After the above questions have been asked for all drives selected for testing, the following questions will be asked if data pattern 16 was selected for any drive:

```
NUMBER OF WORDS IN DATA PATTERN 16 (D) 1 ?
DATA WORD (0) 0 ?
```

Data pattern 16 can be input by these questions. A data pattern consists of a buffer of one to 16 words which is repeated throughout the data portion of the disk block. Enter the contents of the data pattern buffer. The DATA WORD question will be repeated as needed.

Test #4 will then initialize each UDA selected for testing and downline load a "diagnostic machine" program into each UDA. The "diagnostic machine" program asks what drives are to be tested and then for the parameters for each drive (the answers to the manual intervention questions or their defaults). Once all UDAs have beer. started, the PDP-11 program responds to requests from all UDAs.

The disks are then be exercised according to the parameters. The exercise consists of selecting a disk sector, seeking to the proper cylinder, then reading or writing the sector. The parameters control how the disk sector is selected, whether the sector is written or read and whether a write is followed by a read (write check).

The "diagnostic machine" program periodically sends statistics to the PDP-11 program. These statistics include counts of reads, writes, seeks and errors on a per drive basis. The PDP-11 program accumulates the statistics from all tne UDAs and watches for the transfer limit to be exceeded. As long as the error log is not enabled, the exceeding of the transfer limit will cause the end of test #4.

Each time an error occurs, the "diagnostic machine" tells the PDP-11 program. A message is printed (or stored in the log buffer) and then the error limit for the drive is checked. If the error limit has been reached, the drive is dropped from testing. If no more drives remain to be tested, test #4 will end (unless the error log is enabled).

When the end of test #4 ccurs, the accumulated statistics for each drive is printed. This statistical report can be printed at any time during test #4 by typing control-C then the PRINT command.

The data patterns used by test #4 are indicated below. Each pattern is generated by writing the pattern number in each 4-bit nibble of the first word, then repeating the data pattern (sequence of one to 16 words) throughout the rest of the data buffer. Pattern number 16 writes nibbles of zeros. When pattern number zero is used, the actual pattern number written (1 to 15) is placed in the nibbles.

PATTERN 0 This pattern number is used to indicate any pattern number 1 to 15 chosen at random.

PATTERN 1 Words in pattern sequence - 1

Sequence (Octal) 105613
Sequence (Hex) 8888

PATTERN 2 Words in pattern sequence - 1

Sequence (Octal) 031463
Sequence (Hex) 3333

PATTERN 3 Words in pattern sequence - 1

Sequence (Octal) 030221
Sequence (Hex) 3091

PATTERN 4 Words in pattern sequence - 16 (Shifting ones)

Sequence (Octal) 000001, 000003, 000007, 000017, 000037, 000077, 000177, 000377, 000777, 001777, 003777, 007777, 017777, 037777, 077777, 177777

Sequence (Hex) 0001, 0003, 0007, 000F, 001F, 003F, 007F, 00FF, 01FF, 03FF, 07FF, 0FFF, 1FFF, 3FFF, 7FFF, FFFF

PATTERN 5 Words in pattern sequence - 16 (Shifting zeros)

Sequence (Octal) 177776, 177774, 177770, 177760, 177740, 177700, 177600, 177400, 177000, 176000, 174000, 170000, 160000, 140000, 100000, 000000

Sequence (Hex) FFFE, FFFC, FFF8, FFF0, FFE0, FFC0, FF80, FF00, FE00, FC00, F800, F000, E000, C000, 8000, 0000

PATTERN 6 Words in pattern sequence - 16

Sequence (Octal) 000000, 000000, 000000, 177777, 177777,
177777, 000000, 000000, 177777, 177777,
000000, 177777, 000000, 177777, 000000,
177777

Sequence (Hex) 0000, 0000, 0000, FFFF, FFFF, FFFF,
0000, 0000, FFFF, FFFF, 0000, FFFF,
0000, FFFF, 0000, FFFF

PATTERN 7 Words in pattern sequence - (BINARY 1011011011011001)

Sequence (Octal) 133331
Sequence (Hex) B6D9

PATTERN 8 Words in pattern sequence - 16

Sequence (Octal) 052525, 052525, 052525, 125252, 125252,
125252, 052525, 052525, 125252, 125252,
052525, 125252, 052525, 125252, 052525,
125252

Sequence (Hex) 5555, 5555, 5555, AAAA, AAAA, AAAA,
5555, 5555, AAAA, AAAA, 5555, AAAA,
5555, AAAA, 5555, AAAA

PATTERN 9 Words in pattern sequence - 1 (BINARY 1101101101101100)

Sequence (Octal) 155554
Sequence (Hex) DB6C

PATTERN 10 Words in pattern sequence - 16

Sequence (Octal) 026455, 026455, 026455, 151322, 151322,
151322, 026455, 026455, 151322, 151322,
026455, 151322, 026455, 151322, 026455,
151322

Sequence (Hex) 2D2D, 2D2D, 2D2D, D2D2, D2D2, D2D2,
2D2D, 2D2D, D2D2, D2D2, 2D2D, D2D2,
2D2D, D2D2, 2D2D, D2D2

PATTERN 11 Words in pattern sequence - 1 (BINARY 0110110110110110)

Sequence (Octal) 066666
Sequence (Hex) 6DD6

PATTERN 12 Words in pattern sequence - 16 (Ripple one)

Sequence (Octal) 000001, 000002, 000004, 000010, 000020, 000040, 000100, 000200, 000400, 001000, 002000, 004000, 010000, 020000, 040000, 100000

Sequence (Hex) 0001, 0002, 0004, 0008, 0010, 0020, 0040, 0080, 0100, 0200, 0400, 0800, 1000, 2000, 4000, 8000

PATTERN 13 Words in pattern sequence - 16 (Ripple zero)

Sequence (Octal) 177776, 177775, 177773, 177767, 177757, 177737, 177677, 177577, 177377, 176777, 175777, 173777, 167777, 157777, 137777, 077777

Sequence (Hex) FFFE, FFFD, FFFB, FFF7, FFEF, FFDF, FFBF, FF7F, FEFF, FDFF, FBFF, F7FF, EFFF, DFFF, BFFF, 7FFF

PATTERN 14 Words in pattern sequence - 3

Sequence (Octal) 155555, 133333, 155555
Sequence (Hex) DB6D, B6DB, DB6D

PATTERN 15 Words in pattern sequence - 16

Sequence (Octal) 133331, 133331, 133331, 155554, 155554, 155554, 133331, 133331, 155554, 155554, 133331, 155554, 133331, 155554, 133331, 155554

Sequence (Hex) B6D9, B6D9, B6D9, DB6C, DB6C, DB6C, B6D9, B6D9, DB6C, DB6C, B6D9, DB6C, B6D9, DB6C, B6D9, DB6C

PATTERN 16 This is the operator selectable pattern in manual intervention mode. Questions are asked when test #4 is started for the operator to input the number of words in the sequence and the contents of the words.

Sample of terminal dialogue going through manual intervention questions:

```
DR>STA/TEST:4

CHANGE HW (L)  ? N

CHANGE SW (L)  ? Y

ENTER MANUAL INTERVENTION MODE FOR SPECIAL DIAGNOSIS (L) N ? Y

REMAINING SOFTWARE QUESTIONS APPLY TO TEST 4 ONLY

ERROR LIMIT (D)  32 ?
READ TRANSFER LIMIT IN MEGABYTES - 0 FOR NO LIMIT (D)  0 ?
SUPPRESS PRINTING SOFT ERRORS (L) Y ? N
DO INITIAL WRITE ON START (L) Y ?
ENABLE ERROR LOG (L) N ?

THE FOLLOWING QUESTIONS REFER TO UNIT 0 UDA AT 172150 DRIVE 0

NUMBER OF BAD BLOCKS (D) 0 ? 2

BAD BLOCK (A) ? 234

BAD BLOCK (A) ? 8900

DO YOU WANT TO CHANGE TESTING PARAMETERS FOR THIS DRIVE (L) N ? Y

READ ONLY (L) N ?

WRITE ONLY (L) N ?

CHECK ALL WRITES BY READING (L) N ? Y

DATA PATTERN - 0 FOR RANDOM SELECTION (D) 0 ? 1

ENABLE ECC DATA CORRECTION (L) Y ?

COMPARE ALL DATA READ (L) N ? Y

ENABLE RETRIES (L) Y ?

RANDOM ACCESS MODE (L) Y ? N

DO YOU WISH TO:
   0 - TEST ENTIRE AREA SELECTED
   1 - SPECIFY BEGIN/END SETS TO TEST
   2 - SPECIFY TRACKS AND CYLINDERS TO TEST
   3 - SPECIFY GROUPS AND CYLINDERS TO TEST
   4 - SPECIFY CYLINDERS TO TEST
 (D) 0 ? 1

NUMBER OF BEGIN/END SETS (D) 1 ?

BEGIN BLOCK (A) 0 ?
```

```
END BLOCK (A) 0 ? 200

NUMBER OF WORDS IN DATA PATTERN 16 (D) 1 ?

DATA WORD (O) 0 ?



&
```

```
                        .SBTTL  PROGRAM HEADER

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

                                POINTER BGNRPT, BGNSW, BGNSFT, ERRTBL, BGNSETUP

                        HEADER  CZUDC,A,9,0,1,PRIO7     ;FIELD SERVICE
002000                                                                  L$NAME::
002000  103                                                                     .ASCII /C/
002001  132                                                                     .ASCII /Z/
002002  125                                                                     .ASCII /U/
002003  104                                                                     .ASCII /D/
002004  103                                                                     .ASCII /C/
002005  000                                                                     .BYTE   0
002006  000                                                                     .BYTE   0
002007  000                                                                     .BYTE   0
002010                                                                  L$REV::
002010  101                                                                     .ASCII  /A/
002011                                                                  L$DEPO::
002011  071                                                                     .ASCII  /9/
002012                                                                  L$UNIT::
002012  000001                                                                  .WORD   T$PTHV
002014                                                                  L$TIML::
002014  000000                                                                  .WORD   0
002016                                                                  L$HPCP::
002016  034122                                                                  .WORD   L$HARD
002020                                                                  L$SPCP::
002020  034366                                                                  .WORD   L$SOFT
002022                                                                  L$HPTP::
002022  002136                                                                  .WORD   L$HW
002024                                                                  L$SPTP::
002024  002154                                                                  .WORD   L$SW
002026                                                                  L$LADP::
002026  035152                                                                  .WORD   L$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
002052  000000
002054  000000
002056
002056  000000
002060
002060  002436
002062
002062  025550
002064
002064  000000
002066
002066  000000
002070
002070  000000
002072
002072  000000
002074
002074  000000
002076
002076  002462
002100
002100  104035
002102
002102  002162
002104
002104  026600
002106
002106  030206
002110
002110  030204
002112
002112  026572
002114
002114  000000
002116
002116  000000
002120
002120  000000
```

```
L$EF::
        .WORD   0
        .WORD   0
L$SPC::
        .WORD   0
L$DEVP::
        .WORD   L$DVTYP
L$REPP::
        .WORD   L$RPT
L$EXP4::
        .WORD   0
L$EXP5::
        .WORD   0
L$AUT::
        .WORD   0
L$DUT::
        .WORD   0
L$LUN::
        .WORD   0
L$DFSP::
        .WORD   L$DESC
L$LOAD::
        EMT     E$LOAD
L$ETP::
        .WORD   L$ERRTBL
L$ICP::
        .WORD   L$INIT
L$CCP::
        .WORD   L$CLEAN
L$ACP::
        .WORD   L$AUTO
L$PRT::
        .WORD   L$PROT
L$TEST::
        .WORD   0
L$DLY::
        .WORD   0
L$HIME::
        .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 4
002122  000004                                                 .WORD   4
002124                                                      L$DISPATCH::
002124  030230                                                  .WORD   T1
002126  031404                                                  .WORD   T2
002130  031502                                                  .WORD   T3
002132  031540                                                  .WORD   T4
```

```
                                .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.
                                ;--

002134                                  BGNHW   DFPTBL
002134  000006                                                         .WORD   L10000-L$HW/2
002136                                                          L$HW::
002136                                                          DFPTBL::

002136  172150                  .WORD   172150          ; UNIBUS ADDRESS
002140  000154                  .WORD   154             ; VECTOR ADDRESS
002142  000005                  .WORD   5.              ; BR LEVEL
002144  000077                  .WORD   63.             ; UNIBUS BURST RATE
002146  000000                  .WORD   0.              ; LOGICAL DRIVE NUMBER
002150  000000                  .WORD   0.              ; CUSTOMER DATA AREA
002152                          ENDHW
002152                                                  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.
                        ;--

002152                          BGNSW   SFPTBL
002152  000003                                                         .WORD   L10001-L$SW/2
002154                                                                  L$SW::
002154                                                                  SFPTBL::

                                                        ;OFFSET         USE
002154  000040                  .WORD   32.            ; 0.    ERROR LIMIT
002156  000000                  .WORD   0.             ; 2.    DATA TRANSFER LIMIT (MEGABITS)
002160  040400                  .WORD   ^B0100000100000000     ; 4.    SINGLE BIT QUESTIONS
002162                          ENDSW
002162                                                                  L10001:

002162                          ENDMOD
```

```
                                .SBTTL  GLOBAL EQUATES SECTION

002162                                  BGNMOD

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

002162                                  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
```

GLOBAL EQUATES SECTION

```
                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
                        ;
                        ;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
                                
000377                          SA.MCV= 000377          ;UDA MICROCODE VERSION
                                ;       003400          ;RESERVED
                                
                                ;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
```

```
                        ;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.

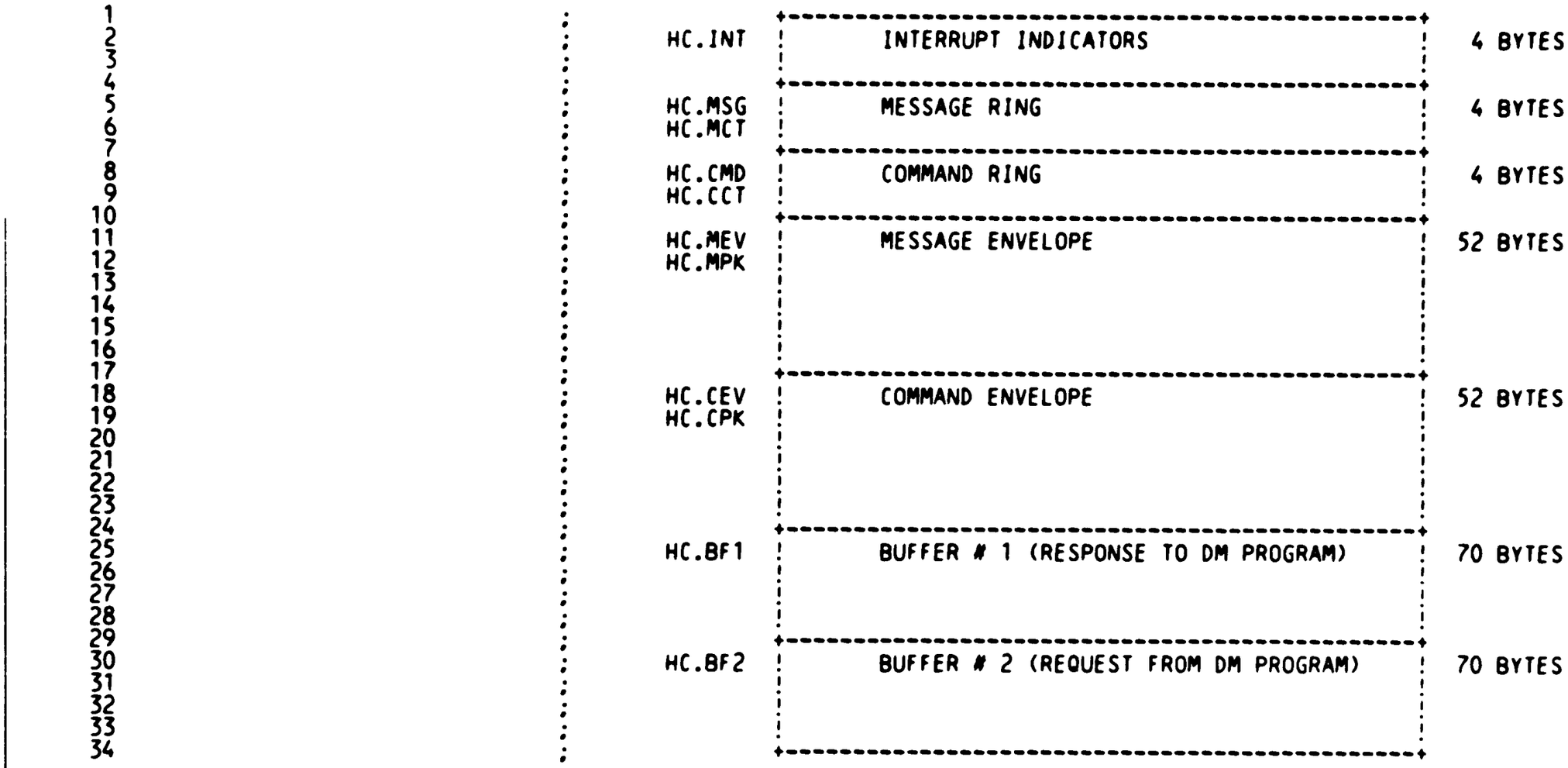
000004                  HC.ISZ=  4.                     ;SIZE OF INTERRUPT INDICATOR WORDS
000004                  HC.RSZ=  4.                     ;SIZE OF RING IN BYTES
000004                  HC.ESZ=  4.                     ;SIZE OF ENVELOPE WORDS BEFORE PACKET
000060                  HC.PSZ= 48.                     ;SIZE OF COMMAND AND MESSAGE PACKETS
000106                  HC.BSZ= 70.                     ;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
000272                  HC.BF2= HC.BF1+HC.BSZ           ;SECOND BUFFER

000400                  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
HC.MCT
MESSAGE RING
4 BYTES
HC.CMD
HC.CCT
COMMAND RING
4 BYTES
HC.MEV
HC.MPK
MESSAGE ENVELOPE
52 BYTES
HC.CEV
HC.CPK
COMMAND ENVELOPE
52 BYTES
HC.BF1
BUFFER # 1 (RESPONSE TO DM PROGRAM)
70 BYTES
HC.BF2
BUFFER # 2 (REQUEST FROM DM PROGRAM)
70 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             ;GET 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.GSS=   1             ;DUP GET STUD 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 OPCODE. 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.SE%= 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 REPLACEMENT
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
```

```
                                ;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

                                ;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
```

```
                                ;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.

002162                          TABLE                                   ;START A TABLE DEFINITION

002162                          ITEM C.UADR     2                       ;UNIBUS ADDRESS OF UDAIP REGISTER
002162                          ITEM C.UNIT     2
        000077                          CT.UNT= 000077                  ; LOGICAL UNIT NUMBER (FIRST)
        100000                          CT.AVL= BIT15                   ; SET WHEN NOT AVAILABLE FOR TESTING
002162                          ITEM C.VEC      2
        000777                          CT.VEC= 000777                  ; VECTOR ADDRESS
        007000                          CT.BRL= 007000                  ; BR LEVEL
002162                          ITEM C.BST      2                       ; BURST LEVEL
002162                          ITEM C.JSR      2                       ;INTERRUPT SERVICE ROUTINE FOR CONTROLLER
002162                          ITEM C.JAD      2                       ;  THESE TWO WORDS LOADED WITH [JSR R0,UDASRV]
002162                          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
002162                          ITEM C.RING     2                       ;RING BUFFER ADDRESS
002162                          ITEM C.DR0      2                       ;POINTER TO DRIVE TABLES
002162                          ITEM C.DR1      2                       ;  IF ZERO, NO DRIVE TABLE EXISTS
002162                          ITEM C.DR2      2
002162                          ITEM C.DR3      2
002162                          ITEM C.DR4      2
002162                          ITEM C.DR5      2
002162                          ITEM C.DR6      2
002162                          ITEM C.DR7      2
002162                          ITEM C.TO       2                       ;TIMEOUT COUNTER
002162                          ITEM C.TOH      2                       ;  (TWO WORDS)
002162                          ITEM C.REF      2                       ;COMMAND REFERENCE NUMBER

002162                          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.

002162                          TABLE                                   ;START A TABLE DEFINITION

002162                          ITEM D.DRV      2                       ;DRIVE NUMBER
002162                          ITEM D.UNIT     2
000077                                  DT.UNT= 000077                  ; LOGICAL UNIT NUMBER OF DRIVE
100000                                  DT.AVL= BIT15                   ; SET WHEN NOT AVAILABLE FOR TESTING
002162                          ITEM D.PRM      2                       ;HARDWARE QUESTION FLAGS
040000                                  D.IW    =BIT14                  ;INITIAL WRITE
020000                                  D.DCY   =BIT13                  ;DIAGNOSTIC CYLINDERS
010000                                  D.ECC   =BIT12                  ;ECC CORRECTION ENABLED
004000                                  D.RO    =BIT11                  ;READ ONLY
002000                                  D.WO    =BIT10                  ;WRITE ONLY
001000                                  D.RET   =BIT9                   ;RETRIES ENABLED
000400                                  D.CYL   =BIT8                   ;START/END CYLINDERS SPECIFIED
000100                                  D.SEQ   =BIT6                   ;SEQUENTIAL ACCESS
000040                                  D.BE    =BIT5                   ;BEGIN/END BLOCKS USED
000020                                  D.TR    =BIT4                   ;WHEN D.BE=0: 1 - TRACKS, 0 - GROUPS
000010                                  D.WC    =BIT3                   ;WRITE CHECKS ENABLED
000004                                  D.WCA   =BIT2                   ;ALWAYS WRITE CHECK
000002                                  D.DC    =BIT1                   ;DATA COMPARES ENABLED
000001                                  D.DCA   =BIT0                   ;ALWAYS DATA COMPARE
011002                                  DDEF=D.ECC+D.WC+D.DC+D.RET      ;DEFAULT D.PRM
140200                                  D.ZERO=BIT15+BIT7+D.IW          ;BITS TO BE CLEARED
002162                          ITEM D.PAT      2                       ;DATA PATTERN NUMBER
002162                          ITEM D.BB       2                       ;BAD BLOCK COUNT
002162                          ITEM D.BB01     4                       ;BAD BLOCK 1
002162                          ITEM D.BB02     4                       ;       2
002162                          ITEM D.BB03     4                       ;       3
002162                          ITEM D.BB04     4                       ;       4
002162                          ITEM D.BB05     4                       ;       5
002162                          ITEM D.BB06     4                       ;       6
002162                          ITEM D.BB07     4                       ;       7
002162                          ITEM D.BB08     4                       ;       8
002162                          ITEM D.BB09     4                       ;       9
002162                          ITEM D.BB10     4                       ;      10
002162                          ITEM D.BB11     4                       ;      11
002162                          ITEM D.BB12     4                       ;      12
002162                          ITEM D.BB13     4                       ;      13
002162                          ITEM D.BB14     4                       ;      14
002162                          ITEM D.BB15     4                       ;      15
002162                          ITEM D.BB16     4                       ;      16
```

```
 1 002162                       ITEM D.BEC      2               ;BEGIN/END SET COUNT
 2 002162                       ITEM D.BGN1     4               ;BEGIN BLOCK 1
 3 002162                       ITEM D.END1     4               ;END
 4 002162                       ITEM D.BGN2     4               ;BEGIN BLOCK 2
 5 002162                       ITEM D.END2     4               ;END
 6 002162                       ITEM D.BGN3     4               ;BEGIN BLOCK 3
 7 002162                       ITEM D.END3     4               ;END
 8 002162                       ITEM D.BGN4     4               ;BEGIN BLOCK 4
 9 002162                       ITEM D.END4     4               ;END
10 002162                       ITEM D.BCYL     4               ;BEGIN CYLINDER
11 002162                       ITEM D.ECYL     4               ;END CYLINDER
12 002162                       ITEM D.XFRW     2               ;MEGABITS WRITTEN COUNT
13 002162                       ITEM D.XFRR     2               ;MEGABITS READ COUNT
14 002162                       ITEM D.HERR     2               ;HARD ERROR COUNTER
15 002162                       ITEM D.SERR     2               ;SOFT ERROR COUNTER
16 002162                       ITEM D.SEEK     2               ;NUMBER OF SEEKS X1000
17 002162                       ITEM D.ECCC     2               ;ECC COUNTER
18 002162                       ITEM D.SERN     6               ;DRIVE SERIAL NUMBER
23
24 002162                       END D.SIZE                      ;SIZE OF DRIVE TABLE IN BYTES
25
26                              ;DM PROGRAM HEADER DEFINITIONS
27
28          000000              DMTRLN= 0                       ;OFFSET TO SIZE OF PROGRAM NEEDING DOWNLINE LOAD
29          000004              DMOVRL= 4                       ;OFFSET TO SIZE OF OVERLAY
30          000040              DMMAIN= 40                      ;OFFSET TO FIRST WORD OF MAIN PROGRAM
31          001000              DMFRST= 1000                    ;ADDRESS IN DM FILE CONTAINING FIRST BYTE OF HEADER
```

```
                        ;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.
                                ;--

                                        ERRTBL
                                                                        L$ERRTBL::
002162  000000                  ERRTYP::      .WORD   0
002164  000000                  ERRNBR::      .WORD   0
002166  000000                  ERRMSG::      .WORD   0
002170  000000                  ERRBLK::      .WORD   0

002172  022144                  PTYPE:  .WORD PF                ;PRINT TYPE
002174    000     000           ERRCHR: .BYTE 0,0               ;FIRST BYTE LOADED WITH OUTPUT CHARACTER
                                                                ;SECOND BYTE REMAINS ZERO TO STOP OUTPUT
002176                          FFREE:: .BLKW 1                 ;FIRST FREE WORD IN MEMORY
002200                          FSIZE:: .BLKW 1                 ;SIZE OF FREE MEMORY IN WORDS
002202                          FMEM:   .BLKW 1                 ;COPY OF FFREE AT END OF INIT SECTION
002204                          FMEMS:  .BLKW 1                 ;COPY OF FSIZE AT END OF INIT SECTION
002206                          CTABS:: .BLKW 1                 ;START OF CONTROLLER TABLE STORAGE
002210                          CTRLRS: .BLKW 1                 ;COUNT OF UDA CONTROLLERS IN PTABLES
002212                          TSTTAB: .BLKW 1                 ;POINTER TO FIRST CONTROLLER TABLE UNDER TEST
002214                          DMPROG: .BLKW 1                 ;START ADDRESS OF DM PROGRAM
002216                          DMEND:  .BLKW 1                 ;END ADDRESS OF DM PROGRAM(FIRST FREE MEMORY ADR)
002220                          DMENDS: .BLKW 1                 ;FREE MEMORY SIZE FROM END OF DM PROGRAM

002222                          KTBASA: .BLKW 1                 ;HIGH TWO BYTES OF BASE ADDRESS FOR KT ACCESS
002224                          KTBASO: .BLKW 1                 ;LOW BYTE OF AD RESS FOR KT ACCESS

002226                          IFLAGS::.BLKW 1                 ;FLAGS FROM INIT CODE FOR TEST 4
        000002                                  ICONT ==BIT1    ; CONTINUE EVENT FLAG
        000004                                  IREST ==BIT2    ; RESTART FLAG
        000010                                  ISTRT ==BIT3    ; START FLAG
        000020                                  ISTRTH==BIT4    ; START FLAG HOLD FOR T4UPRM ROUTINE
002230  000000                  TNUM:   .WORD 0                 ;NUMBER OF TEST EXECUTING
002232                          URUN:   .BLKW 1                 ;NUMBER OF UNITS TO RUN AT ONE TIME
002234                          URNING: .BLKW 1                 ;NUMBER OF UNITS STILL RUNNING
002236                          UCNT:   .BLKW 1                 ;COUNTER OF UNITS UNDER TEST
002240                          INTRCV: .BLKW 1                 ;INTERRUPT RECEIVED FLAG FOR INT TESTING
```

```
      1 002242                                FNAME:
      5 002242      132      125      104              .ASC‚Z\ZUDDB0.PAK\           ;NAME OF DATA FILE
      7                                               .EVEN
      8 002256  000000                        FDATA:  .WORD 0
      9 002260  000000                        FILOPN: .WORD 0                      ;FILE OPEN WHEN NON-ZERO
     10 002262                                TEMP:   .BLKW 12.                    ;TEMPORY STORAGE FOR GMANI RESPONSES
     11
     12 002312  000001                        PAT16C: .WORD 1                      ;COUNT OF WORDS IN DATA PATTERN 16
     13 002314  000000                        PAT16W: .WORD 0                      ;WORD SEQUENCE FOR DATA PATTERN 16
     14 002316  000000                                .WORD 0
     15 002320  000000                                .WORD 0
     16 002322  000000                                .WORD 0
     17 002324  000000                                .WORD 0
     18 002326  000000                                .WORD 0
     19 002330  000000                                .WORD 0
     20 002332  000000                                .WORD 0
     21 002334  000000                                .WORD 0
     22 002336  000000                                .WORD 0
     23 002340  000000                                .WORD 0
     24 002342  000000                                .WORD 0
     25 002344  000000                                .WORD 0
     26 002346  000000                                .WORD 0
     27 002350  000000                                .WORD 0
     28 002352  000000                                .WORD 0
```

```
                                ;CLOCK CONTROL
                                
002354  000000                  KW.CSR: .WORD 0                 ;CSR OF CLOCK
002356                          KW.BRL: .BLKW 1                 ;BR LEVEL
002360                          KW.VEC: .BLKW 1                 ;VECTOR
002362                          KW.HZ:  .BLKW 1                 ;HERTZ (50. OR 60.)
002364                          KW.EL:  .BLKW 2                 ;ELAPSED TIME
002370                          STIME:  .BLKW 2                 ;STATISTICAL REPORT TIMER

002374                          NXMAD:  .BLKW 1                 ;SET TO ALL ONES BY NON-EXISTANT ADDRESS
002376  177777                  KTMEM:  .WORD -1                ;SET TO ALL ONES IF NO KT EXISTS

002400                          T2WRR:  .BLKW 1                 ;WRITE/READ REGION
002402                          T2WRO:  .BLKW 1                 ;WRITE/READ OFFSET
002404                          T2DR:   .BLKW 1                 ;DIAGNOSE REGION


                                ;ERROR LOG CONTROL WORDS

002406                          LBUFS:  .BLKW 1                 ;START ADDRESS OF LOG/ZERO IF NONE
002410                          LBUFN:  .BLKW 1                 ;ADDRESS FOR MORE DATA FOR LOG
002412                          LBUFE:  .BLKW 1                 ;LAST ADDRESS AVAILABLE FOR LOG DATA

                                ;DISK DIAGNOSTIC DLL CONTROL WORDS

002414                          DLL:    .BLKW 1                 ;DOWNLINE LOAD RESPONSE CODE = 0 - NO DATA,
                                                                ;1 - PROGRAM PROVIDED, 2- PROGRAM NOT FOUND
002416                          DLLDR:  .BLKW 1                 ;DRIVE NUMBER REQUESTING PROGRAM
002420                          DLLV:   .BLKW 1                 ;A VALUE FROM DM PROGRAM TO BE RETURNED
002422                          DLLR:   .BLKW 1                 ;REGION
002424                          DLLADR: .BLKW 2                 ;ADDRESS WHERE PROGRAM STORED
002430                          DLLSIZ: .BLKW 1                 ;SIZE OF PROGRAM IN BYTES
002432                          DLLNAM: .BLKW 2                 ;NAME OF PROGRAM IN RAD50
```

```
                                .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
                                ;
002436                                  DEVTYP <LOGICAL DISK DRIVE>
002436                                                                  L$DVTYP::
002436  114     117     107                                                     .ASCIZ  /LOGICAL DISK DRIVE/
                                                                                .EVEN

                                ; TEST DESCRIPTION
                                ;
002462                                  DESCRIPT <CZUDCA9 UDA & DISK DRV DIAG>
002462                                                                  L$DESC::
002462  103     132     125                                                     .ASCIZ  /CZUDCA9 UDA & DISK
                                                                                .EVEN
```

```
                                        ;UNFORMATTED MESSAGES
                                        
002516  116  125  115  T4BB:   .ASCIZ\NUMBER OF BAD BLOCKS\
002543  104  117  040  T4DMN:  .ASCIZ\DO YOU WANT TO CHANGE TESTING PARAMETERS FOR THIS DRIVE\
002633  102  101  104  T4BBI:  .ASCIZ\BAD BLOCK\
002645  122  105  101  T4RO:   .ASCIZ\READ ONLY\
002657  127  122  111  T4WO:   .ASCIZ\WRITE ONLY\
002672  103  110  105  T4WCA:  .ASCIZ\CHECK ALL WRITES BY READING\
002726  122  101  116  T4WCR:  .ASCIZ\RANDOMLY CHECK WRITES BY READING\
002767  104  101  124  T4DP:   .ASCIZ\DATA PATTERN - 0 FOR RANDOM SELECTION\
003035  105  116  101  T4ECC:  .ASCIZ\ENABLE ECC DATA CORRECTION\
003070  103  117  115  T4DCA:  .ASCIZ\COMPARE ALL DATA READ\
003116  122  101  116  T4DCR:  .ASCIZ\RANDOMLY COMPARE DATA READ\
003151  105  116  101  T4RET:  .ASCIZ\ENABLE RETRIES\
003170  122  101  116  T4SEK:  .ASCIZ\RANDOM ACCESS MODE\
003213  040  040  000  T4OPT7: .ASCIZ\  \
003216  116  125  115  T4BE:   .ASCIZ\NUMBER OF BEGIN/END SETS\
003247  102  105  107  T4BEG:  .ASCIZ\BEGIN BLOCK\
003263  105  116  104  T4END:  .ASCIZ\END BLOCK\
003275  116  125  115  T4TRC:  .ASCIZ\NUMBER OF TRACKS TO TEST\
003326  124  122  101  T4TRAK: .ASCIZ\TRACK\
003334  116  125  115  T4GRC:  .ASCIZ\NUMBER OF GROUPS TO TEST\
003365  107  122  117  T4GRP:  .ASCIZ\GROUP\
003373  104  117  040  T4CYL:  .ASCIZ\DO YOU WISH TO LIMIT THE CYLINDERS TESTED\
003445  123  124  101  T4CYLB: .ASCIZ\STARTING CYLINDER\
003467  105  116  104  T4CYLE: .ASCIZ\ENDING CYLINDER\
003507  116  125  115  T4DPC:  .ASCIZ\NUMBER OF WORDS IN DATA PATTERN 16\
003552  104  101  124  T4DPD:  .ASCIZ\DATA WORD\
003564  101  122  105  INITWC: .ASCIZ\ARE YOU SURE CUSTOMER DATA CAN BE DESTROYED\
```

```
                                        ; FORMAT STATEMENTS USED IN PRINT CALLS

003640  045  124  000  ERRONE: .ASCIZ\%T\
003643  045  116  000  ERRNL:  .ASCIZ\%N\
003646  042  040  040  RNTIM:  .ASCIZ\"  RUNTIME '"D16":'"\
003671  104  071  042  RNTIM1: .ASCIZ\D9":'"\
003677  104  071  000  RNTIM2: .ASCIZ\D9\
003702  042  040  040  ERRME1: .ASCIZ\"  *  *  *  ERROR PROCESSING MESSAGE STRING  *  *  *'N\
003771  116  042  122  MXFERP: .ASCIZ\N'REACHED TRANSFER LIMIT - TESTING STOPPED'N\
004046  116  042  125  ERRLIM: .ASCIZ\N'UNIT '"D6" REACHED ERROR LIMIT - WILL NO LONGER BE TESTED'N\
004143  116  042  124  INTST0: .ASCIZ\N'TESTING INTERRUPT ABILITY OF UDA AT ADR '"O16" VEC '"O9"..."\
004240  042  103  117  INTST1: .ASCIZ\"COMPLETED'N\
004255  116  042  103  INITWA: .ASCIZ\N'CUSTOMER DATA WILL BE DESTROYED ON:'NS5'UNIT'S5'UDA AT'S3'DRIVE'N\
004361  045  123  066  INITWB: .ASCIZ\%S6%D2%S6%O6%S4%D3%N\
004406  116  042  115  T4WARN: .ASCIZ\N'MANUAL INTERVENTION NOT ALLOWED. TEST 4 USING DEFAULT PARAMETERS'N\
004513  116  042  124  T4QHED: .ASCIZ\N'THE FOLLOWING QUESTIONS REFER TO UNIT '"D6" UDA AT '"O16" DRIVE '"D9N\
004620  116  042  104  T4OPT1: .ASCII\N'DO YOU WISH TO:'N\
004643  042  040  040          .ASCII\"   0 - TEST ENTIRE AREA SELECTED'N\
004706  042  040  040          .ASCII\"   1 - SPECIFY BEGIN/END SETS TO TEST'N\
004756  042  040  040          .ASCII\"   2 - SPECIFY TRACKS AND CYLINDERS TO TEST'N\
005034  042  040  040          .ASCII\"   3 - SPECIFY GROUPS AND CYLINDERS TO TEST'N\
005112  042  040  040          .ASCIZ\"   4 - SPECIFY CYLINDERS TO TEST'"\
005155  042  114  111  INP28A: .ASCIZ\"LIMITS - LO= 0, HI= 268435455'N\
005216  042  111  116  INP28B: .ASCIZ\"INVALID CHAR, TYPE DECIMAL NUMBER 0 TO 268435455'N\
005302  116  042  125  MESSG:  .ASCIZ\N'UNIT '"D6" UDA AT '"O16" DRIVE '"D9S\
005346  116  042  115  T2WARN: .ASCIZ\N'MANUAL INTERVENTION NOT ALLOWED. TEST 2 RUNNING UNATTENDED'N\
005445  116  042  124  T2CMS1: .ASCII\N'TEST #2 MANUAL INTERVENTION ON UNIT '"D8" UDA AT '"O16" DRIVE '"D9N\
005547  042  124  117          .ASCII\"TO WRITE AND READ MEMORY:'N\
005603  042  040  040          .ASCII\"  W DATA REGION OFFSET'N\
005634  042  040  040          .ASCII\"  R REGION OFFSET'N\
005660  042  124  117          .ASCII\"TO RUN A DIAGNOSTIC:'N\
005707  042  040  040          .ASCII\"  D REGION'N\
005724  042  124  117          .ASCII\"TO EXIT QUESTIONING:'N\
005753  042  040  040          .ASCII\"  E'N\
005761  042  104  101          .ASCIZ\"DATA, REGION AND OFFSET ARE HEX VALUES.'N\
006034  042  077  040  T2CMS5: .ASCIZ\"? INPUT ERROR'N\
006055  042  116  117  NOCLOCK:.ASCIZ\"NO LINE CLOCK AVAILABLE FOR TIMING EVENTS'N\
006132  116  042  103  LOGM1:  .ASCIZ\N'CONTENTS OF ERROR LOG:'"\
006164  116  042  105  LOGM2:  .ASCIZ\N'END OF ERROR LOG'N\
006211  116  042  105  LOGM3:  .ASCIZ\N'ERROR LOG IS EMPTY'N\

006240  042  110  117  BASN0:  .ASCIZ\"HOST PROGRAM'"\
006257  042  125  116  BASN1:  .ASCIZ\"UNIBUS ADDRESSING'"\
006303  042  104  111  BASN2:  .ASCIZ\"DISK RESIDENT'"\
006323  042  104  111  BASN3:  .ASCIZ\"DISK FUNCTION'"\
006343  042  104  111  BASN4:  .ASCIZ\"DISK EXERCISER'"\
006364  042  040  040  BASL1:  .ASCIZ\"  DM PC:'"O12\
006402  042  040  040  BASL2:  .ASCIZ\"  UDA AT '"O16\
006421  042  040  040  BASL3:  .ASCIZ\"  DRIVE '"D9\
006436  000               BAS:    .BYTE 0                         ;NULL TO PRINT NOTHING

006437  122  066  122  BASLN:  .ASCIZ\R6R6R6R6\                  ;USED TO PRINT BASIC LINE OF ERROR MESSAGE
```

```
                                        X1A:
                                        X2A:
                                        X3A:
006450  042     111     040     X8A:    .ASCIZ\''I DON'T LIKE THE ANSWERS YOU GAVE TO THE HARDWARE QUESTIONS'<15><12>\
006547  122     065     122     X1:     .ASCIZ\R5R6''UDA HAS MORE THAN ONE VECTOR, BR LEVEL OR BURST RATE'<15><12>\
006643  122     065     122     X2:     .ASCIZ\R5R6''TWO UNITS SELECT THE SAME DRIVE'<15><12>\
006712  122     065     122     X3:     .ASCIZ\R5R6''MORE THAN EIGHT DRIVES SELECTED ON THIS UDA'<15><12>\
006775  122     064     042     X4:     .ASCII\R4''NOT ENOUGH ROOM IN MEMORY TO TEST THE UNITS SELECTED'<15><12>\
007066  042     120     114             .ASCIZ\''PLEASE START PROGRAM OVER AND TEST FEWER UNITS AT A TIME'<15><12>\
007162  122     064     042     X5:     .ASCIZ\R4''CHECKSUM ERROR IN DM PROGRAM FILE '<15><12>\
007232  122     064     042     X6:     .ASCIZ\R4''TABLE CONSISTANCY ERROR. PLEASE RE-LOAD PROGRAM'<15><12>\
007317  122     064     042     X7:     .ASCIZ\R4''ERROR IN DM PROGRAM FILE. DM PROGRAM NOT FOUND'<15><12>\
007403  122     065     122     X8:     .ASCIZ\R5R6''TWO UDA'S USE THE SAME VECTOR'<15><12>\
007450                                  X20:
007450  122     065     042     X38:    .ASCII\R5''MEMORY ERROR TRYING TO READ UDA REGISTERS'<15><12>\
007526  042     103     110             .ASCII\''CHECK UNIBUS SELECTION SWITCHES ON UDA MODULE M7161'<15><12>\
007614  042     117     122             .ASCII\''OR UNIBUS'<15><12>\
007630  042     117     122             .ASCIZ\''OR '<15>R7\
007640  122     065     042     X21:    .ASCII\R5''UDA RESIDENT DIAGNOSTICS DETECTED FAILURE'<15>R8\
007720  042     122     105             .ASCIZ\''REPLACE UDA MODULE M716'<15>2<12>\
007755  122     065     042     X22:    .ASCII\R5''STEP BIT DID NOT SET IN UDASA REGISTER DURING INITIALIZATION'<15><12>\
010056  042     123     124             .ASCIZ\''STEP BIT EXPECTED '<15>16<12>R8R7\
010113  122     065     042     X23A:   .ASCII\R5''UDA DID NOT CLEAR RING STRUCTURE IN HOST MEMORY DURING INITIALIZATION'<15><12>\
010225  104     071     042             .ASCII\D9'' WORDS WERE TO BE CLEARED STARTING AT ADDRESS '<15>16<12>\
010313  042     106     111             .ASCII\''FIRST SEVERAL WORDS NOT CLEARED (UP TO 6):'<15><12>\
010370  123     066     042             .ASCIZ\S6''ADDRESS''S4''CONTENTS'<15><12>\
010421  123     067     117     X23B:   .ASCIZ\S7016S5016<12>\
010435  122     065     042     X24:    .ASCII\R5''UDASA REGISTER DID NOT GO TO ZERO AFTER STEP 3 WRITE OF INITIALIZATION'<15><12>\
010550  042     120     125             .ASCIZ\''PURGE/POLE DIAGNOSTICS WERE REQUESTED'<15>R8R7\
010625  122     065     042     X25:    .ASCII\R5''UDA DID NOT RETURN CORRECT DATA IN UDASA REGISTER DURING INITIALIZATION'<15><12>\
010741  042     040     040             .ASCIZ\''  UDASA EXPECTED  '<15>16<12>R8R7\
010776  122     065     042     X26:    .ASCII\R5''DATA COMPARISON ERROR DURING DIAGNOSTIC PORT LOOP TEST'<15><12>\
011071  042     040     040             .ASCII\''  DATA SENT TO UDASA  '<15>16<12>\
011125  042     040     040             .ASCIZ\''  RECEIVED FROM UDASA '<15>16<12>R7\
011164  122     065     042     X27:    .ASCII\R5''UDASA REGISTER DID NOT CHANGE AFTER WRITING TO IT'<15><12>\
011252  042     111     116             .ASCIZ\''IN PORT LOOP DIAGNOSTIC'<15>R8R7\
011311  122     065     042     X28:    .ASCIZ\R5''UDA DID NOT INTERRUPT THE PDP-11'<15>R7\
011361  122     065     042     X29:    .ASCII\R5''UDA INTERRUPTED AT DIFFERENT BR LEVEL THAN SPECIFIED IN HARDWARE'<15><12>\
011466  042     121     125             .ASCII\''QUESTIONS. INTERRUPT WAS AT BR LEVEL '<15>3<12>\
011540  042     103     110             .ASCII\''CHECK PRIORITY PLUG ON UDA MODULE M7161'<15><12>\
011612  042     117     122             .ASCIZ\''OR CHANGE HARDWARE QUESTIONS'<15><12>\
011652  122     065     042     X30:    .ASCIZ\R5''UDA REPORTED FATAL ERROR IN UDASA REGISTER WHILE RUNNING DM PROGRAM'<15>R8\
011765  122     065     042     X31:    .ASCII\R5''NO INTERRUPT RECEIVED FROM DM PROGRAM FOR 3 MINUTES'<15><12>\
012055  042     101     123             .ASCIZ\''ASSUME PROGRAM IS HUNG'<15><12>\
012107  122     065     042     X32:    .ASCIZ\R5''MESSAGE BUFFER RECEIVED FROM DM PROGRAM WITH UNKNOWN REQUEST NUMBER'<15><12>\
012220  122     065     042     X35:    .ASCIZ\R5''DM PROGRAM ASKED FOR DATA ON UNKNOWN DRIVE'<15><12>\
012300  122     065     042     X36:    .ASCII\R5''NO INTERRUPT RECEIVED FROM UDA FOR 30 SECONDS'<15><12>\
012362  042     127     110             .ASCIZ\''WHILE LOADING DM PROGRAM'<15><12>\
012416  122     065     042     X37:    .ASCIZ\R5''UDA REPORTED FATAL ERROR IN UDASA REGISTER WHILE LOADING DM PROGRAM'<15>R8R7\
```

GLOBAL TEXT SECTION

```
      1 012533     042     115     105  XMSG1:   .ASCIZ\'MESSAGE BUFFER CONTAINS:'N\
      2 012567     123     063     117  XMSG2:   .ASCIZ\S3016S1016S1016S1016S1016S1016S1016N\
      3 012634     122     065     042  XPKT1:   .ASCII\R5'RESPONSE PACKET FROM UDA DOES NOT CONTAIN EXPECTED DATA'N\
      4 012730     042     105     111           .ASCII\''EITHER UDA RETURNED ERROR STATUS OR PACKET WAS NOT RECEIVED CORRECTLY'N\
      5 013040     123     063     042           .ASCIZ\S3''COMMAND PACKET SENT''S6'RESPONSE PACKET RECEIVED'N\
      6 013125     123     066     117  XPKT2:   .ASCIZ\S6016S1016S14016S1016N\
      7 013154     042     040     040  XSA:     .ASCIZ\''  UDASA CONTAINS  ''016N\
      8 013205     042     122     105  XFRU:    .ASCIZ\''REPLACE UDA MODULE M7161'N\
     12                                          .EVEN
     13
```

```
                                .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

013242                          BGNMSG ERR001
013242                                  PNTB X1,#X1A
013242  012746  00 ,50                                                  MOV #X1A,-(SP)
013246  004137  0' 2276                                                 JSR R1,LPNTB
013252  006547                                                         .WORD X1
013254  000002                                                         .WORD PNT.CT
013256                          ENDMSG

013260                          BGNMSG ERR002
013260                                  PNTB X2,#X2A
013260  012746  006450                                                  MOV #X2A,-(SP)
013264  004137  022276                                                 JSR R1,LPNTB
013270  006643                                                         .WORD X2
013272  000002                                                         .WORD PNT.CT
013274                          ENDMSG

013276                          BGNMSG ERR003
013276                                  PNTB X3,#X3A
013276  012746  006450                                                  MOV #X3A,-(SP)
013302  004137  022276                                                 JSR R1,LPNTB
013306  006712                                                         .WORD X3
013310  000002                                                         .WORD PNT.CT
013312                          ENDMSG

013314                          BGNMSG ERR004
013314                                  PNTB X4
013314  004137  022276                                                 JSR R1,LPNTB
013320  006775                                                         .WORD X4
013322  000000                                                         .WORD PNT.CT
013324                          ENDMSG

013326                          BGNMSG ERR005
013326                                  PNTB X5
013326  004137  022276                                                 JSR R1,LPNTB
013332  007162                                                         .WORD X5
013334  000000                                                         .WORD PNT.CT
013336                          ENDMSG

013340                          BGNMSG ERR006
013340                                  PNTB X6
013340  004137  022276                                                 JSR R1,LPNTB
013344  007232                                                         .WORD X6
013346  000000                                                         .WORD PNT.CT
013350                          ENDMSG
```

```
                                                BGNMSG ERR007
                                                       PNTB X7
013352  004137  022276                                                  JSR R1,LPNTB
013356  007317                                                          .WORD X7
013360  000000                                                          .WORD PNT.CT
                                                ENDMSG

                                                BGNMSG ERR008
                                                       PNTB X8,#X8A
013364  012746  006450                                                  MOV #X8A,-(SP)
013370  004137  022276                                                  JSR R1,LPNTB
013374  007403                                                          .WORD X8
013376  000002                                                          .WORD PNT.CT
                                                ENDMSG

                                                BGNMSG ERR020
                                                       PNTB X20
013402  004137  022276                                                  JSR R1,LPNTB
013406  007450                                                          .WORD X20
013410  000000                                                          .WORD PNT.CT
                                                ENDMSG

                                                BGNMSG ERR021
013414  010201                                        MOV R2,R1
013416  000301                                        SWAB R1
013420                                                AND 2,R1
013420  042701  177775                                                  BIC #^C<2>,R1
013424  006201                                        ASR R1
013426  005201                                        INC R1
013430                                                PNTB X21,R2,R1
013430  010146                                                          MOV R1,-(SP)
013432  010246                                                          MOV R2,-(SP)
013434  004137  022276                                                  JSR R1,LPNTB
013440  007640                                                          .WORD X21
013442  000004                                                          .WORD PNT.CT
                                                ENDMSG

                                                BGNMSG ERR022
013446  042737  100000  024604                        BIC #SA.ERR,UDARSD
013454                                                PNTB X22,UDARSD,R2
013454  010246                                                          MOV R2,-(SP)
013456  013746  024604                                                  MOV UDARSD,-(SP)
013462  004137  022276                                                  JSR R1,LPNTB
013466  007755                                                          .WORD X22
013470  000004                                                          .WORD PNT.CT
                                                      PRINTX #XFRU
                                                ENDMSG

                                                BGNMSG ERR023
                                                       PNTB X23A,R1,FFREE
013514  013746  002176                                                  MOV FFREE,-(SP)
013520  010146                                                          MOV R1,-(SP)
013522  004137  022276                                                  JSR R1,LPNTB
013526  010113                                                          .WORD X23A
013530  000004                                                          .WORD PNT.CT
013532  005742                                        TST -(R2)
```

```
     68 013534  005712                 ERR23A: TST (R2)
     69 013536  001410                         BEQ ERR23B
     70 013540                                 PNTB X23B,R2,(R2)
        013540  011246                                                  MOV (R2),-(SP)
        013542  010246                                                  MOV R2,-(SP)
        013544  004137  022276                                          JSR R1,LPNTB
        013550  010421                                                  .WORD X23B
        013552  000004                                                  .WORD PNT.CT
     71 013554  005304                         DEC R4
     72 013556  001403                         BEQ ERR23C
     73 013560  005722                 ERR23B: TST (R2)+
     74 013562  005303                         DEC R3
     75 013564  001363                         BNE ERR23A
     76 013566                         ERR23C: PNTB XFRU
        013566  004137  022276                                          JSR R1,LPNTB
        013572  013205                                                  .WORD XFRU
        013574  000000                                                  .WORD PNT.CT
     77 013576                                 ENDMSG
     78
     79 013600                                 BGNMSG ERR024
     80 013600                                         PNTB X24,R2
        013600  010246                                                  MOV R2,-(SP)
        013602  004137  022276                                          JSR R1,LPNTB
        013606  010435                                                  .WORD X24
        013610  000002                                                  .WORD PNT.CT
     81 013612                                 ENDMSG
     82
     83 013614                                 BGNMSG ERR025
     84 013614                                         PNTB X25,R1,R2
        013614  010246                                                  MOV R2,-(SP)
        013616  010146                                                  MOV R1,-(SP)
        013620  004137  022276                                          JSR R1,LPNTB
        013624  010625                                                  .WORD X25
        013626  000004                                                  .WORD PNT.CT
     85 013630                                 ENDMSG
     86
     87 013632                                 BGNMSG ERR026
     88 013632                                         PNTB X26,R2,2(R4)
        013632  016446  000002                                          MOV 2(R4),-(SP)
        013636  010246                                                  MOV R2,-(SP)
        013640  004137  022276                                          JSR R1,LPNTB
        013644  010776                                                  .WORD X26
        013646  000004                                                  .WORD PNT.CT
     89 013650                                 ENDMSG
     90
     91 013652                                 BGNMSG ERR027
     92 013652                                         PNTB X27,2(R4)
        013652  016446  000002                                          MOV 2(R4),-(SP)
        013656  004137  022276                                          JSR R1,LPNTB
        013662  011164                                                  .WORD X27
        013664  000002                                                  .WORD PNT.CT
     93 013666                                 ENDMSG
     94
     95 013670                                 BGNMSG ERR028
     96 013670                                         PNTB X28
        013670  004137  022276                                          JSR R1,LPNTB
        013674  011311                                                  .WORD X28
```

```
                013676  000000                                                  .WORD PNT.CT
 97             013700                          ENDMSG
 98
 99             013702                          BGNMSG ERR029
100             013702                                  PNTB X29,R1
                013702  010146                                                  MOV R1,-(SP)
                013704  004137  022276                                          JSR R1,LPNTB
                013710  011361                                                  .WORD X29
                013712  000002                                                  .WORD PNT.CT
101             013714                          ENDMSG
102
103             013716                          BGNMSG ERR030
104             013716                                  PNTB X30,R1
                013716  010146                                                  MOV R1,-(SP)
                013720  004137  022276                                          JSR R1,LPNTB
                013724  011652                                                  .WORD X30
                013726  000002                                                  .WORD PNT.CT
105             013730                          ENDMSG
106
107             013732                          BGNMSG ERR031
108             013732                                  PNTB X31
                013732  004137  022276                                          JSR R1,LPNTB
                013736  011765                                                  .WORD X31
                013740  000000                                                  .WORD PNT.CT
109             013742                          ENDMSG
110
111             013744                          BGNMSG ERR032
112             013744                                  PNTB X32
                013744  004137  022276                                          JSR R1,LPNTB
                013750  012107                                                  .WORD X32
                013752  000000                                                  .WORD PNT.CT
113             013754  004737  014146                  CALL MSGPKT
114             013760                          ENDMSG
115
116             013762                          BGNMSG ERR033
117             013762  004737  014054                  CALL PNTPKT
118             013766                          ENDMSG
119
120             013770                          BGNMSG ERR034
121             013770  004737  014054                  CALL PNTPKT
122             013774                          ENDMSG
123
124             013776                          BGNMSG ERR035
125             013776                                  PNTB X35
                013776  004137  022276                                          JSR R1,LPNTB
                014002  012220                                                  .WORD X35
                014004  000000                                                  .WORD PNT.CT
126             014006  004737  014146                  CALL MSGPKT
127             014012                          ENDMSG
128
129             014014                          BGNMSG ERR036
130             014014                                  PNTB X36
                014014  004137  022276                                          JSR R1,LPNTB
                014020  012300                                                  .WORD X36
                014022  000000                                                  .WORD PNT.CT
131             014024                          ENDMSG
132
```

```
133 014026                          BGNMSG ERR037
134 014026                                 PNTB X37,R1
    014026  010146                                                  MOV R1,-(SP)
    014030  004137  022276                                          JSR R1,LPNTB
    014034  012416                                                  .WORD X37
    014036  000002                                                  .WORD PNT.CT
135 014040                          ENDMSG
136
137 014042                          BGNMSG ERR038
138 014042                                 PNTB X38
    014042  004137  022276                                          JSR R1,LPNTB
    014046  007450                                                  .WORD X38
    01405?  000000                                                  .WORD PNT.CT
139 014052                          ENDMSG
140
141 014054                          PNTPKT: PNTB XPKT1
    014054  004137  022276                                          JSR R1,LPNTB
    014060  012634                                                  .WORD XPKT1
    014062  000000                                                  .WORD PNT.CT
142 014064  010401                        MOV R4,R1
143 014066  062701  000104                ADD #HC.CPK,R1
144 014072  010402                        MOV R4,R2
145 014074  062702  000020                ADD #HC.MPK,R2
146 014100  012703  000014                MOV #12.,R3
147 014104                          PNTPKL: PNTB XPKT2,2(R1),(R1),2(R2),(R2)
    014104  011246                                                  MOV (R2),-(SP)
    014106  016246  000002                                          MOV 2(R2),-(SP)
    014112  011146                                                  MOV (R1),-(SP)
    014114  016146  000002                                          MOV 2(R1),-(SP)
    014120  004137  022276                                          JSR R1,LPNTB
    014124  013125                                                  .WORD XPKT2
    014126  000010                                                  .WORD PNT.CT
148 014130  062701  000004                ADD #4,R1
149 014134  062702  000004                ADD #4,R2
150 014140  005303                        DEC R3
151 014142  001360                        BNE PNTPKL
152 014144  000207                        RETURN
153
154 014146                          MSGPKT: PNTB XMSG1
    014146  004137  022276                                          JSR R1,LPNTB
    014152  012533                                                  .WORD XMSG1
    014154  000000                                                  .WORD PNT.CT
155 01415?  016504  000016                MOV C.RING(R5),R4
156 014162  062704  000272                ADD #HC.BF2,R4
157 014166  012703  000005                MOV #5,R3
158 014172                          MSGPKL: PNTB XMSG2,(R4),2(R4),4(R4),6(R4),8.(R4),10.(R4),12.(R4)
    014172  016446  000014                                        MOV 12.(R4),-(SP)
    014176  016446  000012                                        MOV 10.(R4),-(SP)
    014202  016446  000010                                        MOV 8.(R4),-(SP)
    014206  016446  000006                                        MOV 6(R4),-(SP)
    014212  016446  000004                                        MOV 4(R4),-(SP)
    014216  016446  000002                                        MOV 2(R4),-(SP)
    014222  011446                                                MOV (R4),-(SP)
    014224  004137  022276                                        JSR R1,LPNTB
    014230  012567                                                .WORD XMSG2
    014232  000016                                                .WORD PNT.CT
159 014234  062704  000016                ADD #14.,R4
```

```
    160 014240  005303                    DEC R3
    161 014242  001353                    BNE MSGPKL
    162 014244  000207                    RETURN
```

```
 1 014246                                BGNMSG ERRRTN                          ;ERROR REPORT ROUTINE
 2 014246  013702  002230                       MOV TNUM,R2                     ;GET TEST NUMBER
 3 014252  006302                               ASL R2                          ;DOUBLE
 4 014254  012703  006421                       MOV #BASL3,R3                   ;GET ADDRESS OF DRIVE PRINT LINE
 5 014260  005764  000004                       TST 4(R4)                       ;CHECK IF DRIVE NUMBER GIVEN
 6 014264  100002                               BPL 1$                          ;BRANCH IF SO
 7 014266  012703  006436                       MOV #BAS,R3
 8 014272                                1$:    PNTB BASLN,TNAMES-2(R2),#BASL1,(R4),#BASL2,(R5),R3,4(R4)
   014272  016446  000004                                                                MOV 4(R4),-(SP)
   014276  010346                                                                       MOV R3,-(SP)
   014300  011546                                                                       MOV (R5),-(SP)
   014302  012746  006402                                                               MOV #BASL2,-(SP)
   014306  011446                                                                       MOV (R4),-(SP)
   014310  012746  006364                                                               MOV #BASL1,-(SP)
   014314  016246  020322                                                               MOV TNAMES-2(R2),-(SP)
   014320  004137  022276                                                               JSR R1,LPNTB
   014324  006437                                                                       .WORD BASLN
   014326  000016                                                                       .WORD PNT.CT
 9 014330                                                ASSUME C.UADR EQ 0
10 014330  004737  025356                       CALL RNTIME                     ;GET RUNTIME PARAMETERS
11 014334                                       PRINT #CR                       ;ADVANCE TO NEW LINE
   014334  112700  000015                                                               MOVB #CR,R0
   014340  004737  022114                                                               CALL CPNT
12 014344  062704  000006                       ADD #6,R4                       ;INCREASE R4 TO POINT TO MESSAGE POINTER
13 014350  012402                               MOV (R4)+,R2                    ;GET MESSAGE POINTER
14 014352  006302                               ASL R2                          ;DOUBLE TO MAKE BYTE OFFSET
15 014354  063702  002214                       ADD DMPROG,R2                   ;ADD TO START OF MESSAGE STRINGS
16 014360  067702  165630                       ADD @DMPROG,R2                  ;ADD SIZE OF MAIN PROGRAM
17 014364  105712                               TSTB (R2)                       ;CHECK FIRST BYTE
18 014366  001001                               BNE NCON                        ;IF ZERO
19 014370  005202                               INC R2                          ; INCREMENT TO NEXT BYTE
20 014372  012737  022214  002172    NCON:      MOV #PX,PTYPE                   ;CHANGE TO EXTENDED OUTPUT
21 014400  004737  020022                       CALL OSTRNG                     ;OUTPUT ACCORDING TO STRING
22 014404                                ENDMSG
```

```
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

014406                  FMERR:  ERRSF 4,,ERR004
014406  104454                                                          TRAP    C$ERSF
014410  000004                                                          .WORD   4
014412  000000                                                          .WORD   0
014414  013314                                                          .WORD   ERR004
014416                          DOCLN                           ;ABORT
014416  104444                                                          TRAP    C$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.

014420                          ALOCM:  PUSH FFREE                      ;SAVE FFREE AT ENTRY
014420  013746  002176                                                          MOV FFREE,-(SP)
014424  160137  002200                  SUB R1,FSIZE                    ;REDUCE SIZE OF FREE MEMORY
014430  002766                        BLT FMERR                       ;REPORT ERROR IF NOT ENOUGH MEMORY
014432  060101                        ADD R1,R1                       ;CHANGE WORDS TO BYTES
014434  060137  002176                ADD R1,FFREE                    ;CALCULATE NEW START OF FREE MEMORY
014440                                POP R1                          ;GET START OF ALLOCATED MEMORY
014440  012601                                                                MOV (SP)+,R1
014442  000207                        RETURN
```

```
                                        ;HCOMM
                                        ;
                                        ;ALLOCATES MEMORY FOR HOST COMM AREA AND PACKET BUFFERS WITH ONE
                                        ;DESCRIPTOR IN EACH RING. TO BE CALLED AFTER 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
                                        ;       RING POINTERS TO PACKETS
                                        ;       R4 - ADDRESS OF HOST COMM AREA
                                        
014444  012701  000200        HCOMM:  MOV #HC.SIZ/2,R1                ;GET SIZE OF AREA TO ALLOCATE
014450  004737  014420                CALL ALOCM                      ;ALLOCATE THE MEMORY
014454  010104                        MOV R1,R4                       ;GET ADDRESS OF HOST COMM AREA
014456  010465  000016                MOV R4,C.RING(R5)               ;PLACE IN CONTROLLER TABLE
014462  062701  000020                ADD #HC.MPK,R1                  ;COMPUTE START OF MESSAGE PACKET
014466  010164  000004                MOV R1,HC.MSG(R4)               ;PLACE IN RING
014472  062701  000064                ADD #<HC.CPK-HC.MPK>,R1         ;COMPUTE START OF COMMAND PACKET
014476  010164  000010                MOV R1,HC.CMD(R4)               ;PLACE IN RING
014502  000207                        RETURN
```

```
                                        ;TINIT
                                        ;
                                        ;INITIALIZE VARIABLES FOR TEST
                                        ;
                                        ;INPUTS:
                                        ;       R1 - TEST NUMBER
                                        ;OUTPUTS:
                                        ;       LBUFS - CLEARED (DELETES ERROR LOG)
                                        ;       FFREE - FROM FMEM
                                        ;       FSIZE - FROM FMEMS
                                        ;       TNUM - TEST NUMBER FROM R1
                                        ;       ALL REGISTERS CLOBERED
                                        ;
014504  004737  025334          TINIT:  CALL RESET                      ;RESET ALL DEVICES
014510  005037  002406                  CLR LBUFS                       ;CLEAR ERROR LOG BUFFER POINTER
014514  013737  002202  002176          MOV FMEM,FFREE                  ;INIT FFREE
014522  013737  002204  002200          MOV FMEMS,FSIZE                 ;INIT FSIZE
014530  020137  002230                  CMP R1,TNUM                     ;SEE IF SAME TEST RUNNING
014534  001007                          BNE TINITR                      ;IF NOT, GO TO READ DM PROGRAM
014536  013737  002216  002176          MOV DMEND,FFREE                 ;CHANGE FREE MEMORY TO LEAVE
014544  013737  002220  002200          MOV DMENDS,FSIZE                ;  DM PROGRAM ALLOCATED
014552  000207                          RETURN
                                        ;
014554  004737  014566          TINITR: CALL READDM                     ;READ DM PROGRAM
014560  010137  002230                  MOV R1,TNUM                     ;STORE TEST NUMBER TO SHOW DM PROGRAM IN MEMORY
014564  000207                          RETURN
```

```
                                        ;READDM
                                        ;
                                        ;READ A DM PROGRAM INTO FREE MEMORY
                                        ;
                                        ;INPUTS:
                                        ;       R1 - TEST NUMBER
                                        ;OUTPUTS:
                                        ;       DMPROG - POINTER TO START OF DM PROGRAM IN MEMORY
                                        ;       R1 - UNCHANGED
                                        ;       CARRY CLEAR IF NO ERROR, CARRY SET IF PROGRAM NOT FOUND
                                        ;ALL REGISTERS BUT R1 ARE USED AND PREVIOUS CONTENTS DESTROYED
                                        ;
014566  013737  002176  002214 READDM: MOV FFREE,DMPROG                ;GET STORAGE ADDRESS
014574  004737  024666                  CALL RDREC
014600  103407                        BCS README                      ;CHECK IF ERROR
014602  013737  002176  002216        MOV FFREE,DMEND                 ;SAVE END OF ADDRESS OF DM PROGRAM
014610  013737  002200  002220        MOV FSIZE,DMENDS                ;  AND CURRENT SIZE OF FREE MEMORY
014616  000207                        RETURN
                                        ;
014620                          README: ERRSF 7,,ERR007                 ;REPORT DM PROGRAM NOT FOUND
014620  104454                                                                  TRAP    C$ERSF
014622  000007                                                                  .WORD   7
014624  000000                                                                  .WORD   0
014626  013352                                                                  .WORD   ERR007
014630                                  DOCLN
014630  104444                                                                  TRAP    C$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.

014632  010137  002232          RUNDM:  MOV R1,URUN                     ;SAVE NUMBER OF UNITS TO RUN
014636  005037  002234                  CLR URNING                      ;CLEAR NUMBER OF UNITS RUNNING

                                        ;LOAD DM PROGRAM INTO EACH CONTROLLER

014642  013737  002232  002236          MOV URUN,UCNT                   ;SET COUNTER OF UNITS
014650  013705  002212                  MOV TSTTAB,R5                   ;GET FIRST CONTROLLER TABLE
014654                          LDDM:
014654  005065  000014                  CLR C.FLG(R5)                   ;CLEAR ALL FLAGS
014660  116537  000002  002074          MOVB C.UNIT(R5),L$LUN           ;SEE IF UNIT TO BE TESTED
014666  005765  000002                  TST C.UNIT(R5)
014672  100405                          BMI LDNEXT                      ;IF NOT, DON'T LOAD THIS UNIT
014674                                          ASSUME CT.AVL EQ BIT15
014674  004737  022532                  CALL LOADDM                     ;LOAD THE DM PROGRAM
014700  001402                          BEQ LDNEXT                      ;IF ERROR, GO TO NEXT CONTROLLER
014702  005237  002234                  INC URNING                      ;IF NO ERROR, COUNT UNIT RUNNING
014706  062705  000046          LDNEXT: ADD #C.SIZE,R5                  ;MOVE TO NEXT CONTROLLER TABLE
014712  005337  002236                  DEC UCNT                        ;CHECK IF MORE CONTROLLERS
014716  001356                          BNE LDDM                        ;LOAD NEXT

                                        ;CHECK IF ANY CONTROLLERS LOADED

014720  005737  002234                  TST URNING                      ;ANY UNITS LOADED?

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

014724  000207                          RETURN
```

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

014726  013705  002212          RESPDM: MOV TSTTAB,R5                   ;GET CONTROLLER TABLE ADDRESS
014732  013737  002232  002236          MOV URUN,UCNT                   ;SET COUNTER OF UNITS
014740  016504  000016          RESPCT: MOV C.RING(R5),R4               ;GET HOST COMM AREA ADDRESS
014744  032765  000002  000014          BIT #CT.RN,C.FLG(R5)            ;CHECK IF PROGRAM RUNNING
014752  001446                          BEQ RSPNXT                      ;IF NOT, LOOK AT NEXT
014754  116537  000002  002074          MOVB C.UNIT(R5),L$LUN           ;STORE UNIT NUMBER UNDER TEST
014762  032765  000010  000014          BIT #CT.MSG,C.FLG(R5)           ;SEE IF INTERRUPT RECEIVED
014770  001071                          BNE RSPIN                       ;IF SO, LOOK AT PACKET
014772  032765  000004  000014          BIT #CT.CMD,C.FLG(R5)           ;SEE IF COMMAND HAS BEEN SENT
015000  001520                          BEQ RSPOU                       ;IF NOT, SEND ONE

                                        ;CHECK IF UDA STILL RUNNING

015002  011503                          MOV (R5),R3                     ;GET ADDRESS OF UDAIP
015004  016301  000002                  MOV 2(R3),R1                    ;LOOK AT UDASA REGISTER
015010  001405                          BEQ RSPTM                       ;IF ZERO, UDA STILL RUNNING
015012                                  ERRDF 30,,ERR030                ;REPORT UDA HAS FATAL ERROR
015012  104455                                                                  TRAP    C$ERDF
015014  000036                                                                  .WORD   30
015016  000000                                                                  .WORD   0
015020  013716                                                                  .WORD   ERR030
015022  000405                          BR RSPDRP                       ;DROP CONTROLLER FROM TESTING

                                        ;CHECK FOR TIMEOUT OF RESPONSE

015024                          RSPTM:
015024  005737  002354                  TST KW.CSR                      ;SEE IF A CLOCK ON SYSTEM
015030  001416                          BEQ RSPNTO                      ;DON'T TIME IF NO CLOCK
015032  023765  002366  000042          CMP KW.EL+2,C.TOH(R5)           ;COMPARE TO TIMEOUT COUNTER
015040  101005                          BHI RSPTMO
015042  001011                          BNE RSPNTO
015044  023765  002364  000040          CMP KW.EL,C.TO(R5)
015052  103405                          BLO RSPNTO                      ;IF TOO MUCH TIME ELAPSED SINCE LAST INTERRUPT
015054                          RSPTMO: ERRDF 31,,ERR031                ;REPORT TIMEOUT ERROR
015054  104455                                                                  TRAP    C$ERDF
015056  000037                                                                  .WORD   31
015060  000000                                                                  .WORD   0
015062  013732                                                                  .WORD   ERR031
015064  000424                          BR RSPDRP                       ;DROP CONTROLLER FROM TESTING
015066                          RSPNTO:
015066                                  BREAK                           ;ALLOW DRS TO SEE TERMINAL INPUT
015066  104422                                                                  TRAP    C$BRK
```

```
                                        ;CHECK FOR TIME TO PRINT STATISTICAL REPORT

015070  005737  002354          RSPNXT: TST KW.CSR                      ;ANY CLOCK ON SYSTEM?
015074  001412                          BEQ RSPNRP                      ;BYPASS IF NOT
015076  023737  002366  002372          CMP KW.EL+2,STIME+2             ;  A STATISTICAL REPORT
015104  101005                          BHI RSPRPT
015106  001005                          BNE RSPNRP
015110  023737  002364  002370          CMP KW.EL,STIME
015116  103401                          BLO RSPNRP
015120                          RSPRPT: DORPT                           ;PRINT THE REPORT
015120  104424                                                                  TRAP    C$DRPT

                                        ;SWITCH TO NEXT CONTROLLER

015122  062705  000046          RSPNRP: ADD #C.SIZE,R5                  ;MOVE TO NEXT TABLE
015126  005337  002236                  DEC UCNT                        ;CHECK IF MORE CONTROLLERS
015132  001302                          BNE RESPCT                      ;LOOK AT NEXT CONTROLLER
015134  000674                          BR RESPDM                       ;LOOK AT FIRST CONTROLLER AGAIN

                                        ;REMOVE A CONTROLLER FROM TESTING

015136  042765  000012  000014  RSPDRP: BIC #CT.RN+CT.MSG,C.FLG(R5)     ;CLEAR PROGRAM RUNNING
015144  005337  002234                  DEC URNING                      ;REDUCE RUNNING CONTROLLERS COUNT
015150  001347                          BNE RSPNXT                      ;IF ANY STILL RUNNING, LOOK AT THEM
015152  000207                          RETURN                          ;ELSE RETURN TO TEST SECTION
```

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

                                        ;CHECK FOR PROPER OPCODE IN END PACKET

015154  012700  000204          RSPIN:  MOV #OP.END+OP.SSD,R0           ;GET SEND DATA END PACKET OPCODE
015160  032765  000020  000014          BIT #CT.REQ,C.FLG(R5)           ;LOOK IF SEND DATA OR RECEIVE DATA
015166  001402                        BEQ RSPMWR
015170  012700  000205                MOV #OP.END+OP.RSD,R0           ;CHANGE TO RECEIVE DATA END PACKET OPCODE
015174  120064  000030          RSPMWR: CMPB R0,HC.MPK+P.OPCD(R4)       ;COMPARE TO OPCODE IN END PACKET
015200  001010                        BNE RSPERR

                                        ;LOOK AT STATUS CODE

015202  032764  000037  000032        BIT #ST.MSK,HC.MPK+P.STS(R4)    ;CHECK FOR STATUS CODE ST.SUC (ZERO)
015210  001004                        BNE RSPERR

                                        ;CHECK FOR EXPECTED REFERENCE NUMBER

015212  026564  000044  000020        CMP C.REF(R5),HC.MPK+P.CRF(R4)  ;CHECK IF CORRECT REF NUMBER
015220  001405                        BEQ RSPPTW
015222                          RSPERR: ERRDF 33,,ERR033
015222  104455                                                          TRAP    C$ERDF
015224  000041                                                          .WORD   33
015226  000000                                                          .WORD   0
015230  013762                                                          .WORD   ERR033
015232  000741                        BR RSPDRP                       ;DROP UNIT FROM TESTING

                                        ;CHECK IF RESPONSE FROM SEND OR RECEIVE DATA COMMAND

015234  032765  000020  000014  RSPPTW: BIT #CT.REQ,C.FLG(R5)           ;CHECK IF RESPONSE FROM DM PROGRAM
015242  001445                  RSPOU:  BEQ RSPOUT                      ;LOOK AT REQUEST NUMBER IF SO
```

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

015244  016401  000272        RSPPT2: MOV HC.BF2(R4),R1               ;GET REQUEST NUMBER
015250  042701  007777                BIC     #007777,R1              ;CHECK TYPE
015254  022701  060000                CMP     #DU.SPC,R1              ;IS SPECIAL TYPE SET?
015260  001010                        BNE     1$                      ;IF NOT, ERROR
015262  042764  170000  000272        BIC     #^C007777,HC.BF2(R4)    ;CLEAR TYPE
015270  016401  000272                MOV HC.BF2(R4),R1               ;GET REQUEST NUMBER
015274  020127  000017                CMP R1,#DSPSIZ                  ;CHECK IF IN EXPECTED RANGE
015300  103405                        BLO RSPPT3
015302                          1$:     ERRDF 32,,ERR032                ;BAD REQUEST NUMBER
015302  104455                                                                  TRAP    C$ERDF
015304  000040                                                                  .WORD   32
015306  000000                                                                  .WORD   0
015310  013744                                                                  .WORD   ERR032
015312  000711                        BR RSPDRP                       ;DROP UNIT FROM TESTING

015314  012700  000004        RSPPT3: MOV #OP.SSD,R0                  ;BUILD A SEND DATA COMMAND PACKET
015320  004737  023150                CALL BLDCMD                     ;  FOR ANSWER TO DM PROGRAM
015324  012700  000164                MOV #HC.BF1,R0                  ;POINT TO BUFFER IN PACKET
015330  004737  023332                CALL CLRBUF                     ; AND CLEAR BUFFER
015334  010403                        MOV R4,R3                       ;R3 POINTS TO COMMAND BUFFER
015336  062704  000106                ADD #HC.BSZ,R4                  ;R4 POINTS TO MESSAGE BUFFER
015342  011401                        MOV (R4),R1                     ;GET REQUEST NUMBER
015344  012423                        MOV (R4)+,(R3)+                 ;PUT REQUEST NUMBER INTO COMMAND PACKET
0 5346  060101                        ADD R1,R1                       ;DOUBLE REQUEST NUMBER
015350  004771  015460                CALL @RSPDSP(R1)                ;CALL REQUESTED ROUTINE
015354  001270                        BNE RSPDRP                      ;ROUTINE RETURNS Z CLEAR TO DROP UNIT FROM TESTING
                                                                        ; Z SET IF COMMAND READY TO SEND TO UNIT


                                        ;SEND COMMAND BACK TO UDA

015356  042765  000010  000014  RSPOUT: BIC #CT.MSG,C.FLG(R5)          ;CLEAR MESSAGE RECEIVED FLAG
015364  032765  000020  000014          BIT #CT.REQ,C.FLG(R5)           ;CHECK WHICH COMMAND TO SEND
015372  001014                        BNE RSPOU2                      ;BRANCH IF RESPONSE TO REQUEST

015374  012700  000005                MOV #OP.RSD,R0                  ;BUILD RECEIVE DATA COMMAND
015400  004737  023150                CALL BLDCMD
015404  012700  000272                MOV #HC.BF2,R0                  ;POINT TO MESSAGE BUFFER
015410  004737  023332                CALL CLRBUF                     ;  AND CLEAR IT
015414  052765  000020  000014        BIS #CT.REQ,C.FLG(R5)           ;SET REQUEST BIT
015422  000403                        BR RSPOU3

015424  042765  000020  000014  RSPOU2: BIC #CT.REQ,C.FLG(R5)          ;CLEAR REQUEST BIT
015432                          RSPOU3:
015432  004737  023234                CALL SNDCMD                     ;SEND COMMAND TO UDA
015436  012700  000264                MOV #3.*60.,R0                  ;SET TIMEOUT FOR 3 MINUTES
015442  010501                        MOV R5,R1
015444  062701  000040                ADD #C.TO,R1                    ;PUT TIME IN CONTROLLER TABLE
015450  004737  023604                CALL SETTO
015454  000137  015070                JMP RSPNXT                      ;NOW WAIT FOR END PACKET
```

```
                                ;RESPONSE REQUEST DISPATCH TABLE

015460  015516          RSPDSP: .WORD T1MSIZ            ; 0. SET UP FREE MEMORY FOR ADDRESS TESTING
015462  015636                  .WORD T2DLL             ; 1. PROVIDE DIAGNOSTIC PROGRAM FOR DISK DRIVE
015464  016002                  .WORD T2CMD             ; 2. GET MANUAL INTERVENTION COMMAND
015466  016452                  .WORD T4MPRM            ; 3. TELL DATA PATTERN 16.
015470  016474                  .WORD T4UPRM            ; 4. TELL UNIT PARAMETERS, CLEAR CONTENTS
015472  016754                  .WORD T4BB1             ; 5. TELL BAD BLOCKS (FIRST 14)
015474  017004                  .WORD T4BB2             ; 6. TELL BAD BLOCKS (LAST TWO)
015476  017034                  .WORD T4SOFT            ; 7. ADD TO SOFT ERROR AND ECC COUNTS
015500  017062                  .WORD T4SEEK            ; 8. ADD 1000 TO SEEK COUNT
015502  017102                  .WORD T4MXFR            ; 9. ADD TO MEGABITS READ AND WRITE COUNTS
015504  017244                  .WORD UTOTST            ;10. TELL WHICH DRIVES TO TEST
015506  017350                  .WORD ERRMES            ;11. REPORT ERROR MESSAGE
015510  017564                  .WORD ERRMC             ;12. REPORT ERROR MESSAGE AND COUNT HARD ERROR
015512  017704                  .WORD MESSAG            ;13. PRINT A DESCRIPTIVE MESSAGE
015514  020016                  .WORD DONE              ;14. MARK DM PROGRAM AS NO LONGER RUNNING

000017                  DSPSIZ=<.-RSPDSP>/2     ;LEGAL NUMBERS ARE LOWER THAN THIS
```

```
                        ;NORMAL MAINTENANCE READ BUFFER DESCRIPTION

                        ;BYTE OFFSET FROM
                        ;START OF BUFFER
                        ;       0       +-------------------------------+
                        ;               !        REQUEST NUMBER         !  USED TO SELECT ROUTINE
                        ;               +-------------------------------+
                        ;       2       !        DATA ARGUMENT #1       !  R4 CONTAINS THIS ADDRESS
                        ;               +-------------------------------+
                        ;       4       !        DATA ARGUMENT #2       !
                        ;               +-------------------------------+
                        ;       6       !        DATA ARGUMENT #3       !
                        ;               +-------------------------------+
                        ;       8       !        DATA ARGUMENT #4       !
                        ;               +-------------------------------+
                        ;       10      !        DATA ARGUMENT #5       !
                        ;               +-------------------------------+
                        ;       12      !        DATA ARGUMENT #6       !
                        ;               +-------------------------------+
                        ;       14      !        DATA ARGUMENT #7       !
                        ;               +-------------------------------+
                        ;       16      !        DATA ARGUMENT #8       !
                        ;               +-------------------------------+
                        ;       18      !        DATA ARGUMENT #9       !
                        ;               +-------------------------------+
                        ;       20      !        DATA ARGUMENT #10      !
                        ;               +-------------------------------+
                        ;       22      !        DATA ARGUMENT #11      !
                        ;               +-------------------------------+
                        ;
                        ;       .               .
                        ;       .               .
                        ;       .               .
                        ;               +-------------------------------+
                        ;       68      !        DATA ARGUMENT #34      !
                        ;               +-------------------------------+
```

```
                ;NORMAL PSEUDO-TERMINAL IN PACKET DESCRIPTION GIVEN IN RESPONSE TO ABOVE PACKET

                ;BYTE OFFSET FROM
                ;START OF PACKET
                ;        0          +-------------------------------+
                ;                   !        REQUEST NUMBER         !  ECHOED FROM REQUEST PACKET
                ;        2          +-------------------------------+
                ;                   !        DATA ARGUMENT #1       !  R3 CONTAINS THIS ADDRESS
                ;        4          +-------------------------------+
                ;                   !        DATA ARGUMENT #2       !  ALL DATA ARGUMENTS ARE RETURNED
                ;        6          +-------------------------------+  CONTAINING ZEROS UNLESS
                ;                   !        DATA ARGUMENT #3       !  SPECIFICALLY INDICATED BY
                ;        8          +-------------------------------+  RESPONSE ROUTINE.
                ;                   !        DATA ARGUMENT #4       !
                ;       10          +-------------------------------+
                ;                   !        DATA ARGUMENT #5       !
                ;       12          +-------------------------------+
                ;                   !        DATA ARGUMENT #6       !
                ;       14          +-------------------------------+
                ;                   !        DATA ARGUMENT #7       !
                ;       16          +-------------------------------+
                ;                   !        DATA ARGUMENT #8       !
                ;       18          +-------------------------------+
                ;                   !        DATA ARGUMENT #9       !
                ;       20          +-------------------------------+
                ;                   !        DATA ARGUMENT #10      !
                ;       22          +-------------------------------+
                ;                   !        DATA ARGUMENT #11      !
                ;                   +-------------------------------+
                ;
                ;        .                          .
                ;        .                          .
                ;        .                          .
                ;
                ;       68          +-------------------------------+
                ;                   !        DATA ARGUMENT #34      !
                ;                   +-------------------------------+
```

```
                                ;T1MSIZ  -  DM REQUEST 0
                                ;
                                ;SET UP MEMORY FOR ADDRESS TESTING FROM UDA.
                                ;PLACE ADDRESS OF EACH LOCATION INTO EAC' LOCATION IN FREE
                                ;MEMORY. RETURN FIRST LOCATION OF FREE MEMORY IN CMD.02 (LOW BITS)
                                ;AND CMD.03 (HIGH BITS). RETURN LAST LOCATION OF FREE MEMORY IN
                                ;CMD.04 AND CMD.05. ALSO RETURN FIRST EXISTANT LOCATION IN CMD.06
                                ;AND CMD.07; LAST EXISTANT LOCATION IN CMD.08 AND CMD.09.
                                ;
                                ;INPUTS:
                                ;       R5 - CONTROLLER TABLE ADDRESS
                                ;       R4 - MESSAGE PACKET DATA ADDRESS (POINTING TO MSG.02)
                                ;       R3 - COMMAND PACKET DATA ADDRESS (POINTING TO CMD.02)
                                ;OUTPUTS:
                                ;       COMMAND PACKET CONTAINING:
                                ;         (R3) LOW ADDRESS BITS OF FIRST WRITABLE ADDRESS
                                ;       2.(R3) HIGH ADDRESS BITS OF FIRST WRITABLE ADDRESS
                                ;       4.(R3) LOW ADDRESS BITS OF LAST WRITABLE ADDRESS
                                ;       6.(R3) HIGH ADDRESS BITS OF LAST WRITABLE ADDRESS
                                ;       8.(R3) LOW ADDRESS BITS OF FIRST READABLE ADDRESS
                                ;      10.(R3) HIGH ADDRESS BITS OF FIRST READABLE ADDRESS
                                ;      12.(R3) LOW ADDRESS BITS OF LAST READABLE ADDRESS
                                ;      14.(R3) HIGH ADDRESS BITS OF LAST READABLE ADDRESS
                                ;       Z SET
                                
015516  013701  002176        T1MSIZ: MOV FFREE,R1                    ;GET FIRST ADDRESS OF FREE MEMORY
015522  013702  002200                MOV FSIZE,R2                    ;GET SIZE
                                
                                ;FILL MEMORY WITH ADDRESS PATTERN
                                
015526  010111                MEMFIL: MOV R1,(R1)                     ;WRITE DATA INTO LOCATION
015530  062701  000002                ADD #2,R1                       ;INCREASE ADDRESS TO NEXT LOCATION
015534  005302                        DEC R2                          ;COUNT THE WORDS
015536  001373                        BNE MEMFIL                      ;FILL ALL WORDS
                                
                                ;SEND LOCATION OF FREE MEMORY TO UDA
                                
015540  013723  002176                MOV FFREE,(R3)+                 ;LOAD FIRST ADDRESS OF FREE MEMORY
015544  005023                        CLR (R3)+                       ; HIGH ORDER BITS ARE ZERO
015546  013700  002200                MOV FSIZE,R0                    ;GET SIZE OF FREE MEMORY
015552  006300                        ASL R0                          ;CONVERT TO BYTES
015554  063700  002176                ADD FFREE,R0                    ;COMPUTE LAST LOCATION
015560  162700  000002                SUB #2,R0
015564  010023                        MOV R0,(R3)+                    ;LOAD LAST LOCATION
015566  005023                        CLR (R3)+                       ;CLEAR HIGH ORDER BITS
```

```
                                ;SEND LOCATION OF READABLE MEMORY
                                
015570  005023                  CLR (R3)+               ;SEND ZERO AS START OF READABLE MEMORY
015572  005023                  CLR (R3)+
015574  013700  002120          MOV L$HIMEM,R0          ;GET HIGH MEMORY ADDRESS
015600  005001                  CLR R1                  ;CLEAR HIGH BITS
015602  006300                  ASL R0                  ;SHIFT LEFT 6 PLACES
015604  006300                  ASL R0
015606  006300                  ASL R0
015610  006300                  ASL R0
015612  006300                  ASL R0
015614  006101                  ROL R1
015616  006300                  ASL R0
015620  006101                  ROL R1
015622  052700  000076          BIS #76,R0              ;SET LOW ORDER BITS
015626  010023                  MOV R0,(R3)+            ;PUT INTO BUFFER
015630  010123                  MOV R1,(R3)+
015632  000264                  SEZ
015634  000207                  RETURN
```

```
                                ;T2DLL - DM REQUEST 1
                                ;
                                ;PROVIDE DIAGNOSTIC TO DOWNLINE LOAD INTO DISK DRIVE.
                                ;
                                ;THE UDA MAY BE USED TO GET THE DIAGNOSTIC IF THE SYSTEM LOAD DEVICE
                                ;IS ON THE UDA. THIS ACTION WILL CAUSE A REINITIALIZATION OF THE UDA
                                ;AND THE RING STRUCTURE MOVED. SINCE THIS PROGRAM HAS NO WAY TO
                                ;DETERMINE IF THE UDA IS USED  IT WILL ALWAYS ASSUME IT IS USED AND
                                ;WILL INITIALIZE AND RELOAD THE DM PROGRAM AFTER READING THE
                                ;DIAGNOSTIC. THE OUTPUTS OF THIS ROUTINE ARE STORED AND SENT TO THE
                                ;DM PROGRAM IN THE UTOTST REQUEST.
                                ;
                                ;INPUTS:
                                ;       R5 - CONTROLLER TABLE ADDRESS
                                ;       R4 - MESSAGE DATA ADDRESS
                                ;            (R4) DRIVE NUMBER
                                ;          2.(R4) A VALUE THE DM PROGRAM WISHES RETURNED
                                ;          4.(R4) REGION TO WHICH PROGRAM IS TO BE LOADED IN DISK
                                ;          6.(R4) 2 WORD PROGRAM NAME IN RAD50
                                ;       R3 - COMMAND DATA ADDRESS
                                ;OUTPUTS:
                                ;       COMMAND PACKET COULD CONTAIN THE FOLLOWING:
                                ;            (R3) ONE IF PROGRAM PROVIDED, TWO IF PROGRAM NOT AVAILABLE
                                ;          2.(R3) DRIVE NUMBER
                                ;          4.(R3) COPY OF THE VALUE FROM DM PROGRAM
                                ;          6.(R3) REGION TO WHICH PROGRAM IS TO BE LOADED
                                ;          8.(R3) ADDRESS OF FIRST BYTE TO BE DOWNLINE LOADED
                                ;         10.(R3) HIGH ORDER BITS OF ADDRESS
                                ;         12.(R3) BYTE COUNT OF PROGRAM TO BE DOWNLINE LOADED
                                ;       Z SET
                                ;THIS PROGRAM WILL NOT SEND A COMMAND PACKET IN RESPONSE TO THIS REQUEST.
                                ;THE UDA WILL BE REINITIALIZED AND THE DM PROGRAM RELOADED. THEN THIS DATA
                                ;WILL BE APPENDED TO THE NEXT UTOTST REQUEST.

                                ;COPY REQUEST DATA TO STORAGE

015636  005037  002414  T2DLL:  CLR DLL                  ;CLEAR CONTROL WORD
015642  012437  002416          MOV (R4)+,DLLDR         ;DRIVE NUMBER
015646  012437  002420          MOV (R4)+,DLLV          ;VALUE FROM DM
015652  012437  002422          MOV (R4)+,DLLR          ;REGION
015656  012437  002432          MOV (R4)+,DLLNAM        ;PROGRAM NAME
015662  012437  002434          MOV (R4)+,DLLNAM+2      ;  (TWO WORDS)
```

```
                                        ;RESET UDA AND READ DM PROGRAM
 1
 2
 3 015666  005075  000000                      CLR @(R5)               ;RESET THE UDA
 4 015672  013737  002176  002424              MOV FFREE,DLLADR        ;GET ADDRESS WHERE PROGRAM
 5 015700  005037  002426                      CLR DLLADR+2            ;  TO BE STORED
 6 015704  013737  002200  002430              MOV FSIZE,DLLSIZ        ;SAVE CURRENT SIZE OF MEMORY
 7 015712  004737  024626                      CALL RDDLL              ;READ DLL PROGRAM FROM DATA FILE
 8 015716  103002                              BCC 1$                  ;PROGRAM NOT FOUND IF CARRY SET
 9 015720  005237  002414                      INC DLL                 ;RETURN 1 IF PROGRAM FOUND
10 015724  005237  002414              1$:     INC DLL                 ;RETURN 2 IF PROGRAM NOT FOUND
11 015730  013737  002430  002200              MOV DLLSIZ,FSIZE        ;COMPUTE SIZE OF DLL PROGRAM
12 015736  013737  002176  002430              MOV FFREE,DLLSIZ        ;  AND RESTORE ORIGINAL FFREE
13 015744  163737  002424  002430              SUB DLLADR,DLLSIZ       ;  AND FSIZE VALUES
14 015752  013737  002424  002176              MOV DLLADR,FFREE
15 015760  005726                              TST (SP)+               ;POP RETURN ADDRESS OFF STACK
16 015762  012701  000001                      MOV #1,R1               ;RUN THE DM PROGRAM AGAIN
17 015766  004737  014632                      CALL RUNDM
18 015772  001402                              BEQ 2$
19 015774  000137  014726                      JMP RESPDM
20 016000  000207                      2$:     RETURN
```

```
                                ;T2CMD - DM REQUEST 2
                                ;
                                ;GET MANUAL INTERVENTION COMMAND
                                ;
                                ;INPUTS:
                                ;       R5 - CONTROLLER TABLE ADDRESS
                                ;       R4 - MESSAGE DATA ADDRESS
                                ;          (R4) DRIVE NUMBER
                                ;           2.(R4) OPERATION CODE
                                ;                  0 ON FIRST REQUEST FOR DRIVE. ECHO OF PREVIOUS RESPONSE ALL OTHER TIMES.
                                ;             IF OPERATION CODE = 2
                                ;           4.(R4) DATA BYTE READ (TO BE PRINTED)
                                ;       R3 - COMMAND DATA ADDRESS
                                ;OUTPUTS:
                                ;       COMMAND DATA FILLED WITH THE FOLLOWING:
                                ;          (R3) OPERATION CODE
                                ;                  0 - EXIT
                                ;                  1 - WRITE
                                ;                  2 - READ
                                ;                  3 - DIAGNOSE
                                ;             IF OPERATION CODE = 1, 2 OR 3
                                ;           2.(R3) REGION NUMBER
                                ;           4.(R3) OFFSET INTO REGION
                                ;             IF OPERATION CODE = 1
                                ;           6.(R3) DATA BYTE
                                ;       Z SET IF DATA RETURNED
                                ;       Z CLEAR IF DRIVE NUMBER NOT ON THIS CONTROLLER

016002  032737  000200  002160 T2CMD:  BIT #SM.MAN,SFPTBL+SO.BIT       ;LOOK AT MANUAL INTERVENTION MODE
016010  001002                        BNE T2CMDM                      ;EXIT IF NOT WANTED
016012  000137  016434                JMP T2CMDX
016016                          T2CMDM: MANUAL                          ;MANUAL INTERVENTION ALLOWED?
016016  104450                                                                  TRAP    C$MANI
016020                                  BCOMPLETE T2CMDO                ;PRINT WARNING IF NOT
016020  103406                                                                  BCS     T2CMDO
016022                          T2CMD9: PNTF T2WARN
016022  004137  022266                                                          JSR R1,LPNTF
016026  005346                                                                  .WORD T2WARN
016030  000000                                                                  .WORD PNT.CT
016032  000137  016434                JMP T2CMDX
016036  012401                  T2CMDO: MOV (R4)+,R1                    ;GET DRIVE NUMBER
016040  012402                          MOV (R4)+,R2                    ;GET OPERATION CODE
016042  001022                          BNE T2CMD2                      ;BRANCH IF NOT ZERO
016044  004737  020734                  CALL GTDRVT                     ;GET DRIVE TABLE ADDRESS
016050  001401                          BEQ 1$                          ;CHECK IF DRIVE FOUND
016052  000207                          RETURN                          ;RETURN WITH Z CLEAR IF NOT
```

```
      1 016054                          1$:     PNTF T2CMS1,D.UNIT(R4),(R5),(R4)        ;PRINT DESCRIPTION
        016054  011446                                                                    MOV (R4),-(SP)
        016056  011546                                                                    MOV (R5),-(SP)
        016060  016446  000002                                                            MOV D.UNIT(R4),-(SP)
        016064  004137  022266                                                            JSR R1,LPNTF
        016070  005445                                                                    .WORD T2CMS1
        016072  000006                                                                    .WORD PNT.CT
      2 016074  005037  002400                  CLR T2WRR                       ;CLEAR ALL STORAGE WORDS
      3 016100  005037  002402                  CLR T2WRO
      4 016104  005037  002404                  CLR T2DR
```

```
      1 016110  022702  000002          T2CMD2: CMP #2,R2                ;SEE IF LAST OPERATION WAS READ
      2 016114  001027                          BNE T2CMDQ               ;BRANCH IF NOT TO QUESTION
      3 016116                                  PRINT <#' >              ;PRINT ONF SPACE
        016116  112700  000040                                                   MOVB #' ,R0
        016122  004737  022114                                                   CALL CPNT
      4 016126  013701  002400                  MOV T2WRR,R1             ;PRINT REGION
      5 016132  004737  021654                  CALL T2PNTW
      6 016136  013701  002402                  MOV T2WRO,R1             ;PRINT OFFSET
      7 016142  004737  021654                  CALL T2PNTW
      8 016146                                  PRINT #'/                ;PRINT A SLASH
        016146  112700  000057                                                   MOVB #'/,R0
        016152  004737  022114                                                   CALL CPNT
      9 016156  012401                          MOV (R4)+,R1             ;PRINT THE DATA
     10 016160  004737  021704                  CALL T2PNTB
     11 016164                                  PRINT #CR                ;END THE LINE
        016164  112700  000015                                                   MOVB #CR,R0
        016170  004737  022114                                                   CALL CPNT
```

```
                                ;NOW ASK FOR COMMAND INPUT

                                T2CMDQ: GMANID T4OPT7,TEMP,A,-1,1,20.,NO        ;ASK FOR COMMAND
016174  104443                                                                        TRAP    C$GMAN
016176  000406                                                                      BR      10000$
016200  002262                                                                      .WORD   TEMP
016202  000142                                                                      .WORD   T$CODE
016204  003213                                                                      .WORD   T4OPT7
016206  177777                                                                      .WORD   -1
016210  000001                                                                      .WORD   T$LOLIM
016212  000024                                                                      .WORD   T$HILIM
016214                                                                          10000$:
016214  012701  002262                    MOV #TEMP,R1                    ;GET POINTER TO STRING
016220  112100                          MOVB (R1)+,R0                   ;GET COMMAND CHARACTER
016222  022700  000105                    CMP #'E,R0
016226  001415                            BEQ T2CMDV
016230  022700  000104                    CMP #'D,R0
016234  001016                            BNE T2CMD3
016236  012713  000003                    MOV #3,(R3)                     ;STORE DIAGNOSE OPERATION CODE
016242  004737  021766                    CALL T2GNUM                     ;GET REGION FROM COMMAND
016246  001402                            BEQ 1$
016250  010437  002404                    MOV R4,T2DR
016254  013763  002404  000002  1$:       MOV T2DR,2(R3)
016262  004737  021766          T2CMDV:   CALL T2GNUM                     ;MAKE SURE AT END OF LINE
016266  001064                            BNE T2CMDE
016270  000461                            BR T2CMDX
```

```
                                        ;COMMAND MUST BE EITHER READ OR WRITE
                                        
016272  012713  000002          T2CMD3: MOV #2,(R3)                     ;CHECK IF READ
016276  022700  000122                  CMP #'R,R0
016302  001415                          BEQ T2CMDR
016304  022700  000127                  CMP #'W,R0                      ;CHECK IF WRITE
016310  001053                          BNE T2CMDE                      ;  IF NOT - ERROR
016312  012713  000001                  MOV #1,(R3)
016316  004737  021766                  CALL T2GNUM                     ;GET DATA BYTE
016322  001446                          BEQ T2CMDE                      ;ERROR IF NO DATA
016324  162700  000002                  SUB #2,R0
016330  003043                          BGT T2CMDE                      ;OR GREATER THAN TWO DIGITS
016332  010463  000006                  MOV R4,6(R3)                    ;STORE DATA BYTES IN BUFFER
016336  013763  002400  000002  T2CMDR: MOV T2WRR,2(R3)                 ;PUT REGION AND OFFSET
016344  013763  002402  000004          MOV T2WRO,4(R3)                 ;  INTO BUFFER
016352  021302                          CMP (R3),R2                     ;IF SO,
016354  001002                          BNE T2CMDN
016356  005263  000004                  INC 4(R3)                       ;  INCREMENT OFFSET
016362  004737  021766          T2CMDN: CALL T2GNUM
016366  001411                          BEQ T2CMDW
016370  010463  000002                  MOV R4,2(R3)
016374  005063  000004                  CLR 4(R3)
016400  004737  021766                  CALL T2GNUM
016404  001402                          BEQ T2CMDW
016406  010463  000004                  MOV R4,4(R3)
016412  004737  021766          T2CMDW: CALL T2GNUM
016416  001010                          BNE T2CMDE
016420  016337  000002  002400          MOV 2(R3),T2WRR                 ;SAVE REGION
016426  016337  000004  002402          MOV 4(R3),T2WRO                 ;SAVE OFFSET
016434  000264                  T2CMDX: SEZ
016436  000207                          RETURN
016440                          T2CMDE: PNTF T2CMS5                     ;REPORT ERROR MESSAGE
016440  004137  022266                                                          JSR R1,LPNTF
016444  006034                                                                  .WORD T2CMS5
016446  000000                                                                  .WORD PNT.CT
016450  000651                          BR T2CMDQ                       ;GO ASK AGAIN
```

```
                                        ;T4MPRM - DM REQUEST 3
                                        ;
                                        ;REQUEST FOR TEST 4 CONTENTS OF DATA PATTERN 16.
                                        ;
                                        ;INPUTS:
                                        ;       R5 - CONTROLLER TABLE ADDRESS
                                        ;       R4 - MESSAGE DATA ADDRESS
                                        ;            (NO DATA)
                                        ;       R3 - COMMAND DATA ADDRESS
                                        ;OUTPUTS:
                                        ;       COMMAND DATA FILLED WITH THE FOLLOWING:
                                        ;          (R3) NUMBER OF WORDS IN DATA PATTERN 16
                                        ;        2.(R3) DATA IN PATTERN 16
                                        ;          !                 ''
                                        ;       32.(R3)              ''
                                        ;       Z SET

016452  012700  000021        T4MPRM: MOV #17.,R1                     ;GET COUNT
016456  012702  002312                MOV #PAT16C,R2                  ; AND ADDRESS OF PATTERN 16 PARAMETERS
016462  012223                1$:     MOV (R2)+,(R3)+                 ;COPY THE DATA TO BUFFER
016464  005301                        DEC R1
016466  001375                        BNE 1$
016470  000264                        SEZ                             ;RETURN WITH Z SET
016472  000207                        RETURN
```

```
                        ;T4UPRM - DM REQUEST 4
                        ;
                        ;REQUEST FOR TEST 4 UNIT PARAMETERS
                        ;
                        ;INPUTS:
                        ;       R5 - CONTROLLER TABLE ADDRESS
                        ;       R4 - MESSAGE DATA ADDRESS
                        ;          (R4) DRIVE NUMBER
                        ;        2.(R4) DRIVE SERIAL NUMBER
                        ;          :
                        ;        6.(R4)
                        ;        8.(R4) HDA SERIAL NUMBER
                        ;          :
                        ;       14.(R4)
                        ;       R3 - COMMAND DATA ADDRESS
                        ;OUTPUTS:
                        ;       COMMAND DATA FILLED WITH THE FOLLOWING:
                        ;          (R3) PARAMETER BITS (1 FOR TRUE)
                        ;               BIT 14 - INITIAL WRITE
                        ;               BIT 13 - DIAGNOSTIC CYLINDERS
                        ;               BIT 12 - ECC CORRECTION
                        ;               BIT 11 - READ ONLY
                        ;               BIT 10 - WRITE ONLY
                        ;               BIT  9 - RETRIES
                        ;               BIT  8 - TRACK/GROUP AND CYLINDERS SPECIFIED
                        ;               BIT  7 - (NOT USED)
                        ;               BIT  6 - SEQUENTIAL SEEKS
                        ;               BIT  5 - BEGIN/END SETS SPECIFIED
                        ;               BIT  4 - TRACK SPECIFIED (0 - GROUPS SPECIFIED)
                        ;                        HAS MEANING ONLY WHEN BIT 5 IS ZERO
                        ;               BIT  3 - WRITE CHECKS ENABLED
                        ;               BIT  2 - WRITE CHECKS ALWAYS
                        ;               BIT  1 - DATA COMPARES ENABLED
                        ;               BIT  0 - DATA COMPARE ALWAYS
                        ;        2.(R3) DATA PATTERN NUMBER
                        ;       IF PARAMETER BIT 5 SET
                        ;        4.(R3) COUNT OF BEGIN/END SETS
                        ;        6.(R3) BEGIN BLOCK (2 WORDS) THEN END BLOCK (2 WORDS)
                        ;          :       1 TO 4 SETS
                        ;          :            OR
                        ;          :       IF COUNT OF BEGIN/END BLOCKS = 0
                        ;       36.(R3)    START CYLINDER (2 WORDS) THEN END CYLINDER (2 WORDS)
                        ;                  END CYLINDER A NEGATIVE VALUE IF TO TEST ENTIRE AREA
                        ;       IF PARAMETER BIT 5 CLEAR
                        ;        4.(R3) STARTING CYLINDER
                        ;        6.(R3)   (2 WORDS)
                        ;        8.(R3) ENDING CYLINDER (2 WORDS)
                        ;       10.(R3)   NEGATIVE FOR ALL CYLINDERS
                        ;       12.(R3) NUMBER OF TRACKS OR GROUPS SPECIFIED
                        ;       14.(R3) 1 TO 7 TRACK OR GROUP NUMBERS
                        ;          :      DETERMINED BY PARAMETER BIT 4
                        ;       26.(R3)
                        ;       Z SET IF DATA RETURNED
                        ;       Z CLEAR IF UNIT NUMBER NOT ON THIS CONTROLLER
```

```
 1 016474  012401                  T4UPRM: MOV (R4)+,R1                    ;GET DRIVE NUMBER
 2 016476  010402                          MOV R4,R2                       ;SAVE DATA ADDRESS
 3 016500  004737  020734                  CALL GTDRVT                     ;GET DRIVE TABLE ADDRESS
 4 016504  001122                          BNE T4UPRX                      ;CHECK IF DRIVE FOUND
 5 016506  012264  000200                  MOV (R2)+,D.SERN(R4)            ;COPY DRIVE SERIAL NUMBER TO DRIVE TABLE
 6 016512  012264  000202                  MOV (R2)+,D.SERN+2(R4)
 7 016516  012264  000204                  MOV (R2)+,D.SERN+4(R4)
13 016522  016401  000004                  MOV D.PRM(R4),R1                ;GET PARAMETER BITS
14 016526  042701  140200                  BIC #D.ZERO,R1                  ;CLEAR SOME BITS
15 016532  032737  000020  002226          BIT #ISTRTH,IFLAGS              ;IF FIRST TIME TEST 4 BEING RUN
16 016540  001406                          BEQ 2$                          ;  AFTER A START COMMAND
17 016542  032737  040000  002160          BIT #SM.IW,SFPTBL+S0.BIT        ;GET INITIAL WRITE BIT
18 016550  001402                          BEQ 2$
19 016552  052701  040000                  BIS #D.IW,R1                    ;MOVE INTO PARAMETER BITS
20 016556  010123                  2$:     MOV R1,(R3)+                    ;PUT INTO BUFFER
21 016560  016423  000006                  MOV D.PAT(R4),(R3)+             ;PUT PATTERN NUMBER IN BUFFER
22 016564  032701  000040                  BIT #D.BE,R1                    ;CHECK BEGIN/END PARAMETER BIT
23 016570  001411                          BEQ 10$                         ;BRANCH IF NOT SET
24
25                                  ;RETURN BEGIN/END SETS
26
27 016572  012701  000021                  MOV #4*4+1,R1                   ;COUNT OF SETS TIMES WORDS PER SET PLUS COUNT WORD
28 016576  010402                          MOV R4,R2                       ;GET INDEX INTO DRIVE TABLE
29 016600  062702  000112                  ADD #D.BEC,R2
30 016604  012223                  1$:     MOV (R2)+,(R3)+                 ;TRANSFER THE BEGIN/END SETS
31 016606  005301                          DEC R1
32 016610  001375                          BNE 1$
33 016612  000457                          BR T4UPRX
34
35 016614  032764  000400  000004  10$:    BIT #D.CYL,D.PRM(R4)            ;LOOK AT D.CYL BIT
36 016622  001441                          BEQ 20$                         ;BRANCH IF NOT SET
37
38                                  ;RETURN TRACKS/GROUPS AND CYLINDERS
39
40 016624  005764  000112                  TST D.BEC(R4)                   ;CHECK IF ANY TRACKS/GROUPS
41 016630  001421                          BEQ 25$                         ;BRANCH IF NONE
42 016632  012701  000004                  MOV #4,R1                       ;COUNT OF CYLINDER WORDS
43 016636  010402                          MOV R4,R2
44 016640  062702  000154                  ADD #D.BCYL,R2
45 016644  012223                  11$:    MOV (R2)+,(R3)+                 ;CYLINDERS
46 016646  005301                          DEC R1
47 016650  001375                          BNE 11$
48 016652  012701  000010                  MOV #8.,R1
49 016656  010402                          MOV R4,R2
50 016660  062702  000112                  ADD #D.BEC,R2
51 016664  012223                  12$:    MOV (R2)+,(R3)+                 ;TRACKS/GROUPS
52 016666  005301                          DEC R1
53 016670  001375                          BNE 12$
54 016672  000427                          BR T4UPRX
```

```
                                        ;RETURN CYLINDERS ONLY
                                        
016674  052763  000040  177774  25$:    BIS #D.BE,-4(R3)            ;SET D.BE FOR DM PROGRAM
016702  005023                          CLR (R3)+                   ;SEND ZERO BEGIN/END COUNT
016704  012701  000004                  MOV #4,R1
016710  010402                          MOV R4,R2
016712  062702  000154                  ADD #D.BCYL,R2
016716  012223                  26$:    MOV (R2)+,(R3)+             ;CYLINDERS
016720  005301                          DEC R1
016722  001375                          BNE 26$
016724  000412                          BR T4UPRX
                                        
                                        ;RETURN ENTIRE AREA
                                        
016726  052763  000040  177774  20$:    BIS #D.BE,-4(R3)            ;SET D.BE FOR DM PROGRAM
016734  005023                          CLR (R3)+                   ;BEGIN/END COUNT OF ZERO
016736  005023                          CLR (R3)+                   ;START CYLINDER OF ZERO
016740  005023                          CLR (R3)+
016742  005023                          CLR (R3)+                   ;END CYLINDER NEGATIVE
016744  012723  177777                  MOV #-1,(R3)+
016750  000264                          SEZ
016752  000207                  T4UPRX: RETURN
```

```
                                        ;T4BB1 - DM REQUEST 5
                                        ;
                                        ;REQUEST FOR FIRST 14 BAD BLOCKS
                                        ;
                                        ;INPUTS:
                                        ;       R5 - CONTROLLER TABLE ADDRESS
                                        ;       R4 - MESSAGE DATA ADDRESS
                                        ;          (R4) DRIVE NUMBER
                                        ;       R3 - COMMAND DATA ADDRESS
                                        ;OUTPUTS:
                                        ;       COMMAND DATA FILLED WITH BAD BLOCKS
                                        ;          (R3) COUNT OF BAD BLOCKS
                                        ;        2.(R3) BAD BLOCK 1 (LOW)
                                        ;        4.(R3)             (HIGH)
                                        ;           :
                                        ;           :
                                        ;       56.(R3) BAD BLOCK 14 (LOW)
                                        ;       58.(R3)              (HIGH)
                                        ;       Z SET IF DATA RETURNED
                                        ;       Z CLEAR IF DRIVE NUMBER NOT ON THIS CONTROLLER
                                        ;
016754  011401                  T4BB1: MOV (R4),R1                     ;GET DRIVE NUMBER
016756  004737  020734                 CALL GTDRVT                     ;GET DRIVE TABLE ADDRESS
016762  001007                         BNE T4BB1E                      ;CHECK IF DRIVE FOUND
016764  062704  000010                 ADD #D.BB,R4                    ;INCREASE ADDRESS TO DATA TO COPY
016770  012701  000035                 MOV #<1+<14.*2>>,R1             ;GET COUNT OF WORDS
016774  012423                  1$:    MOV (R4)+,(R3)+                 ;COPY THE WORDS
016776  005301                         DEC R1
017000  001375                         BNE 1$
017002  000207                  T4BB1E: RETURN
```

```
                                        ;T4BB2 - DM REQUEST 6
                                        ;
                                        ;REQUEST LAST TWO BAD BLOCKS
                                        ;
                                        ;INPUTS:
                                        ;       R5 - CONTROLLER TABLE ADDRESS
                                        ;       R4 - MESSAGE DATA ADDRESS
                                        ;          (R4) DRIVE NUMBER
                                        ;       R3 - COMMAND DATA ADDRESS
                                        ;OUTPUTS:
                                        ;       COMMAND DATA FILLED WITH BAD BLOCKS 15 AND 16
                                        ;       Z SET IF DATA RETURNED
                                        ;       Z CLEAR IF UNIT NUMBER NOT ON THIS CONTROLLER
                                        ;
017004  011401                  T4BB2:  MOV (R4),R1                     ;GET DRIVE NUMBER
017006  004737  020734                  CALL GTDRVT                     ;GET DRIVE TABLE ADDRESS
017012  001007                          BNE T4BB2E                      ;CHECK IF DRIVE FOUND
017014  062704  000102                  ADD #D.BB15,R4                  ;INCREASE ADDRESS TO DATA TO COPY
017020  012701  000004                  MOV #4,R1                       ;GET COUNT OF WORDS
017024  012423                  1$:     MOV (R4)+,(R3)+                 ;COPY THE WORDS
017026  005301                          DEC R1
017030  001375                          BNE 1$
017032  000207                  T4BB2E: RETURN
```

```
                                        ;T4SOFT - DM REQUEST 7
                                        ;
                                        ;ADD TO SOFT ERROR AND ECC COUNTS
                                        ;
                                        ;INPUTS:
                                        ;       R5 - CONTROLLER TABLE ADDRESS
                                        ;       R4 - MESSAGE DATA ADDRESS
                                        ;          (R4) DRIVE NUMBER
                                        ;           2.(R4) VALUE TO ADD TO SOFT ERROR COUNT
                                        ;           4.(R4) VALUE TO ADD TO ECC COUNT
                                        ;       R3 - COMMAND DATA ADDRESS
                                        ;
017034  012401                  T4SOFT: MOV (R4)+,R1                    ;GET DRIVE NUMBER
017036  010402                          MOV R4,R2                       ;SAVE DATA ADDRESS
017040  004737  020734                  CALL GTDRVT                     ;GET DRIVE TABLE ADDRESS
017044  001005                          BNE 1$                          ;CHECK IF DRIVE FOUND
017046  062264  000172                  ADD (R2)+,D.SERR(R4)            ;ADD TO SOFT ERROR COUNT
017052  062264  000176                  ADD (R2)+,D.ECCC(R4)            ;ADD TO ECC COUNT
017056  000264                          SEZ                             ;EXIT
017060  000207                  1$:     RETURN
```

```
      1 017062                          T4SEEK:
      2                                 ;       DM REQUEST 8.
      3                                 ;
      4                                 ;RECORD 1000 SEEKS COMPLETED ON DRIVE
      5                                 ;
      6                                 ;INPUTS:
      7                                 ;       R5 - CONTROLLER TABLE ADDRESS
      8                                 ;       R4 - MESSAGE DATA ADDRESS
      9                                 ;          (R4) DRIVE NUMBER
     10                                 ;       R3 - COMMAND DATA ADDRESS
     11                                 ;
     12 017062  011401                  ;       MOV     (R4),R1                 ; GET DRIVE NUMBER
     13 017064  004737  020734          ;       CALL    GTDRVT                  ; GET DRIVE TABLE ADDRESS
     14 017070  001003                  ;       BNE     SEKERE                  ; CHECK IF DRIVE FOUND
     15 017072  005264  000174          ;       INC     D.SEEK(R4)              ; COUNT THE BITS TRANSFERRED
     16 017076  000264                  ;       SEZ                             ; NORMAL RETURN
     17 017100  000207                  SEKERE: RETURN
```

```
                                        ;T4MXFR - DM REQUEST 9.
                                        ;
                                        ;RECORD 1M BITS TRANSFERRED ON UNIT. COMPARE TO TRANSFER LIMIT AND
                                        ;REPORT LIMIT REACHED.
                                        ;
                                        ;INPUTS:
                                        ;       R5 - CONTROLLER TABLE ADDRESS
                                        ;       R4 - MESSAGE DATA ADDRESS
                                        ;          (R4) DRIVE NUMBER
                                        ;           2.(R4) VALUE TO ADD TO READ COUNT
                                        ;           4.(R4) VALUE TO ADD TO WRITE COUNT
                                        ;       R3 - COMMAND DATA ADDRESS
                                        ;OUTPUTS:
                                        ;          (R3) BIT 15 SET IF TRANSFER LIMIT REACHED
                                        ;       MESSAGE PRINTED IF TRANSFER LIMIT REACHED
                                        ;       Z CLEAR IF DRIVE NUMBER NOT ON THIS CONTROLLER

017102  010402                 T4MXFR: MOV R4,R2                       ;GET MESSAGE DATA ADDRESS
017104  011401                         MOV (R4),R1                     ;GET DRIVE NUMBER
017106  004737  020734                 CALL GTDRVT                     ;GET DRIVE TABLE ADDRESS
017112  001053                         BNE MXFERE                      ;CHECK IF DRIVE FOUND
017114  005764  000002                 TST D.UNIT(R4)                  ;SEE IF UNIT HAS BEEN DROPPED
017120  100003                         BPL 1$                          ;CONTINUE IF STILL TO BE TESTED
017122                                         ASSUME DT.AVL EQ BIT15
017122  052713  100000                 BIS #BIT15,(R3)                 ;TELL DM PROGRAM TO STOP TESTING THIS UNIT
017126  000444                         BR MXFERX                       ;  AND EXIT WITHOUT ADDING TO ADDING TO COUNTS

017130                           1$:
017130  066264  000002  000163       ADD 2(R2),D.XFRR(R4)             ;ADD MEGABITS READ
017136  066264  000004  000164       ADD 4(R2),D.XFRW(R4)             ;ADD MEGABITS WRITTEN
017144  005737  002156               TST SFPTBL+SO.XL                 ;SEE IF LIMIT SPECIFIED
017150  001433                       BEQ MXFERX                      ;BRANCH IF NOT
017152  026437  000166  002156       CMP D.XFRR(R4),SFPTBL+SO.XL      ;CHECK IF LIMIT REACHED
017160  103427                       BLO MXFERX                      ;BRANCH IF LIMIT NOT REACHED
017162                               RFLAGS R0                       ;CHECK FLAGS
017162  104421                                                                TRAP    C$RFLA
017164  032700  000040               BIT #IDU,R0                     ;SEE IF DROPPING UNITS IS INHIBITED
017170  001023                       BNE MXFERX
017172  052713  100000               BIS #BIT15,(R3)                 ;SET DROP UNIT BIT
017176  042765  000010  000014       BIC #CT.MSG,C.FLG(R5)           ;CLEAR MESSAGE RECEIVED FLAG
017204                               PNTX MESSG,D.UNIT(R4),(R5),(R4) ;PRINT TESTING DONE
017204  011446                                                                MOV (R4),-(SP)
017206  011546                                                                MOV (R5),-(SP)
017210  016446  000002                                                        MOV D.UNIT(R4),-(SP)
017214  004137  022306                                                        JSR R1,LPNTX
017220  005302                                                                .WORD MESSG
017222  000006                                                                .WORD PNT.CT
017224  004737  025356               CALL RNTIME                     ;PRINT RUNTIME
017230                               PNTX MXFERP
017230  004137  022306                                                        JSR R1,LPNTX
017234  003771                                                                .WORD MXFERP
017236  000000                                                                .WORD PNT.CT
017240  000264           MXFERX: SEZ                                 ;NORMAL RETURN
017242  000207           MXFERE: RETURN
```

```
                                ;UTOTST - DM REQUEST 10
                                ;
                                ;TELL DM PROGRAM WHICH DRIVES ARE SELECTED FOR TESTING
                                ;AND CLEAR STATISTICS IN DRIVE TABLE
                                ;
                                ;INPUTS:
                                ;       R5 - CONTROLLER TABLE ADDRESS
                                ;       R4 - MESSAGE DATA ADDRESS
                                ;            (NO DATA)
                                ;       R3 - COMMAND DATA ADDRESS
                                ;OUTPUTS:
                                ;       COMMAND PACKET CONTAINING UP TO 8 DRIVE NUMBERS.
                                ;         LIST IS ENDED BY A WORD WITH BIT 15 SET.
                                ;         FOLLOWING LIST IS THE INFORMATION FROM T2DLL REQUEST IF APPLICABLE.
                                ;       D.XFRW, D.XFRR, D.HERR, D.SERR, D.SEEK AND D.ECC CLEARED IN DRIVE TABLE
                                ;       Z SET
                                ;
017244  010504                  UTOTST: MOV R5,R4                       ;GET ADDRESS OF CONTROLLER TABLE
017246  062704  000020                  ADD #C.DRO,R4                   ;BUMP TO DRIVE TABLE POINTERS
017252  012702  000010                  MOV #8.,R2                      ;GET COUNT OF PORTS
017256  012400                  UTOT1:  MOV (R4)+,R0                    ;SEE IF DRIVE TABLE POINTER EXISTS
017260  001415                          BEQ UTOT2                       ;BRANCH IF NOT
017262  005760  000002                  TST D.UNIT(R0)                  ;LOOK IF UNIT AVAILABLE FOR TESTING
017266  100410                          BMI UTOT1A
017270                                      ASSUME DT.AVL EQ BIT15
017270  011023                          MOV (R0),(R3)+                  ;LOAD DRIVE NUMBER FROM TABLE
017272  062700  000164                  ADD #D.XFRW,R0                  ;CLEAR STATISTICS IN DRIVE TABLE
017276  012701  000011                  MOV #D.SIZE-D.XFRW/2,R1
017302  005020                  1$:     CLR (R0)+
017304  005301                          DEC R1
017306  001375                          BNE 1$
017310  005302                  UTOT1A: DEC R2                          ;COUNT THE DRIVE TABLES
017312  001361                          BNE UTOT1                       ;REPEAT FOR EACH TABLE
017314  012723  100000          UTOT2:  MOV #BIT15,(R3)+                ;TERMINATE LIST
017320  013723  002414                  MOV DLL,(R3)+                   ;GET DLL CONTROL WORD
017324  001407                          BEQ UTOT4                       ; IF NON-ZERO
017326  012701  002416                  MOV #DLLDR,R1                   ;  TRANSFER ALL DLL WORDS INTO BUFFER
017332  012702  000020                  MOV #<DLLNAM+4-DLLDR>,R2
017336  012123                  UTOT3:  MOV (R1)+,(R3)+
017340  005302                          DEC R2
017342  001375                          BNE UTOT3
017344  000264                  UTOT4:  SEZ
017346  000207                          RETURN                          ;RETURN WITH Z SET
```

```
                                ;FRRMES  - DM REQUEST 11
                                ;
                                ;PRINT AN ERROR MESSAGE
                                ;
                                ;INPUTS:
                                ;       R5 - CONTROLLER TABLE ADDRESS
                                ;       R4 - MESSAGE DATA ADDRESS
                                ;            (R4)  ERROR PC IN DM PROGRAM
                                ;          2.(R4)  <15:14> ERROR TYPE
                                ;                  <13:0 > ERROR NUMBER
                                ;          4.(R4)  DRIVE NUMBER (-1 IF NOT GIVEN)
                                ;          6.(R4)  MESSAGE POINTER
                                ;          8.(R4)  OPTIONAL PARAMETERS FOR ERROR PRINT ROUTINE
                                ;         10.(R4)                  ''
                                ;            !                     ''
                                ;            !                     ''
                                ;         58.(R4)                  ''
                                ;       R3 - COMMAND DATA ADDRESS
                                ;OUTPUTS:
                                ;       COMMAND PACKET CONTAINING THE FOLLOWING:
                                ;            (R3) - BIT 15 SET IF FATAL ERROR TO INDICATE DRIVE SHOULD NO LONGER BE TESTED
                                ;       Z SET TO INDICATE DATA RETURNED
                                ;       Z CLEAR IF DRIVE NUMBER NOT ON THIS CONTROLLER

017350                          ERRMES:
017350  005764  000002                  TST 2(R4)                       ;CHECK IF FATAL ERROR
017354  100406                          BMI 5$                          ;BRANCH IF NOT
017356                          RFLAGS R0                               ;LOOK AT FLAGS
017356  104400                                                                  TRAP    C$RFLA
017360  032700  000040                  BIT #IDU,R0                     ;SEE IF ALLOWED TO DROP UNITS
017364  001014                          BNE 6$                          ;BRANCH IF NOT
017366  052713  100000                  BIS #BIT15,(R3)                 ;SET DROP DRIVE BIT
017372  016400  000002          5$:     MOV 2(R4),R0                    ;SEE IF SOFT ERROR
017376  005100                          COM R0
017400  032700  140000                  BIT #140000,R0
017404  001004                          BNE 6$                          ;BRANCH IF NOT
017406  032737  000400  002160          BIT #SM.SSF,SO.BIT+SFPTBL       ;SEE IF SOFT ERRORS SUPPRESSED
017414  001061                          BNE     ERRMSX                  ;DON'T PRINT IF SO
017416                          6$:
017416  042765  000010  000014          BIC #CT.MSG,C.FLG(R5)           ;CLEAR MESSAGE RECEIVED FLAG
017424  022737  000004  002230          CMP #4,TNUM                     ;IF TEST # 4,
017432  001004                          BNE 7$
017434  032737  001000  002160          BIT #SM.LOG,SFPTBL+SO.BIT       ;  SEE IF LOG BEING USED
017442  001005                          BNE ERRMSL
017444  004737  022372          7$:     CALL PNTERR                     ;IF NOT, PRINT THE ERROR MESSAGE
017450  103043                          BCC ERRMSX                      ;IF DRIVE HASN'T BEEN DROPPED, PRINT
017452  000244                          CLZ                             ;ELSE RETURN
017454  000207                          RETURN
```

```
      1 017456  005737  002406           ERRMSL: TST LBUFS                ;SEE IF LOG BUFFER ESTABLISHED
      2 017462  001014                           BNE 1$                   ;  LBUFS CONTAINS ADDRESS IF ESTABLISHED
      3 017464  013701  002176                   MOV FFREE,R1             ;GET START ADDRESS OF BUFFER
      4 017470  010137  002406                   MOV R1,LBUFS             ;INITIALIZE BUFFER STORAGE
      5 017474  010137  002410                   MOV R1,LBUFN             ;SAVE ADDRESS WHERE TO ADD
      6 017500  063701  002200                   ADD FSIZE,R1             ;COMPUTE END OF STORAGE AREA
      7 017504  063701  002200                   ADD FSIZE,R1
      8 017510  010137  002412                   MOV R1,LBUFE
      9 017514  013701  002410           1$:     MOV LBUFN,R1             ;GET ADDRESS OF DATA STORAGE AREA
     10 017520  062737  000106  002410           ADD #HC.BSZ,LBUFN        ;ADD BYTES OF STORAGE NEEDED
     11 017526  023737  002410  002412           CMP LBUFN,LBUFE          ;SEE IF ENOUGH ROOM
     12 017534  103007                           BHIS 3$                  ;  BRANCH IF NOT
     13 017536  010521                           MOV R5,(R1)+             ;STORE CONTROLLER TABLE ADDRESS
     14 017540  012700  000042                   MOV #<HC.BSZ-2>/2,R0     ;GET COUNT OF REST OF DATA IN WORDS
     15 017544  012421                   2$:     MOV (R4)+,(R1)+          ;STORE DATA
     16 017546  005300                           DEC R0
     17 017550  001375                           BNE 2$
     18 017552  000402                                 BR ERRMSX
     19 017554  010137  002410           3$:     MOV R1,LBUFN             ;RESTORE OLD VALUE OF LBUFN
     20 017560  000264                   ERRMSX: SEZ
     21 017562  000207                           RETURN
```

```
                                ;ERRMC - DM REQUEST 12.
                                ;
                                ;REPORT AN ERROR MESSAGE IDENTICAL TO DM REQUEST ERRMES
                                ;THEN ADD ONE TO THE ERROR COUNT FOR THE DRIVE AND SEE IF
                                ;ERROR LIMIT REACHED.
                                ;
                                ;INPUTS:
                                ;       R5 - CONTROLLER TABLE ADDRESS
                                ;       R4 - MESSAGE DATA ADDRESS
                                ;            (R4)  ERROR PC IN DM PROGRAM
                                ;          2.(R4)  < 9:8 > ERROR TYPE
                                ;                  < 7:0 > ERROR NUMBER
                                ;          4.(R4)  DRIVE NUMBER (-1 IF NOT GIVEN)
                                ;          6.(R4)  <15:12> TYPE
                                ;                  <11:0 > MESSAGE POINTER
                                ;          8.(R4)  OPTIONAL PARAMETERS FOR ERROR PRINT ROUTINE
                                ;         10.(R4)                  "
                                ;            !                     "
                                ;            !                     "
                                ;         58.(R4)                  "
                                ;       R3 - COMMAND DATA ADDRESS
                                ;OUTPUTS:
                                ;       COMMAND PACKET CONTAINING THE FOLLOWING:
                                ;         (R3) BIT 15 SET IF ERROR COUNT REACHED
                                ;              TO INDICATE DRIVE SHOULD NO LONGER BE TESTED.
                                ;       Z CLEAR IF DRIVE NUMBER NOT ON THIS CONTROLLER
                                ;       Z SET TO INDICATE DATA RETURNED
                                ;
017564                          ERRMC:  PUSH R4
017564  010446                                                          MOV R4,-(SP)
017566  004737  017350                 CALL    ERRMES                  ; CALL REQUEST ERRMES
017572                                  POP R4
017572  012604                                                          MOV (SP)+,R4
017574  005713                          TST (R3)                        ;SEE IF UNIT ALREADY TO BE DROPPED
017576  100436                          BMI 3$                          ;  IF SO, JUST EXIT NOW
017600  016401  000004                  MOV     4(R4),R1                ; GET DRIVE NUMBER
017604  016402  000002                  MOV 2(R4),R2                    ;GET ERROR TYPE
017610  004737  020734                  CALL    GTDRVT                  ; GET DRIVE TABLE
017614  001031                          BNE     5$                      ; EXIT IF NO TABLE FOR UNIT
017616  042702  037777                  BIC #^C140000,R2
017622  022702  100000                  CMP #100000,R2                  ;CHECK IF HARD ERROR
017626  001022                          BNE 3$                          ;BRANCH IF NOT
017630  005264  000170                  INC     D.HERR(R4)              ; COUNT THE ERROR
017634  026437  000170  002154          CMP     D.HERR(R4),SFPTBL+SO.EL ; CHECK IF AT LIMIT
017642  103414                          BLO     3$                      ; IF LIMIT REACHED, BRANCH
017644                                  RFLAGS R0                       ;LOOK AT THE FLAGS
017644  104421                                                          TRAP    C$RFLA
017646  032700  000040                  BIT #IDU,R0                     ;SEE IF DROPPING UNITS INHIBITED
017652  001010                          BNE 3$                          ;BRANCH IF SO
```

```
      8 017654                                  PNTX ERRLIM,D.UNIT(R4)          ; PRINT LIMIT REACHED
        017654  016446  000002                                                          MOV D.UNIT(R4),-(SP)
        017660  004137  022306                                                          JSR R1,LPNTX
        017664  004046                                                                  .WORD ERRLIM
        017666  000002                                                                  .WORD PNT.CT
      9 017670  052713  100000                  BIS #BIT15,(R3)                 ;SET STOP TESTING BIT
     13 017674  000264                  3$:     SEZ                             ; SET Z FOR NORMAL RETURN
     14 017676  000207                          RETURN                          ; RETURN TO CALLING PROGRAM
     15
     16 017700  000244                  5$:     CLZ                             ; FLAG AS ERROR
     17 017702  000207                          RETURN                          ; RETURN TO CALLING PROGRAM
```

```
                                ;MESSAG - DM REQUEST 13.
                                ;
                                ;PRINT A MESSAGE WITH HEADER AS FOLLOWS:
                                ;   'UNIT XX UDA AT XXXXXX DRIVE XXX RUNTIME HH:MM:SS ''
                                ;ENTIRE MESSAGE IS PRINTED WITH PRINTX CALLS.
                                ;
                                ;INPUTS:
                                ;       R5 - CONTROLLER TABLE ADDRESS
                                ;       R4 - MESSAGE DATA ADDRESS
                                ;          (R4) DRIVE NUMBER
                                ;           2.(R4) MESSAGE POINTER
                                ;           2.(R4) MESSAGE POINTER
                                ;           4.(R4) OPTIONAL MESSAGE PARAMETERS
                                ;             :
                                ;             :
                                ;       58.(R4) COMMAND DATA ADDRESS

017704  042765  000010  000014  MESSAG: BIC #CT.MSG,C.FLG(R5)          ;CLEAR MESSAGE RECEIVED FLAG
017712  012401                          MOV (R4)+,R1                    ;GET DRIVE NUMBER
017714                                  PUSH R4                         ;SAVE DATA POINTER
017714  010446                                                                  MOV R4,-(SP)
017716  004737  020734                  CALL GTDRVT                     ;GET DRIVE TABLE ADDRESS
017722  001033                          BNE 1$                          ;CHECK IF DRIVE FOUND
017724  005764  000002                  TST D.UNIT(R4)                  ;IF UNIT DROPPED FROM TESTING
017730  100430                          BMI 1$                          ;  DON'T PRINT ANYTHING
017732                                  PNTX MESSG,D.UNIT(R4),(R5),(R4) ;PRINT HEADER
017732  011446                                                                  MOV (R4),-(SP)
017734  011546                                                                  MOV (R5),-(SP)
017736  016446  000002                                                          MOV D.UNIT(R4),-(SP)
017742  004137  022306                                                          JSR R1,LPNTX
017746  005302                                                                  .WORD MESSG
017750  000006                                                                  .WORD PNT.CT
017752  004737  025356                  CALL RNTIME                     ;GET RUNTIME PARAMETERS
017756                                  POP R4
017756  012604                                                                  MOV (SP)+,R4
017760  012402                          MOV (R4)+,R2                    ;GET MESSAGE POINTER
017762  006302                          ASL R2                          ;DOUBLE TO MAKE BYTE OFFSET
017764  063702  002214                  ADD DMPROG,R2                   ;ADD TO START OF MESSAGE STRINGS
017770  067702  162220                  ADD @DMPROG,R2                  ;ADD SIZE OF MAIN PROGRAM
017774  105712                          TSTB (R2)                       ;CHECK FIRST BYTE
017776  001001                          BNE 2$                          ;IF ZERO
020000  005202                          INC R2                          ;  INCREMENT TO NEXT BYTE
020002  004737  020022          2$:     CALL OSTRNG                     ;OUTPUT ACCORDING TO STRING
020006  000264                          SEZ
020010  000207                          RETURN
020012                          1$:     POP R4
020012  012604                                                                  MOV (SP)+,R4
020014  000207                          RETURN
```

```
                                ;DONE - DM REQUEST 14
                                ;
                                ;MARK DM PROGRAM AS NO LONGER RUNNING
                                ;
                                ;INPUTS:
                                ;       R5 - CONTROLLER TABLE ADDRESS
                                ;       R4 - MESSAGE DATA ADDRESS
                                ;               (NO DATA)
                                ;       R3 - COMMAND DATA ADDRESS
                                ;OUTPUTS:
                                ;       Z CLEAR TO DROP UNIT FROM TESTING
                                
020016  000244                  DONE:   CLZ                             ;DROP UNIT FROM TESTING
020020  000207                          RETURN
```

```
                                        ;OSTRNG
                                        ;
                                        ;OUTPUT A MESSAGE ACCORDING TO A FORMAT STRING
                                        ;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.
                                        ;
                                        ;INPUTS:
                                        ;       R2 - ADDRESS OF START OF FORMAT STRING
                                        ;       R4 - ADDRESS OF PARAMETERS
                                        ;OUTPUTS:
                                        ;       R2 AND R4 UPDATED TO END OF STRING AND PARAMETERS
                                        ;
020022  112201          OSTRNG: MOVB (R2)+,R1           ;GET CONTROL CHARACTER
020024  001421                  BEQ OSTRE              ;EXIT IF NULL CHARACTER
020026  012700  020374          MOV #ERRC,R0           ;GET POINTER TO CHARACTER TABLE
020032  120110          NCONS:  CMPB R1,(R0)           ;COMPARE CHARACTER WITH TABLE ENTRY
020034  001407                  BEQ NCONF              ;BRANCH IF MATCH FOUND
020036  105720                  TSTB (R0)+             ;INCREMENT POINTER
020040  001374                  BNE NCONS              ;CONTINUE SEARCH IF NOT END OF TABLE
020042                          PNTF ERRME1            ;REPORT BAD CONTROL CHARACTER
020042  004137  022266                                                  JSR R1,LPNTF
020046  003702                                                          .WORD ERRME1
020050  000000                                                          .WORD PNT.CT
020052  000406                  BR OSTRE
020054  162700  020334  NCONF:  SUB #ERRC,R0           ;GET INCREMENT INTO TABLE
020060  006300                  ASL R0                 ;DOUBLE TO WORD COUNT
020062  004770  020346          CALL @ERRD(R0)         ;DISPATCH TO PRINT ROUTINE
020066  000755                  BR OSTRNG              ;GET NEXT
020070  000207          OSTRE:  RETURN
```

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

020072  112200                  CON.QU: MOVB (R2)+,R0                   ;GET CHARACTER
020074  120027  000042                  CMPB R0,#'"                     ;CHECK IF ENDING QUOTE
020100  001403                          BEQ CON.QX                      ;IF SO, GO GET NEXT CONTROL CHARACTER
020102                                  PRINT R0                        ;PRINT THE CHARACTER
020102  004737  022114                                                                  CALL CPNT
020106  000771                          BR CON.QU                       ;CONTINUE PRINTING
020110  000207                  CON.QX: RETURN

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

020112  004737  021024          CON.A:  CALL GETCNT                     ;GET COUNT OF CHARACTERS
020116                          CON.A1: PRINT (R4)+                     ;PRINT THE CHARACTER
020116  112400                                                                          MOVB (R4)+,R0
020120  004737  022114                                                                  CALL CPNT
020124  005301                          DEC R1                          ;COUNT THE CHARACTERS
020126  001373                          BNE CON.A1                      ;PRINT UNTIL COUNT REACHES ZERO
020130  032704  000001                  BIT #1,R4                       ;CHECK IF R4 NOW ODD
020134  001401                          BEQ CON.A2
020136  005204                          INC R4                          ;IF SO, INCREMENT TO NEXT EVEN ADDRESS
020140  000207                  CON.A2: RETURN                          ;NOW GET NEXT CONTROL CHARACTER

                                        ;CONTROL CHARACTER WAS A D. PRINT DECIMAL NUMBER.

020142  012701  000012          CON.D:  MOV #10.,R1                      ;LOAD RADIX
020146  004737  021102                  CALL PNTNUM                     ;PRINT NUMBER
020152  000207                          RETURN                          ;NOW GET NEXT CONTROL CHARACTER

                                        ;CONTROL CHARACTER WAS AN H. PRINT HEX NUMBER.

020154  012701  000020          CON.H:  MOV #16.,R1                      ;LOAD RADIX
020160  004737  021102                  CALL PNTNUM                     ;PRINT NUMBER
020164  000207                          RETURN                          ;NOW GET NEXT CONTROL CHARACTER
```

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

                        CON.O:  MOV #8.,R1                      ;LOAD RADIX
                                CALL PNTNUM                     ;PRINT NUMBER
                                RETURN                          ;NOW GET NEXT CONTROL CHARACTER

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

                        CON.N:  CALL GETCNT                     ;GET COUNT
                        CON.N1: PRINT #CR                       ;PRINT NEW LINE SEQUENCE
                                                                        MOVB #CR,R0
                                                                        CALL CPNT
                                DEC R1                          ;COUNT THE SEQUENCES
                                BNE CON.N1
                                RETURN                          ;NOW GET NEXT CONTROL CHARACTER

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

                        CON.R:  CALL GETCNT                     ;GET ROUTINE NUMBER
                                CMP R1,#ERRRSZ                  ;CHECK IF DEFINED ROUTINE NUMBER
                                BHI CON.R1
                                ADD R1,R1                       ;DOUBLE COUNT TO GET WORD INDEX
                                CALL @ERRRTB-2(R1)              ;CALL ROUTINE
                                RETURN                          ;NOW GET NEXT CONTROL CHARACTER
                        CON.R1: PNTF ERRME1                     ;REPORT BAD MESSAGE STRING
                                                                        JSR R1,LPNTF
                                                                        .WORD ERRME1
                                                                        .WORD PNT.CT
                                POP R1                          ;FIX THE STACK
                                                                        MOV (SP)+,R1
                                RETURN

                                ;CONTROL CHARACTER WAS AN S. PRINT SPACES.

                        CON.S:  CALL GETCNT                     ;GET COUNT
                        CON.S1: PRINT <#' >                     ;PRINT A SPACE
                                                                        MOVB #' ,R0
                                                                        CALL CPNT
                                DEC R1                          ;COUNT THE SPACES
                                BNE CON.S1
                                RETURN                          ;NOW GET NEXT CONTROL CHARACTER
```

```
                                ;ERROR ROUTINE DISPATCH TABLE
                                
020302  020366                  ERRRTB: .WORD CALR1                     ;CALL ALTERNATE PRINT STRING IN DM MEMORY IMAGE
020304  020414                          .WORD CALR2                     ;PRINT AN SDI DIAGNOSE RESPONSE
020306  020512                          .WORD CALR3                     ;DECIDE WHETHER TO PRINT RBN
020310  020526                          .WORD CALR4                     ;PRINT BASIC LINE WITHOUT UDA ADDRESS
020312  020602                          .WORD CALR5                     ;PRINT BASIC LINE WITH UDA ADDRESS
020314  020660                          .WORD CALR6                     ;CALL ALTERNATE PRINT STRING IN PDP-11 MEMORY
020316  020674                          .WORD CALR7                     ;PRINT  "REPLACE UDA MODULE M7161"
020320  020712                          .WORD CALR8                     ;PRINT  "  UDASA CONTAINS  XXXXXX"
020322  020730                          .WORD CALR9                     ;REPRINT LAST NUMBER
        000011                          ERRRSZ=<.-ERRRTB>/2
                                
020324                          TNAMES:
020324  006257                          .WORD BASN1
020326  006303                          .WORD BASN2
020330  006323                          .WORD BASN3
020332  006343                          .WORD BASN4
                                
                                ;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

020334                          ERRC:   BUILD
020334  042                             .BYTE '''
020335  101                             .BYTE 'A
020336  104                             .BYTE 'D
020337  110                             .BYTE 'H
020340  117                             .BYTE 'O
020341  116                             .BYTE 'N
020342  122                             .BYTE 'R
020343  123                             .BYTE 'S
020344  000                             .BYTE 0                 ;FOLLOW WITH A NULL BYTE
                                        .EVEN

                                ;HERE IS SECOND TABLE

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

020346                          ERRD:   BUILD
020346  020072                          .WORD CON.GU
020350  020112                          .WORD CON.A
020352  020142                          .WORD CON.D
020354  020154                          .WORD CON.H
020356  020166                          .WORD CON.O
020360  020200                          .WORD CON.N
020362  020222                          .WORD CON.R
020364  020260                          .WORD CON.S
```

```
                                ;PRE-PROGRAMMED ROUTINE 1
                                ;CALL ALTERNATE PRINT STRING IN DM PROGRAM IMAGE

020366                          CALR1:  PUSH R2                 ;SAVE CURRENT STRING POINTER
020366  010246                                                                MOV R2,-(SP)
020370  012402                          MOV (R4)+,R2            ;GET NEW STRING POINTER
020372  006302                          ASL R2                  ;DOUBLE FOR WORD COUNT
020374  063702  002214                  ADD DMPROG,R2           ;ADD START OF STRING STORAGE
020400  067702  161610                  ADD @DMPROG,R2          ;ADD SIZE OF MAIN PROGRAM
020404  004737  020022                  CALL OSTRNG             ;OUTPUT USING THIS STRING
020410                                  POP R2                  ;GET OLD POINTER BACK
020410  012602                                                              MOV (SP)+,R2
020412  000207                          RETURN                  ;NOW CONTINUE THE OLD STRING
```

```
                                ;PRE-PROGRAMMED ROUTINE 2
                                ;PRINT AN SDI DIAGNOSE RESPONSE

020414                  CALR2:  PUSH R2                 ;SAVE CURRENT STRING POINTER
020414  010246                                                  MOV R2,-(SP)
020416  012402                  MOV (R4)+,R2            ;GET COUNTS
020420                          PUSH R2                 ;SAVE COUNTS
020420  010246                                                  MOV R2,-(SP)
020422  042702  177400         BIC #177400,R2          ;GET BINARY COUNT
020426  001414                 BEQ 2$                  ;BYPASS BINARY IF COUNT IS ZERO
020430  012700  000020  1$:     MOV #16.,R0             ;RADIX IS HEX
020434  012701  000040         MOV #32.,R1             ;32 BIT NUMBERS
020440  004737  021110         CALL PNTNUS             ;PRINT THE NUMBER
020444                          PRINT #CR               ;GO TO NEW LINE
020444  112700  000015                                          MOVB #CR,R0
020450  004737  022114                                          CALL CPNT
020454  005302                 DEC R2
020456  001364                 BNE 1$
020460                  2$:     POP R1                  ;GET ASCII COUNT
020460  012601                                                  MOV (SP)+,R1
020462  000301                 SWAB R1                 ;GET ASCII COUNT
020464  042701  177400         BIC #177400,R1
020470  001406                 BEQ 3$                  ;BYPASS IS COUNT IS ZERO
020472  004737  020116         CALL CON.A1             ;PRINT THE ASCII
020476                          PRINT #CR               ;GO TO NEW LINE
020476  112700  000015                                          MOVB #CR,R0
020502  004737  022114                                          CALL CPNT
020506                  3$:     POP R2                  ;RESTORE STRING POINTER
020506  012602                                                  MOV (SP)+,R2
020510  000207                 RETURN
```

```
                                ;PRE-PROGRAMMED ROUTINE 3
                                ;DECIDE WHETHER TO PRINT RBN
                                ;
                                ;FOUR PARAMETERS ARE PROVIDED FOR THIS ROUTINE. THE FIRST PARAMETER
                                ;SHOULD BE CHECKED TO SEE IF BIT 7 IS SET:
                                ;   IF SET - TURN INTO A CALL TO ROUTINE 1 (WHICH WILL USE OTHER 3 PARAMETERS)
                                ;   IF CLEAR - SKIP OVER NEXT 3 PARAMETERS AND END ROUTINE

020512  032724  000200          CALR3:  BIT #BIT7,(R4)+         ;CHECK BIT 7 IN FIRST PARAMETER WORD
020516  001323                          BNE CALR1               ;IF SET, TURN INTO A CALR1
020520  062704  000006                  ADD #6,R4               ;ELSE, SKIP OVER NEXT 3 PARAMETERS
020524  000207                          RETURN
```

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

020526                          CALR4:  PNTB BASLN,#BASN0,#BAS,#BAS,#BAS
020526  012746  006436                                                    MOV #BAS,-(SP)
020532  012746  006436                                                    MOV #BAS,-(SP)
020536  012746  006436                                                    MOV #BAS,-(SP)
020542  012746  006240                                                    MOV #BASN0,-(SP)
020546  004137  022276                                                    JSR R1,LPNTB
020552  006437                                                           .WORD BASLN
020554  000010                                                           .WORD PNT.CT
020556  004737  025356                  CALL PNTIME
020562                                  PRINT #CR
020562  112700  000015                                                    MOVB #CR,R0
020566  004737  022114                                                    CALL CPNT
020572  012737  022214  002172          MOV #PX,PTYPE
020600  000207                          RETURN
```

```
                                ;PRE-PROGRAMMED ROUTINE 5
                                ;PRINT BASIC LINE FOR HOST PROGRAM ERROR WITH UDA ADDRESS
                                ;THEN SWITCH TO EXTENDED FORMAT

020602                          CALR5:  PNTB BASLN,#BASN0,#BASL2,(R5),#BAS,#BAS
020602  012746  006436                                                          MOV #BAS,-(SP)
020606  012746  006436                                                          MOV #BAS,-(SP)
020612  011546                                                                  MOV (R5),-(SP)
020614  012746  006402                                                          MOV #BASL2,-(SP)
020620  012746  006240                                                          MOV #BASN0,-(SP)
020624  004137  022276                                                          JSR R1,LPNTB
020630  006437                                                                  .WORD BASLN
020632  000012                                                                  .WORD PNT.CT
020634  004737  025356                  CALL RNTIME
020640                                  PRINT #CR
020640  112700  000015                                                          MOVB #CR,R0
020644  004737  022114                                                          CALL CPNT
020650  012737  022214  002172          MOV #PX,PTYPE
020656  000207                          RETURN
```

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

020660                          CALR6:  PUSH R2                         ;SAVE CURRENT STRING POINTER
020660  010246                                                                  MOV R2,-(SP)
020662  012402                          MOV (R4)+,R2                    ;GET NEW STRING POINTER
020664  004737  020022                 CALL OSTRNG                     ;OUTPUT USING THIS STRING
020670                                  POP R2                          ;GET OLD POINTER BACK
020670  012602                                                                  MOV (SP)+,R2
020672  000207                          RETURN                          ;NOW CONTINUE THE OLD STRING
```

```
      1                                 ;PRE-PROGRAMMED ROUTINE 7
      2                                 ;PRINT "REPLACE UDA MODULE M7161"
      3
      4 020674                          CALR7:  PUSH R2
        020674  010246                                                    MOV R2,-(SP)
      5 020676  012702  013205                  MOV #XFRU,R2
      6 020702  004737  020022                  CALL OSTRNG
      7 020706                                  POP R2
        020706  012602                                                    MOV (SP)+,R2
      8 020710  000207                          RETURN
```

```
                                ;PRE-PROGRAMMED ROUTINE 8
                                ;PRINT  '' UDASA CONTAINS  XXXXXX''
                                
020712                          CALR8:  PUSH R2                         MOV R2,-(SP)
020712  010246
020714  012702  013154                  MOV #XSA,R2
020720  004737  020022                  CALL OSTRNG
020724                                  POP R2                          MOV (SP)+,R2
020724  012602
020726  000207                          RETURN
```

```
                                ;       REPRINT LAST NUMBER
                                ;               R4 -> TABLE
020730  005744                  CALR9:  TST     -(R4)
020732  000207                          RETURN
```

```
                                ;GTDRVT
                                ;
                                ;GET DRIVE TABLE POINTER
                                ;
                                ;INPUTS:
                                ;       R5 - CONTROLLER TABLE ADDRESS
                                ;       R1 - DRIVE NUMBER
                                ;OUTPUTS:
                                ;       R4 - DRIVE TABLE ADDRESS
                                ;       L$LUN - LOADED WITH UNIT NUMBER OF DRIVE
                                ;       Z CLEAR IF DRIVE TABLE NOT FOUND AFTER ERROR PRINTED

020734                          GTDRVT: PUSH R2                                                 MOV R2,-(SP)
020734  010246
020736  010504                          MOV R5,R4                       ;GET CONTROLLER TABLE ADRESS
020740  062704  000020                  ADD #C.DRO,R4                   ;ADD OFFSET TO DRIVE TABLE ADDRESS
020744  012702  000010                  MOV #8.,R2                      ;GET COUNT OF DRIVES
020750  005714                  1$:     TST (R4)                        ;CHECK IF AN ADDRESS HERE
020752  001406                          BEQ 3$
020754  027401  000000                  CMP @(R4),R1                    ;COMPARE DRIVE NUMBERS
020760  001412                          BEQ 10$                         ;BRANCH IF A MATCH
020762  005724                  2$:     TST (R4)+                       ;BUMP ADDRESS
020764  005302                          DEC R2
020.66  001370                          BNE 1$                          ;LOOK AT ALL OF THEM
020770                          3$:     ERRDF 35.,ERR035                ;UNIT NUMBER NOT FOUND
020770  104455                                                                  TRAP    C$ERDF
020772  000043                                                                  .WORD   35
020774  000000                                                                  .WORD   0
020776  013776                                                                  .WORD   ERR035
021000                                  POP R2
021000  012602                                                                  MOV (SP)+,R2
021002  000244                          CLZ                             ;CLEAR Z AS ERROR FLAG
021004  000207                          RETURN
021006  011404                  10$:    MOV (R4),R4                     ;GET ADDRESS OF TABLE
021010  116437  000002  002074          MOVB D.UNIT(R4),L$LUN           ;GET UNIT NUMBER
021016                                  POP R2
021016  012602                                                                  MOV (SP)+,R2
021020  000264                          SEZ                             ;SET Z FLAG
021022  000207                          RETURN
```

```
                                ;GETCNT
                                ;
                                ;GET COUNT IN NEXT CHARACTERS OF STRING POINTED TO BY R2.
                                ;NUMBER WILL BE IN DECIMAL. IF NO NUMBER, RETURN A
                                ;DEFAULT OF 1.
                                ;
                                ;INPUTS:
                                ;       R2 - POINTER TO ASCII STRING
                                ;OUTPUTS:
                                ;       R1 - NUMBER READ OR A ONE
                                ;       R2 - POINTING TO CHARACTER AFTER NUMBER

021024                          GETCNT: PUSH R0
021024  010046                                                          MOV R0,-(SP)
021026  005001                          CLR R1                  ;START WITH ZERO COUNT
021030  121227  000060          GETCNX: CMPB (R2),#'0           ;CHECK IF CHARACTER A DIGIT
021034  103415                          BLO GETCDN              ;BRANCH IF LOWER THAN ZERO
021036  121227  000071                  CMPB (R2),#'9
021042  101012                          BHI GETCDN              ;BRANCH IF HIGHER THAN NINE
021044  006301                          ASL R1                  ;MULTIPLY NUMBER BY 10
021046  010100                          MOV R1,R0               ; SAVE 2N
021050  006301                          ASL R1                  ; COMPUTE 4N
021052  006301                          ASL R1                  ; COMPUTE 8N
021054  060001                          ADD R0,R1               ; 8N + 2N = 10N
021056  112200                          MOVB (R2)+,R0           ;GET DIGIT FROM STING
021060  162700  000060                  SUB #'0,R0              ;GET RID OF ASCII
021064  060001                          ADD R0,R1               ;ADD TO NUMBER
021066  000760                          BR GETCNX               ;GO TO NEXT CHARACTER
021070  005701                  GETCDN: TST R1                  ;CHECK IF NUMBER IS ZERO
021072  001001                          BNE GETCXX              ;IF ZERO, CHANGE
021074  005201                          INC R1                  ; TO DEFAULT OF ONE
021076                          GETCXX: POP R0
021076  012600                                                          MOV (SP)+,R0
021100  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
                                ;
021102  010100                  PNTNUM: MOV R1,R0                       ;SAVE RADIX
021104  004737  021024                  CALL GETCNT                     ;GET COUNT OF BITS
021110                          PNTNUS: PUSH <R2,R3,R5>
021110  010246                                                                  MOV R2,-(SP)
021112  010346                                                                  MOV R3,-(SP)
021114  010546                                                                  MOV R5,-(SP)
021116  012403                          MOV (R4)+,R3                    ;GET ONE PARAMETER WORD
021120  005005                          CLR R5                          ;CLEAR STORAGE FOR OTHER
021122  020127  000020                  CMP R1,#16.                     ;MORE THAN 16 BITS IN NUMBER?
021126  003401                          BLE 1$
021130  012405                          MOV (R4)+,R5                    ;YES, GET SECOND PARAMETER WORD
021132                          1$:     PUSH R4
021132  010446                                                                  MOV R4,-(SP)
021134  010504                          MOV R5,R4                       ;PUT HIGH WORD IN R4
021136  012702  000020                  MOV #16.,R2                     ;COMPUTE BITS NOT WANTED
021142  160102                          SUB R1,R2                       ;BY SUBTRACTING BITS TO USE
021144  002002                          BGE 2$                          ;FROM 16.
021146  062702  000020                  ADD #16.,R2                     ;IF NEGATIVE, ADD 16 FOR FIRST WORD
021152  001414                  2$:     BEQ 6$                          ;IF ZERO, NO BITS NEED BE CLEARED
021154  012705  100000                  MOV #BIT15,R5                   ;START MASK WITH SIGN BIT SET
021160  005302                  3$:     DEC R2                          ;COUNT BITS IN MASK
021162  001402                          BEQ 4$
021164  006205                          ASR R5                          ;SHIFT MORE BITS TO RIGHT
021166  000774                          BR 3$
021170  020127  000020          4$:     CMP R1,#16.                     ;MORE THAN 16 BITS IN NUMBER?
021174  003402                          BLE 5$
021176  040504                          BIC R5,R4                       ;YES, CLEAR IN HIGH WORD
021200  000401                          BR 6$
021202  040503                  5$:     BIC R5,R3                       ;NO, CLEAR IN LOW WORD
021204  004737  021344          6$:     CALL DIVIDE                     ;DIVIDE BY RADIX IN R0
021210                                  PUSH R5                         ;PUSH REMAINDER ON STACK
021210  010546                                                                  MOV R5,-(SP)
021212  005202                          INC R2                          ;COUNT DIGITS ON STACK
021214  005703                          TST R3                          ;CHECK IF QUOTIENT IS ZERO
021216  001372                          BNE 6$
021220  005704                          TST R4
021222  001370                          BNE 6$
```

```
 1 021224  020027  000012                CMP R0,#10.                ;IF RADIX IS DECIMAL
 2 021230  001423                        BEQ 10$                    ; JUST GO PRINT DIGITS ON STACK
 3 021232  010103                        MOV R1,R3                  ;OTHERWISE COMPUTE NUMBER OF LEADING ZEROS
 4 021234  162700  000014                SUB #12.,R0                ;DIVIDEND IS BITS IN NUMBER
 5 021240  003002                        BGT 7$                     ;DIVISOR IS BITS PER DIGIT PRINTED
 6 021242  012700  000003                MOV #3,R0                  ;   (3 OR 4)
 7 021246  004737  021344      7$:       CALL DIVIDE
 8 021252  005705                        TST R5                     ;IF REMAINDER NOT ZERO
 9 021254  001401                        BEQ 8$                     ;INCREMENT QUOTIENT
10 021256  005203                        INC R3
11 021260  160203                8$:     SUB R2,R3                  ;SUBTRACT DIGITS ON STACK
12 021262  001406                        BEQ 10$                    ;NO LEADING ZEROS IF ZERO
13 021264                         9$:     PRINT #'0                  ;PRINT A ZERO
   021264  112700  000060                                                    MOVB #'0,R0
   021270  004737  022114                                                    CALL CPNT
14 021274  005303                        DEC R3
15 021276  001372                        BNE 9$                     ;REPEAT UNTIL COUNT REACHES ZERO
16
17 021300                         10$:    POP R5                     ;GET CHACACTER FROM STACK
   021300  012605                                                           MOV (SP)+,R5
18 021302  062705  000060                ADD #'0,R5                 ;CNVERT TO ASCII DIGIT
19 021306  020527  000071                CMP R5,#'9                 ;IF GREATER THAN A 9
20 021312  003402                        BLE 11$                    ; CONVERT TO A OR HIGHER
21 021314  062705  000007                ADD #<'A-'9-1>,R5          ; FOR HEX DIGIT
22 021320                         11$:    PRINT R5                   ;PRINT THE CHARACTER
   021320  110500                                                           MOVB R5,R0
   021322  004737  022114                                                    CALL CPNT
23 021326  005302                        DEC R2                     ;REPEAT FOR ALL DIGITS
24 021330  001363                        BNE 10$                    ; ON STACK
25 021332                                 POP <R4,R5,R3 R2>
   021332  012604                                                           MOV (SP)+,R4
   021334  012605                                                           MOV (SP)+,R5
   021336  012603                                                           MOV (SP)+,R3
   021340  012602                                                           MOV (SP)+,R2
26 021342  000207                        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
                                ;
021344                          DIVIDE: PUSH R2                                 MOV R2,-(SP)
021344  010246
021346  012702  000040                  MOV #32.,R2             ;SET UP SHIFT COUNT
021352  005005                          CLR R5                  ;START WITH ZERO REMAINDER
021354  006303                  1$:     ASL R3                  ;SHIFT LEFT INTO R5
021356  006104                          ROL R4
021360  006105                          ROL R5
021362  020005                          CMP R0,R5               ;WILL DIVISOR GO INTO REMAINDER
021364  101002                          BHI 2$                  ;ONLY SUBTRACT IF IT WILL
021366  160005                          SUB R0,R5               ;SUBTRACT DIVISOR
021370  005203                          INC R3                  ;PUT A ONE INTO QUOTIENT
021372  005302                  2$:     DEC R2                  ;COUNT THE SHIFTS
021374  001367                          BNE 1$
021376                                  POP R2                                  MOV (SP)+,R2
021376  012602
021400  000207                          RETURN
```

```
                                ;BUILD DEFAULT 28-BIT NUMBER
                                ;
                                ;INPUT:
                                ;       R4 - POINTER TO 2 WORD DEFAULT NUMBER
                                ;OUTPUT:
                                ;       TEMP - ASCIZ STRING REPRESENTING DEFAULT NUMBER
                                ;
021402                          BLD28:  PUSH <R0,R1,R3,R4,R5>
021402  010046                                                          MOV R0,-(SP)
021404  010146                                                          MOV R1,-(SP)
021406  010346                                                          MOV R3,-(SP)
021410  010446                                                          MOV R4,-(SP)
021412  010546                                                          MOV R5,-(SP)
021414  011403                          MOV (R4),R3             ;GET NUMBER
021416  016404  000002                  MOV 2(R4),R4
021422  012700  000012                  MOV #10.,R0             ;DIVISOR IS 10.
021426  005001                          CLR R1                  ;CLEAR CHARACTER COUNT
021430  004737  021344          1$:     CALL DIVIDE
021434  062705  000060                  ADD #'0,R5              ;CONVERT REMAINDER TO ASCII CHARACTER
021440                          PUSH R5                         ;STORE ON STACK
021440  010546                                                          MOV R5,-(SP)
021442  005201                          INC R1                  ;COUNT THE CHARACTER
021444  010305                          MOV R3,R5               ;REPEAT UNTIL QUOTIENT IS ZERO
021446  050405                          BIS R4,R5
021450  001367                          BNE 1$
021452  012700  002262                  MOV #TEMP,R0            ;GET POINTER TO STRING
021456                          2$:     POP R5                  ;PUT CHARACTERS INTO STRING
021456  012605                                                          MOV (SP)+,R5
021460  110520                          MOVB R5,(R0)+
021462  005301                          DEC R1
021464  001374                          BNE 2$
021466  105020                          CLRB (R0)+                      ;END WITH NULL
021470                          POP <R5,R4,R3,R1,R0>
021470  012605                                                          MOV (SP)+,R5
021472  012604                                                          MOV (SP)+,R4
021474  012603                                                          MOV (SP)+,R3
021476  012601                                                          MOV (SP)+,R1
021500  012600                                                          MOV (SP)+,R0
021502  000207                  RETURN
```

```
                                ;CONVERT ASCIZ STRING TO 28-BIT NUMBER
                                ;
                                ;INPUTS:
                                ;       TEMP - ASCIZ STRING UP TO 9 CHARACTERS LONK
                                ;       R4 - ADDRESS OF TWO WORD STORAGE
                                ;OUTPUTS:
                                ;       IF STRING IS VALID NUMBER
                                ;         TWO WORDS AT R4 LOADED WITH NUMBER
                                ;         R4 POINTING TO WORD AFTER STORAGE
                                ;         CARRY CLEAR
                                ;       IF STRING INVALID
                                ;         ERROR MESSAGE PRINTED
                                ;         CARRY SET
                                ;
021504                          CNV28:  PUSH <R0,R1,R2,R3>
021504  010046                                                          MOV R0,-(SP)
021506  010146                                                          MOV R1,-(SP)
021510  010246                                                          MOV R2,-(SP)
021512  010346                                                          MOV R3,-(SP)
021514  005000                          CLR R0                  ;START WITH ZEROS
021516  005001                          CLR R1
021520  012702  002262                 MOV #TEMP,R2            ;GET ADDRESS OF STRING
021524  112203                  1$:     MOVB (R2)+,R3           ;GET A DIGIT FROM STRING
021526  001442                          BEQ 3$                  ;IF NULL CHARACTER, ALL DONE
021530  162703  000060                 SUB #'0,R3              ;SUBTRACT CHARACTER 0
021534  100431                          BMI 2$
021536  022703  000011                 CMP #9.,R3
021542  103426                          BLO 2$
021544  006300                          ASL R0                  ;MULTIPLY BY 2
021546  006101                          ROL R1
021550                                  PUSH <R1,R0>            ;SAVE N X 2
021550  010146                                                          MOV R1,-(SP)
021552  010046                                                          MOV R0,-(SP)
021554  006300                          ASL R0                  ;TIMES 2 AGAIN FOR N X 4
021556  006101                          ROL R1
021560  006300                          ASL R0                  ;TIMES 2 AGAIN FOR N X 8
021562  006101                          ROL R1
021564  062600                          ADD (SP)+,R0            ;ADD N X 2 TO GIVE N X 10
021566  005501                          ADC R1
021570  062601                          ADD (SP)+,R1
021572  060300                          ADD R3,R0               ;ADD CURRENT DIGIT
021574  005501                          ADC R1
021576  032701  170000                 BIT #170000,R1          ;CHECK SIZE OF NUMBER
021602  001750                          BEQ 1$                  ;MUST NOT BE MORE THAN 28 BITS
```

GLOBAL SUBROUTINES SECTION

```
     1 021604                           PNTF INP28A             ;PRINT PROPER RANGE
       021604  004137  022266                                                 JSR R1,LPNTF
       021610  005155                                                        .WORD INP28A
       021612  000000                                                        .WORD PNT.CT
     2 021614  000261                   SEC                     ;SET CARRY TO ASK AGAIN
     3 021616  000411                   BR 4$
     4
     5 021620                     2$:   PNTF INP28B             ;PRINT ILLEGAL CHARACTER
       021620  004137  022266                                                 JSR R1,LPNTF
       021624  005216                                                        .WORD INP28B
       021626  000000                                                        .WORD PNT.CT
     6 021630  000261                   SEC
     7 021632  000403                   BR 4$
     8
     9 021634  010024                3$:   MOV R0,(R4)+            ;MOVE NUMBER TO STORAGE AREA
    10 021636  010124                      MOV R1,(R4)+
    11 021640  000241                      CLC                     ;CLEAR CARRY TO INDICATE ALL IS WELL
    12 021642                        4$:   POP <R3,R2,R1,R0>
       021642  012603                                                        MOV (SP)+,R3
       021644  012602                                                        MOV (SP)+,R2
       021646  012601                                                        MOV (SP)+,R1
       021650  012600                                                        MOV (SP)+,R0
    13 021652  000207                      RETURN
```

GLOBAL SUBROUTINES SECTION

```
                                ;PRINT HEX NUMBERS WITH LEADING SPACE
                                
021654                          T2PNTW: PRINT <#' >             ;PRINT A SPACE
021654  112700  000040                                                  MOVB #' ,R0
021660  004737  022114                                                  CALL CPNT
021664                                  PUSH R1                                 
021664  010146                                                          MOV R1,-(SP)
021666  000301                          SWAB R1
021670  004737  021714                  CALL T2PNT              ;PRINT HIGH TWO DIGITS
021674                                  POP R1
021674  012601                                                          MOV (SP)+,R1
021676  004737  021714                  CALL T2PNT              ;PRINT LOW TWO DIGITS
021702  000207                          RETURN
                                
021704                          T2PNTB: PRINT <#' >             ;PRINT A SPACE
021704  112700  000040                                                  MOVB #' ,R0
021710  004737  022114                                                  CALL CPNT
                                
                                ;PRINT TWO HEX DIGITS FROM NUMBER IN R1
                                
021714                          T2PNT:  PUSH R1                 ;SAVE NUMBER
021714  010146                                                          MOV R1,-(SP)
021716  006001                          ROR R1                  ;SHIFT TO GET HIGH DIGIT
021720  006001                          ROR R1
021722  006001                          ROR R1
021724  006001                          ROR R1
021726  004737  021734                  CALL T2PNTO             ;PRINT TWO DIGITS
021732                                  POP R1                  ;GET LOW DIGIT AGAIN
021732  012601                                                          MOV (SP)+,R1
022734  042701  177760         T2PNTO: BIC #^C17,R1            ;CLEAR OTHER BITS
022740  062701  000060                 ADD #'0,R1              ;CONVERT TO ASCII CHARACTER
022744  020127  000071                 CMP R1,#'9              ;IF GREATER THAN A 9
022750  003402                         BLE T2PNTD              ;  CONVERT TO A OR HIGHER
022752  062701  000007                 ADD #<'A-'9-1>,R1       ;  FOR HEX DIGIT
022756                          T2PNTD: PRINT R1                ;PRINT THE DIGIT
022756  110100                                                          MOVB R1,R0
022760  004737  022114                                                  CALL CPNT
022764  000207                          RETURN
```

GLOBAL SUBROUTINES SECTION

```
                                        ;T2GNUM
                                        ;
                                        ;GET A HEX DIGIT FROM AN ASCII INPUT STRING
                                        ;
                                        ;INPUTS:
                                        ;       R1 - STRING POINTER
                                        ;OUTPUTS:
                                        ;       R4 - NUMBER
                                        ;       R1 - UPDATED STRING TO CHARACTER AFTER NUMBER
                                        ;       R0 - COUNT OF DIGITS (0 IF END OF LINE FOUND)

021766  005000                  T2GNUM: CLR R0                          ;CLEAR DIGIT COUNT
021770  105711                          TSTB (R1)                       ;CHECK IF END OF LINE
021772  001442                          BEQ T2GNX                       ;REPORT NULL CHARACTER FOUND
021774  121127  000040                  CMPB (R1),#'                    ;CHECK IF A SPACE
022000  001002                          BNE T2GND1                      ;IF SO, IGNORE IT
022002  005201                          INC R1
022004  000770                          BR T2GNUM
022006  005004                  T2GND1: CLR R4                          ;CLEAR NUMBER STORAGE
022010                          T2GND2: PUSH R2                         ;SAVE REGISTER
022010  010246                                                                  MOV R2,-(SP)
022012  112102                          MOVB (R1)+,R2                   ;GET CHARACTER
022014  162702  000060                  SUB #'0,R2                      ;CONVERT TO HEX DIGIT
022020  100431                          BMI T2GNE
022022  020227  000011                  CMP R2,#9.
022026  003410                          BLE T2GND3
022030  020227  000021                  CMP R2,#<'A-'0>
022034  103423                          BLO T2GNE
022036  020227  000026                  CMP R2,#<'F-'0>
022042  101020                          BHI T2GNE
022044  162702  000007                  SUB #<'A-'9-1>,R2
022050  006304                  T2GND3: ASL R4
022052  006304                          ASL R4
022054  006304                          ASL R4
022056  006304                          ASL R4
022060  050204                          BIS R2,R4
022062  005200                          INC R0
022064                                  POP R2
022064  012602                                                                  MOV (SP)+,R2
022066  105711                          TSTB (R1)
022070  001403                          BEQ T2GNX
022072  121127  000040                  CMPB (R1),#'
022076  001344                          BNE T2GND2
022100  005700                  T2GNX:  TST R0
022102  000207                          RETURN

022104                          T2GNE:  POP R2                          ;CLEAN UP THE STACK
022104  012602                                                                  MOV (SP)+,R2
022106                                  POP R0
022106  012600                                                                  MOV (SP)+,R0
022110  000137  016440                  JMP T2CMDE
```

```
                                        ;PRINT ONE CHARACTER
                                        ;
                                        ;CALL WITH MACRO PRINT
                                        ;
022114  110037  002174          CPNT:   MOVB R0,ERRCHR
022120                                  PUSH R1
022120  010146                                                  MOV R1,-(SP)
022122  012701  003640                  MOV #ERRONE,R1
022126  120027  000015                  CMPB R0,#CR
022132  001002                          BNE 1$
022134  012701  003643                  MOV #ERRNL,R1
022140  000177  160026          1$:     JMP @PTYPE
022144                          PF:     PRINTF R1,#ERRCHR
022144  012746  002174                                          MOV     #ERRCHR,-(SP)
022150  010146                                                  MOV     R1,-(SP)
022152  012746  000002                                          MOV     #2,-(SP)
022156  010600                                                  MOV     SP,R0
022160  104417                                                  TRAP    C$PNTF
022162  062706  000006                                          ADD     #6,SP
022166  000435                          BR CPNTX
022170                          PB:     PRINTB R1,#ERRCHR
022170  012746  002174                                          MOV     #ERRCHR,-(SP)
022174  010146                                                  MOV     R1,-(SP)
022176  012746  000002                                          MOV     #2,-(SP)
022202  010600                                                  MOV     SP,R0
022204  104414                                                  TRAP    C$PNTB
022206  062706  000006                                          ADD     #6,SP
022212  000423                          BR CPNTX
022214                          PX:     PRINTX R1,#ERRCHR
022214  012746  002174                                          MOV     #ERRCHR,-(SP)
022220  010146                                                  MOV     R1,-(SP)
022222  012746  000002                                          MOV     #2,-(SP)
022226  010600                                                  MOV     SP,R0
022230  104415                                                  TRAP    C$PNTX
022232  062706  000006                                          ADD     #6,SP
022236  000411                          BR CPNTX
022240                          PS:     PRINTS R1,#ERRCHR
022240  012746  002174                                          MOV     #ERRCHR,-(SP)
022244  010146                                                  MOV     R1,-(SP)
022246  012746  000002                                          MOV     #2,-(SP)
022252  010600                                                  MOV     SP,R0
022254  104416                                                  TRAP    C$PNTS
022256  062706  000006                                          ADD     #6,SP
022262                          CPNTX:  POP R1
022262  012601                                                  MOV (SP)+,R1
022264  000207                          RETURN
```

```
                                        ;PRINT FORMATTED MESSAGE
                                        ;
                                        ;CALL WITH MACRO PNT, PNTF, PNTB, PNTX, OR PNTS
                                        
022266  012737  022144  002172 LPNTF:  MOV #PF,PTYPE
022274  000413                         BR LPNT
022276  012737  022170  002172 LPNTB:  MOV #PB,PTYPE
022304  000407                         BR LPNT
022306  012737  022214  002172 LPNTX:  MOV #PX,PTYPE
022314  000403                         BR LPNT
022316  012737  022240  002172 LPNTS:  MOV #PS,PTYPE
022324                         LPNT:   PUSH <R2,R3,R4,R5>
022324  010246                                                          MOV R2,-(SP)
022326  010346                                                          MOV R3,-(SP)
022330  010446                                                          MOV R4,-(SP)
022332  010546                                                          MOV R5,-(SP)
022334  012102                         MOV (R1)+,R2                     ;GET ADDRESS OF STRING
022336  010604                         MOV SP,R4                        ;COMPUTE ADDRESS OF ARGUMENTS
022340  062704  000012                 ADD #10.,R4                      ;  WHICH ARE NOW ON STACK (IF ANY)
022344                                 PUSH R1                          ;SAVE RETURN ADDRESS
022344  010146                                                          MOV R1,-(SP)
022346  004737  020022                 CALL OSTRNG                      ;PRINT THE FORMATTED MESSAGE
022352                                 POP <R0,R5,R4,R3,R2,R1>          ;RESTORE ALL REGISTERS
022352  012600                                                          MOV (SP)+,R0
022354  012605                                                          MOV (SP)+,R5
022356  012604                                                          MOV (SP)+,R4
022360  012603                                                          MOV (SP)+,R3
022362  012602                                                          MOV (SP)+,R2
022364  012601                                                          MOV (SP)+,R1
022366  062006                         ADD (R0)+,SP                     ;ADJUST STACK POINTER OVER ARGUMENTS
022370  000110                         JMP @R0                          ;RETURN
```

```
                                ;PNTERR
                                ;
                                ;PRINT ERROR MESSAGE FROM DM PROGRAM REQUEST 11 OR 12.
                                ;
                                ;INPUTS:
                                ;       R5 - CONTROLLER TABLE ADDRESS
                                ;       R4 - MESSAGE DATA ADDRESS
                                ;       R3 - COMMAND DATA ADDRESS
                                ;OUTPUTS:
                                ;       ERROR MESSAGE PRINTED
                                ;       BIT 15 SET IN COMMAND DATA IF DRIVE HAS BEEN DROPPED

022372                          PNTERR: PUSH <R0,R1,R2>
022372  010046                                                                  MOV R0,-(SP)
022374  010146                                                                  MOV R1,-(SP)
022376  010246                                                                  MOV R2,-(SP)
022400  005764  000004                  TST 4(R4)                      ;GET DRIVE NUMBER
022404  002004                          BGE 1$                         ;CHECK IF BIT 15 SET
022406  116537  000002  002074          MOVB C.UNIT(R5),L$LUN          ;IF SO, GET UNIT FROM CONTROLLER TABLE
022414  000416                          BR 2$
022416                          1$:     PUSH R4                        ;SAVE DATA ADDRESS
022416  010446                                                                  MOV R4,-(SP)
022420  016401  000004                  MOV 4(R4),R1                   ;GET DRIVE NUMBER
022424  004737  020734                  CALL GTDRVT                    ;GET DRIVE TABLE ADDRESS
022430  001036                          BNE     5$                     ;IF UNIT DROPPED, EXIT
022432  005764  000002                  TST D.UNIT(R4)                 ;SEE IF UNIT HAS BEEN DROPPED FROM TESTING
022436  100004                          BPL 3$                         ;  PROCEED IF STILL TO BE TESTED
022440  052713  100000                  BIS #BIT15,(R3)                ;TELL DM PROGRAM TO STOP TESTING THIS UNIT
022444                                  POP R4
022444  012604                                                                  MOV (SP)+,R4
022446  000423                          BR 4$
022450                          3$:     POP R4                         ;RESTORE DATA ADDRESS
022450  012604                                                                  MOV (SP)+,R4
022452  012702  002162          2$:     MOV #ERRTYP,R2                 ;GET POINTER TO ERROR TABLE
022456  016412  000002                  MOV 2(R4),(R2)                 ;GET ERROR TYPE
022462  006112                          ROL (R2)
022464  006112                          ROL (R2)
022466  006112                          ROL (R2)
022470  042722  177774                  BIC #^C3,(R2)+                 ;CLEAR LOW 2 BITS
022474  016412  000002                  MOV 2(R4),(R2)
022500  042722  140000                  BIC #140000,(R2)+              ;MASK LOW 14 BITS
022504  005022                          CLR (R2)+                      ;CLEAR MESSAGE POINTER
022506  012712  014246                  MOV #ERRRTN,(R2)               ;GET ROUTINE NUMBER
022512                                  ERROR                          ;PRINT THE ERROR MESSAGE
022512  104460                                                                  TRAP    C$ERROR
022514  000241                          CLC                            ;DRIVE HAS NOT BEEN DROPPED
022516                          4$:     POP <R2,R1,R0>
022516  012602                                                                  MOV (SP)+,R2
022520  012601                                                                  MOV (SP)+,R1
022522  012600                                                                  MOV (SP)+,R0
022524  000207                          RETURN
022526  000261                  5$:     SEC                            ;DRIVE HAS BEEN DROPPED
022530  000772                          BR      4$
```

```
                                ;LOADDM
                                ;
                                ;LOAD AND START A DM PROGRAM INTO A CONTROLLER
                                ;
                                ;INPUTS:
                                ;       R5 - CONTROLLER TABLE ADDRESS
                                ;IMPLICIT INPUTS:
                                ;       DMPROG - POINTER TO START OF DM PROGRAM IN MEMORY
                                ;OUTPUTS:
                                ;       IF LOAD SUCCEEDS - Z CLEAR
                                ;                          CONTROLLER TAPE MARKED LOADED
                                ;       IF ERROR - Z SET
                                ;
022532                          LOADDM:
022532  016504  000004                  MOV C.VEC(R5),R4                ;GET VECTOR OF UDA
022536                                  AND CT.VEC,R4
022536  042704  177000                                                  BIC #^C<CT.VEC>,R4
022542  010501                          MOV R5,R1                       ;GET INTERRUPT SERVICE LINK
022544  062701  000010                  ADD #C.JSR,R1
022550                                  SETVEC R4,R1,#PRIO7             ;SET UP INTERRUPT VECTOR
022550  012746  000340                                                  MOV     #PRIO7,-(SP)
022554  010146                                                          MOV     R1,-(SP)
022556  010446                                                          MOV     R4,-(SP)
022560  012746  000003                                                  MOV     #3,-(SP)
022564  104437                                                          TRAP    C$SVEC
022566  062706  000010                                                  ADD     #10,SP
                                ;INITIALIZE UDA WITH SMALLEST
022572  006204                          ASR R4                          ;POSITION VECTOR FOR UDA
022574  006204                          ASR R4
022576  004737  023666                  CALL UDAINT                     ; RING BUFFER AND INTERRUPTS ENABLED
022602  001560                          BEQ LOADER                      ;BRANCH IF AN ERROR
022604  004737  014444                  CALL HCOMM                      ;ALLOCATE SPACE FOR HOST COMM AREA
```

```
    2 022610  023727  002230  000001          CMP TNUM,#1                     ;IF TEST NUMBER 1
    3 022616  001440                          BEQ LOADT1                      ;  DO SPECIAL LOAD
    5 022620  017701  157370                  MOV @DMPROG,R1                  ;GET SIZE OF PROGRAM
    6 022624  012700  000002          LOADB:  MOV #OP.ESP,R0                  ;BUILD EXECUTE SUPPLIED PROGRAM COMMAND PACKET
    7 022630  004737  023150                  CALL BLDCMD
    8 022634  013764  002214  000124          MOV DMPROG,HC.CPK+P.UADR(R4)    ;LOAD MAIN PROGRAM ADDRESS
    9 022642  010164  000120                  MOV R1,HC.CPK+P.BCNT(R4)        ;  AND SIZE
   10 022646  013764  002214  000140          MOV DMPROG,HC.CPK+P.OVRL(R4)    ;LOAD OVERLAY ADDRESS
   11 022654  067764  157334  000140          ADD @DMPROG,HC.CPK+P.OVRL(R4)
   15 022662  004737  023234                  CALL SNDCMD                     ;SEND COMMAND TO UDA
   16 022666  004737  023374                  CALL WAITMS                     ;WAIT FOR MESSAGE RESPONSE
   17 022672  032764  000037  000032          BIT #ST.MSK,HC.MPK+P.STS(R4)    ;CHECK FOR ERRORS
   18 022700  001115                          BNE LOADE1
   19 022702  042765  000024  000014          BIC #CT.CMD+CT.REQ,C.FLG(R5)    ;CLEAR COMMAND OUTSTANDING FLAG
   20 022710  052765  000002  000014          BIS #CT.RN,C.FLG(R5)            ;SET DM PROGRAM RUNNING FLAG
   21 022716  000207                          RETURN
```

```
                                ;LOAD DM PROGRAM FROM MEMORY SPACE TESTED DURING
                                ;INITIALIZATION IN TEST 1
                                
022720  017704  157270  LOADT1: MOV @DMPROG,R4           ;GET SIZE OF DM PROGRAM IN BYTES
022724  162704  000040          SUB #DMMAIN,R4
022730  013700  002214          MOV DMPROG,R0           ;GET ADDRESS OF DM PROGRAM
022734  062700  000040          ADD #DMMAIN,R0
022740  005001                  CLR R1                  ;START WITH OFFSET OF ZERO
                                
022742  012703  000214  LT1L1:  MOV #<HC.BSZ*2>,R3     ;GET SIZE OF BOTH BUFFERS
022746  020403                  CMP R4,R3               ;IF FEWER BYTES REMAINING IN PROGRAM
022750  103001                  BHIS LT11
022752  010403                  MOV R4,R3               ;USE ACTUAL BYTE COUNT
022754          LT11:   PUSH R3                         ;SAVE THE BYTE COUNT
022754  010346                                                  MOV R3,-(SP)
022756  013702  002176          MOV FFREE,R2            ;GET ADDRESS OF BUFFER
022762  162702  000214          SUB #<HC.BSZ*2>,R2
022766                          PUSH R2                 ;SAVE BUFFER ADDRESS
022766  010246                                                  MOV R2,-(SP)
022770  012022          LT1L2:  MOV (R0)+,(R2)+         ;MOVE DATA TO BUFFER
022772  162703  000002          SUB #2,R3               ;COUNT BYTES
022776  001374                  BNE LT1L2
023000                          POP R2                  ;RESTORE BUFFER ADDRESS
023000  012602                                                  MOV (SP)+,R2
023002                          POP R3                  ;RESTORE BYTE COUNT
023002  012603                                                  MOV (SP)+,R3
023004  004737  023032          CALL LOAD               ;LOAD INTO UDA
023010  001455                  BEQ LOADER              ;IF ERROR, GET OUT NOW
023012  006203                  ASR R3                  ;CONVERT BYTES TO WORDS
023014  060301                  ADD R3,R1               ;INCREASE OFFSET FOR NEXT BUFFER
023016  006303                  ASL R3                  ;CONVERT WORDS TO BYTES
023020  160304                  SUB R3,R4               ;REDUCE REMAINING BYTE COUNT
023022  001347                  BNE LT1L1               ;GET NEXT BUFFER
023024  012701  000040          MOV #DMMAIN,R1          ;GET A BYTE COUNT OF HEADER ONLY
023030  000675                  BR LOADB                ;NOW START
```

```
                                ;LOAD
                                ;
                                ;ISSUE DOWNLINE LOAD COMMAND TO UDA. CHECK THAT LOAD
                                ;HAPPENS WITHOUT ERROR.
                                ;
                                ;INPUTS:
                                ;       R1 - OFFSET FOR DM PROGRAM
                                ;       R2 - ADDRESS OF BUFFER CONTAINING PROGRAM
                                ;       R3 - SIZE OF BUFFER IN BYTES
                                ;       R5 - CONTROLLER TABLE ADDRESS
                                ;OUTPUTS:
                                ;       Z CLEAR IF NO ERROR
                                ;       Z SET IF ERROR AND ERROR REPORTED
                                
023032                          LOAD:   PUSH <R0,R3,R4>
023032  010046                                                                 MOV R0,-(SP)
023034  010346                                                                 MOV R3,-(SP)
023036  010446                                                                 MOV R4,-(SP)
023040  012700  000031                 MOV #OP.MWR,R0          ;GET DOWNLINE LOAD COMMAND
023044  004737  023150                 CALL BLDCMD             ;BUILD COMMAND PACKET
023050  010264  000124                 MOV R2,HC.CPK+P.UADR(R4) ;STUFF IN BUFFER ADDRESS
023054  010364  000120                 MOV R3,HC.CPK+P.BCNT(R4) ;STUFF IN BYTE COUNT
023060  010164  000144                 MOV R1,HC.CPK+P.RGOF(R4) ;STUFF IN OFFSET
023064  012764  000001  000140         MOV #1,HC.CPK+P.RGID(R4) ;STUFF IN REGION ID 1
023072  004737  023234                 CALL SNDCMD             ;SEND COMMAND TO UDA
023076  004737  023374                 CALL WAITMS             ;WAIT FOR MESSAGE RESPONSE
023102  001420                         BEQ     LOADER          ; IF FAILED, EXIT
023104  032764  000037  000032         BIT #ST.MSK,HC.MPK+P.STS(R4) ;LOOK FOR ANY ERROR
023112  001010                         BNE LOADE1
023114  042765  000004  000014         BIC #CT.CMD,C.FLG(R5)   ;CLEAR COMMAND ISSUED
023122                          LOADER: POP <R4,R3,R0>
023122  012604                                                                 MOV (SP)+,R4
023124  012603                                                                 MOV (SP)+,R3
023126  012600                                                                 MOV (SP)+,R0
023130  000244                         CLZ                     ;CLEAR Z TO INDICATE NO ERROR
023132  000207                         RETURN
```

```
      1                                 ;UDA FAILED TO DOWNLINE LOAD DM PROGRAM
      2
      3 023134                          LOADE1: ERRDF 34,,ERR034
        023134  104455                                                          TRAP    C$ERDF
        023136  000042                                                          .WORD   34
        023140  000000                                                          .WORD   0
        023142  013770                                                          .WORD   ERR034
      4 023144  000264                  LOADER: SEZ                     ;SET Z TO INDICATE ERROR OCCURRED
      5 023146  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
                                        ;
023150                                  BLDCMD: PUSH <R1,R0>
023150  010146                                                                                    MOV R1,-(SP)
023152  010046                                                                                    MOV R0,-(SP)
023154  016504  000016                        MOV C.RING(R5),R4       ;GET ADDRESS OF HOST COMM AREA
023160  010400                                MOV R4,R0               ;COPY TO R0
023162  062700  000100                        ADD #HC.CEV,R0          ;COMPUTE ADDRESS OF COMMAND ENVELOPE
023166  012720  000060                        MOV #HC.PSZ,(R0)+       ;LOAD PACKET LENGTH
023172  012701  001000                        MOV #DUP,R1             ;LOAD DIAG CIRCUIT IDENTIFIER
023176  022716  000031                        CMP #OP.MWR,(SP)        ;IF CODE IS MAINTENANCE WRITE
023202  001002                                BNE BLDC0               ;  GET OTHER CIRCUIT IDENTIFIER
023204  012701  177777                        MOV #DIAG,R1
023210  010120                          BLDC0:  MOV R1,(R0)+            ;PUT IDENTIFIER INTO PACKET
023212  012701  000030                        MOV #<HC.PSZ>/2,R1      ;GET WORDS TO CLEAR
023216  005020                          BLDC1:  CLR (R0)+               ;CLEAR PACKET
023220  005301                                DEC R1
023222  001375                                BNE BLDC1
023224                                  POP HC.CPK+P.OPCD(R4)           ;PUT OPCODE IN PACKET
023224  012664  000114                                                                            MOV (SP)+,HC.CPK+P.OPCD(R4)
023230                                  POP R1                          ;RESTORE R1
023230  012601                                                                                    MOV (SP)+,R1
023232  000207                          RETURN
```

```
                                        ;SNDCMD
                                        ;
                                        ;SEND A COMMAND TO THE UDA.
                                        ;CLEAR THE RESPONSE PACKET. 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


023234                                  SNDCMD: PUSH <R0,R1>
023234  010046                                                                        MOV R0,-(SP)
023236  010146                                                                        MOV R1,-(SP)
023240  016504  000016                          MOV C.RING(R5),R4               ;LOAD R4 WITH HOST COMM AREA ADDRESS
023244  005265  000044                          INC C.REF(R5)                   ;INCREMENT CMD REFERENCE NUMBER
023250  016564  000044  000104                  MOV C.REF(R5),HC.CPK+P.CRF(R4)  ;PUT IN PACKET
023256  012700  000014                          MOV #HC.MEV,R0                  ;POINT TO MESSAGE ENVELOPE
023262  060400                                  ADD R4,R0
023264  012701  000032                          MOV #<HC.PSZ+HC.ESZ>/2,R1       ;SIZE OF MESSAGE PACKET
023270  005020                          SNDC1:  CLR (R0)+                       ;CLEAR ENTIRE MESSAGE PACKET
023272  005301                                  DEC R1
023274  001375                                  BNE SNDC1
023276  012764  140000  000006                  MOV #RG.OWN+RG.FLG,HC.MCT(R4)   ;MARK MESSAGE PACKET AVAILABLE
023304  012764  100000  000012                  MOV #RG.OWN,HC.CCT(R4)          ;MARK COMMAND TO UDA
023312  005775  000000                          TST @(R5)                       ;TELL UDA COMMAND IS THERE
023316  052765  000004  000014                  BIS #CT.CMD,C.FLG(R5)           ;MARK COMMAND ISSUED
023324                                          POP     <R1,R0>
023324  012601                                                                      MOV (SP)+,R1
023326  012600                                                                      MOV (SP)+,R0
023330  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

023332                                  CLRBUF: PUSH <R0,R1>
023332  010046                                                                    MOV R0,-(SP)
023334  010146                                                                    MOV R1,-(SP)
023336  060400                                  ADD R4,R0                       ;ADD START OF HOST COMM AREA TO OFFSET
023340  010064  000124                          MOV R0,HC.CPK+P.UADR(R4)        ;PUT BUFFER ADDRESS IN COMMAND PACKET
023344  012764  000106  000120                  MOV #HC.BSZ,HC.CPK+P.BCNT(R4)   ;PUT SIZE OF BUFFER IN COMMAND PACKET
023352  010004                                  MOV R0,R4                       ;PUT BUFFER ADDRESS IN R4
023354  012701  000043                          MOV #HC.BSZ/2,R1                ;GET SIZE OF BUFFER IN WORDS
023360  005020                          CLRBFL: CLR (R0)+                       ;CLEAR ALL THE WORDS
023362  005301                                  DEC R1
023364  001375                                  BNE CLRBFL
023366                                          POP <R1,R0>
023366  012601                                                                    MOV (SP)+,R1
023370  012600                                                                    MOV (SP)+,R0
023372  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

023374                                  WAITMS: PUSH <R0,R1>
023374  010046                                                                  MOV R0,-(SP)
023376  010146                                                                  MOV R1,-(SP)
023400  012700  000036                         MOV #30.,R0                    ;SET TIME OUT VALUE OF 30 SECONDS
023404  010501                                 MOV R5,R1                      ;POINT TO TIME OUT COUNTER
023406  062701  000040                         ADD #C.TO,R1
023412  004737  023604                         CALL SETTO
023416  011500                          1$:    MOV (R5),R0                    ;GET ADDRESS OF UDAIP REGISTER
023420  032765  000010  000014                 BIT #CT.MSG,C.FLG(R5)          ;LOOK IF INTERRUPT OCCURRED
023426  001030                                 BNE 3$                         ;BRANCH IF SO
023430  016001  000002                         MOV 2(R0),R1                   ;LOOK AT UDASA REGISTER
023434  001034                                 BNE 4$                         ;BRANCH IF ERROR CODE PRESENT
023436                                         BREAK
023436  104422                                                                  TRAP    C$BRK
023440  005737  002354                         TST KW.CSR                     ;SEE IF A CLOCK ON SYSTEM
023444  001764                                 BEQ 1$
023446  023765  002366  000042                 CMP KW.EL+2,C.TOH(R5)          ;CHECK IF TIMEOUT HAS HAPPENED
023454  101005                                 BHI 2$
023456  001357                                 BNE 1$
023460  023765  002364  000040                 CMP KW.EL,C.TO(R5)
023466  103753                                 BLO 1$
023470                                  2$:    ERRDF 36,,ERR036
023470  104455                                                                  TRAP    C$ERDF
023472  000044                                                                  .WORD   36
023474  000000                                                                  .WORD   0
023476  014014                                                                  .WORD   ERR036
023500                                         POP <R1,R0>
023500  012601                                                                  MOV (SP)+,R1
023502  012600                                                                  MOV (SP)+,R0
023504  000264                                 SEZ
023506  000207                                 RETURN
```

```
      1 023510  042765  000010  000014  3$:     BIC #CT.MSG,C.FLG(R5)          ;CLEAR MESSAGE RECEIVED FLAG
      2 023516                                  POP <R1,R0>
        023516  012601                                                          MOV (SP)+,R1
        023520  012600                                                          MOV (SP)+,R0
      3 023522  000244                          CLZ                           ;GIVE NO ERROR RETURN
      4 023524  000207                          RETURN
      5 023526                            4$:   ERRDF 37,,ERR037
        023526  104455                                                          TRAP    C$ERDF
        023530  000045                                                          .WORD   37
        023532  000000                                                          .WORD   0
        023534  014026                                                          .WORD   ERR037
      6 023536                                  POP <R1,R0>
        023536  012601                                                          MOV (SP)+,R1
        023540  012600                                                          MOV (SP)+,R0
      7 023542  000264                          SEZ
      8 023544  000207                          RETURN
```

```
                                        ;APRINT
                                        ;
                                        ;CONVERT AN 18 BIT ADDRESS STORED IN TWO WORDS INTO A FORMAT
                                        ;THAT WILL ALLOW PRINTING OF THE 18 BIT NUMBER.
                                        ;
                                        ;INPUTS:
                                        ;       R0 - ADDRESS OF T   WORD BLOCK CONTAINING ADDRESS.
                                        ;                FIRST WORL CONTAINING LOW 16 BITS.
                                        ;                SECOND WORD CONTAINING HIGH 2 BITS.
                                        ;OUTPUTS:
                                        ;       R1 - HIGH 3 BITS OF ADDRESS
                                        ;       R2 - LOW 15 BITS OF ADDRESS
                                        ;
023546  016001  000002          APRINT: MOV 2(R0),R1                    ;GET HIGH 2 BITS
023552  006301                          ASL R1                          ;SHIFT LEFT
023554  011002                          MOV (R0),R2                     ;GET LOW 16 BITS
023556  100001                          BPL APRIZ                       ;IF 16TH BIT SET
023560  005201                          INC R1                          ;PLACE IT IN WITH HIGH 2 BITS
023562  000207                  APRIZ:  RETURN
```

```
      1                                 ;NXMI
      2                                 ;
      3                                 ;NON-EXISTANT MEMORY SERVICE ROUTINE
      4                                 ;
      5                                 ;INPUTS:
      6                                 ;       NXMAD SET TO ZERO
      7                                 ;OUTPUTS:
      8                                 ;       NXMAD SET TO ONES IF NON-EXISTANT TRAP OCCURED
      9
     10 023564                          BGNSRV NXMI
        023564                                                                  NXMI::
     11
     12 023564  012737  177777  002374          MOV #-1,NXMAD
     13
     14 023572                          ENDSRV
        023572                                                                  L10036:
        023572  000002                                                                 RTI
```

```
                                ;UDASRV
                                ;
                                ;UDA INTERRUPT SERVICE ROUTINE. MARKS UDA CONTROLLER TABLE THAT AN
                                ;INTERRUPT HAS BEEN RECEIVED.
                                ;
                                ;THIS ROUTINE IS CALLED BY A [JSR R0,UDASRV] INSTRUCTION FROM WITHIN
                                ;THE CONTROLLER TABLE. THE PC STORED IN R0 IS THE ADDRESS OF THE C.FLG
                                ;WORD IN THE CONTROLLER TABLE. THE STACK CONTAINS THE SAVED CONTENTS
                                ;OF R0 FOLLOWED BY THE INTERRUPTED PC AND PS.
                                ;
                                ;INPUTS:
                                ;       R0 - ADDRESS OF C.FLG WORD IN CONTROLLER TABLE
                                ;       STACK - SAVED CONTENTS OF R0
                                ;OUTPUTS:
                                ;       CT.CMD CLEARED AND CT.MSG SET IN C.FLG WORD OF CONTROLLER TABLE
                                ;       R0 - RESTORED FROM STACK

023574                          BGNSRV UDASRV
023574                                                                  UDASRV::
023574  052710  000010                  BIS #CT.MSG,(R0)                ;SET CT.MSG
023600                                  POP R0                          ;RESTORE R0
023600  012600                                                                  MOV (SP)+,R0
023602                          ENDSRV
023602                                                                  L10037:
023602  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
                                ;
023604                          SETTO:  PUSH <R2,R3>
023604  010246                                                                    MOV R2,-(SP)
023606  010346                                                                    MOV R3,-(SP)
023610  005002                          CLR R2                  ;CLEAR PRODUCT
023612  013703  002362                  MOV KW.HZ,R3            ;GET MULTIPLICAND
023616  006200                  SETO0:  ASR R0                  ;SHIFT MULTIPLIER TO RIGHT
023620  103001                          BCC SETO1               ;IF A ONE BIT SHIFTED OUT
023622  060302                          ADD R3,R2               ;  ADD MULTIPLICAND TO PRODUCT
023624  006303                  SETO1:  ASL R3                  ;DOUBLE THE MULTIPLICAND
023626  005700                          TST R0
023630  001372                          BNE SETO0               ;CONTINUE UNTIL MULTIPLIER IS ZERO
                                ;GET CURRENT TIME
                                ;
023632  013700  002364          SETO2:  MOV KW.EL,R0            ;GET TIME
023636  013703  002366                  MOV KW.EL+2,R3
023642  020037  002364                  CMP R0,KW.EL            ;IF CHANGED DURING RETRIEVAL
023646  001371                          BNE SETO2               ;  GET IT AGAIN
                                ;
                                ;ADD TIME TIL TIMEOUT
                                ;
023650  060200                          ADD R2,R0               ;ADD
023652  005503                          ADC R3
                                ;
                                ;PUT RESULT IN STORAGE
                                ;
023654  010021                          MOV R0,(R1)+
023656  010311                          MOV R3,(R1)
                                ;
023660                                  POP <R3,R2>
023660  012603                                                                    MOV (SP)+,R3
023662  012602                                                                    MOV (SP)+,R2
023664  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.
                                ;       R4 - LEN, INTI AND VECTOR FIELDS TO SEND TO UDA
                                ;IMPLICIT INPUTS:
                                ;       FFREE - FIRST FREE ADDRESS OF MEMORY. THIS ADDRESS IS GIVEN TO UDA
                                ;               AS START OF RING BUFFER.
                                ;       FSIZE - SIZE OF FREE MEMORY AVAILABLE IN WORDS.
                                ;OUTPUTS:
                                ;       CONDITION Z - SET IF ANY ERROR REPORTED. CLEAR IF NO ERROR.
                                ;       R1 - SIZE OF RING BUFFER IN WORDS IF NO ERROR.
                                ;       R4 - ADDRESS OF UDAIP REGISTER IN UDA
                                ;       R5 - UNCHANGED.

                                ;CHECK IF ENOUGH FREE MEMORY FOR RING BUFFER

023666  010400                  UDAINT: MOV R4,R0                       ;GET MESSAGE LENGTH
023670  000300                          SWAB R0
023672  042700  177770                  BIC #177770,R0
023676  004737  024606                  CALL CLOG                       ;COMPUTE LOGARITHMIC VALUE
023702  010102                          MOV R1,R2                       ;SAVE RESULT IN R2
023704  010400                          MOV R4,R0                       ;GET COMMAND LENGTH
023706  000300                          SWAB R0
023710  006000                          ROR R0
023712  006000                          ROR R0
023714  006000                          ROR R0
023716  042700  177770                  BIC #177770,R0
023722  004737  024606                  CALL CLOG                       ;COMPUTE LOGARITHMIC VALUE
023726  060201                          ADD R2,R1                       ;ADD THE TWO RESULTS
023730  006301                          ASL R1                          ;MULTIPLY BY 2 WORDS PER RING
023732  062701  000002                  ADD #HC.ISZ/2,R1                ;ADD SPACE FOR INTERRUPT INDICATORS
023736  020137  002200                  CMP R1,FSIZE                    ;COMPARE WITH SIZE OF FREE MEMORY
023742  101402                          BLOS UDAI1
023744  000137  014406                  JMP FMERR                       ;FATAL ERROR IF NOT ENOUGH MEMORY
```

```
                                        ;FILL HOST COMMUNICATION AREA WITH ALL ONES

023750  013702  002176        UDAI1:  MOV FFREE,R2            ;GET FIRST ADDRESS OF RING BUFFER
023754  010103                        MOV R1,R3               ;GET SIZE OF RING BUFFER
023756  012722  177777        UDAI1L: MOV #-1,(R2)+           ;WRITE ONES TO BUFFER
023762  005303                        DEC R3                  ;COUNT THE WORDS IN BUFFER
023764  003374                        BGT UDAI1L              ;LOOP UNTIL ENTIRE BUFFER WRITTEN

                                        ;DO THE INITIALIZATION

023766  004737  024136                CALL UDAIST             ;DO FIRST THREE STEPS
023772  103457                        BCS UDAIEX              ;GET OUT IF UDA MICROCODE REPORTED FAILURE
023774  012364  000002                MOV (R3)+,2(R4)         ;WRITE NEXT WORD TO UDASA REGISTER
024000  012700  000310                MOV #200.,R0            ;GET TRY COUNTER
024004  016402  000002        UDAI1A: MOV 2(R4),R2            ;LOOK AT UDASA
024010  001410                        BEQ UDAI1C
024012  100005                        BPL UDAI1B
024014                                ERRDF 24,,ERR024
024014  104455                                                                TRAP    C$ERDF
024016  000030                                                                .WORD   24
024020  000000                                                                .WORD   0
024022  013600                                                                .WORD   ERR024
024024  000442                        BR UDAIEX
024026  005300                UDAI1B: DEC R0
024030  001365                        BNE UDAI1A
024032  010264  000002        UDAI1C: MOV R2,2(R4)            ;WRITE 0 TO UDASA (PURGE)
024036  011402                        MOV (R4),R2             ;READ FROM UDAIP (POLL)
024040  004737  024446                CALL UDARSP             ;WAIT FOR STEP OR ERROR BIT
024044  103432                        BCS UDAIEX              ;GET OUT IF UDA MICROCODE REPORTED FAILURE
024046                                PUSH    R1
024046  010146                                                                MOV R1,-(SP)
024050  004733                        CALL    @(R3)+          ; CALL LAST ROUTINE
024052                                POP     R1
024052  012601                                                                MOV (SP)+,R1

                                        ;CHECK HOST COMMUNICATION AREA FOR ALL ZEROS

024054  013702  002176        UDAI2:  MOV FFREE,R2            ;GET FIRST ADDRESS OF RING BUFFER
024060  010103                        MCV R1,R3               ;GET SIZE OF RING BUFFER
024062  005722                UDAI2L: TST (R2)+               ;CHECK WORD IN BUFFER
024064  001003                        BNE UDAI2E              ;GO TO ERROR REPORTER IF NOT ZERO
024066  005303                        DEC R3                  ;COUNT THE WORDS IN BUFFER
024070  003374                        BGT UDAI2L              ;LOOP UNTIL ALL WORDS CHECKED
024072  000405                        BR UDAI3

024074                        UDAI2E: ERRDF 23,,ERR023        ;REPORT BUFFER NOT CLEARED
024074  104455                                                                TRAP    C$ERDF
024076  000027                                                                .WORD   23
024100  000000                                                                .WORD   0
024102  013514                                                                .WORD   ERR023
024104  000412                        BR UDAIEX
```

```
                                ;SEND GO BIT TO UDASA REGISTER TO END INITIALIZATION

                                UDAI3:
                                        MOV C.BST(R5),R0                ;GET BURST VALUE
                                        ASL R0                          ;SHIFT TO POSITION
                                        ASL R0
                                        BIS #SA.GO,R0                   ;SET THE GO BIT
                                        MOV R0,2(R4)                    ;SEND TO UDA
                                        CLZ                             ;CLEAR Z AS NO ERROR INDICATION
                                        RETURN

                                ;ERROR RETURN

                                UDAIEX: SEZ                             ;SET Z TO INDICATE ERROR OCCURRED
                                        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
                                        ;       R4 - LEN, INTI AND VECTOR FIELDS TO SEND TO UDA

                                        ;LOAD TABLE OF DATA TO SEND TO UDASA REGISTER

024136                                  UDAIST: BREAK
024136  104422                                                                  TRAP    C$BRK
024140                                          PUSH R1
024140  010146                                                                  MOV R1,-(SP)
024142  052704  100000                          BIS #SA.STP,R4                  ;SET STEP BIT IN DATA WORD
024146  010437  024340                          MOV R4,UDAID1                   ;LOAD LENGTH AND INTERRUPT VECTOR
024152  013737  002176  024344                 MOV FFREE,UDAID2                ;LOAD MEMORY ADDRESS
024160  062737  000004  024344                 ADD #HC.MSG,UDAID2              ;  OF FIRST RESPONSE RING

                                        ;START THE INITIALIZATION BY WRITING TO UDAIP REGISTER

024166  016504  000000                          MOV C.UADR(R5),R4               ;GET ADDRESS OF UDAIP REGISTER
024172  005037  002374                          CLR NXMAD                       ;CLEAR MEMORY ERROR FLAG
024176                                          SETVEC #4,#NXMI,#PRI07          ;SET UP VECTOR 4
024176  012746  000340                                                          MOV     #PRI07,-(SP)
024202  012746  023564                                                          MOV     #NXMI,-(SP)
024206  012746  000004                                                          MOV     #4,-(SP)
024212  012746  000003                                                          MOV     #3,-(SP)
024216  104437                                                                  TRAP    C$SVEC
024220  062706  000010                                                          ADD     #10,SP
024224  005764  000002                          TST 2(R4)                       ;ACCESS UDASA REGISTER
024230  005014                                  CLR (R4)                        ;WRITE TO UDAIP
024232                                          CLRVEC #4                       ;GIVE UP THE VECTOR
024232  012700  000004                                                          MOV     #4,R0
024236  104436                                                                  TRAP    C$CVEC
024240  005737  002374                          TST NXMAD                       ;SEE IF A MEMORY ERROR OCCURRED
024244  001406                                  BEQ UDAISG
024246                                          ERRDF 20,,ERR020
024246  104455                                                                  TRAP    C$ERDF
024250  000024                                                                  .WORD   20
024252  000000                                                                  .WORD   0
024254  013402                                                                  .WORD   ERR020
024256  000261                                  SEC
024260  000424                                  BR UDAISE
```

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

 024262  012737  004000  024604  UDAISG: MOV #SA.S1,UDARSD               ;STORE RESPONSE MASK
 024270  012703  024336                  MOV #UDAIDT,R3                  ;AND INDEX TO TABLE

                                        ;WAIT FOR AND CHECK RESPONSE DATA

 024274  004737  024446          UDAISL: CALL UDARSP                     ;WAIT FOR STEP OR ERROR BITS
 024300  103414                          BCS UDAISE                      ;EXIT IF ERROR
 024302  004733                          CALL @(R3)+                     ;CALL RESPONSE CHECKER FOR STEP
 024304  103412                          BCS UDAISE                      ;GET OUT IF ERROR
 024306  006337  024604                  ASL UDARSD                      ;SHIFT TO NEXT STEP BIT
 024312  032737  040000  024604          BIT #SA.S4,UDARSD               ;CHECK IF NOW AT STEP 4
 024320  001003                          BNE UDAISX                      ;GET OUT IF SO
 024322  012364  000002                  MOV (R3)+,2(R4)                 ;WRITE DATA TO UDASA REGISTER
 024326  000762                          BR UDAISL                       ;STAY IN LOOP

 024330  000241          UDAISX: CLC                                     ;CLEAR CARRY FOR NO ERROR INDICATION
 024332          UDAISE: POP R1
 024332  012601                                                          MOV (SP)+,R1
 024334  000207                          RETURN
```

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

024336  024354                  UDAIDT: .WORD UDAIR1                    ;FIRST WORD RESPONSE CHECK ROUTINE
024340  000000                  UDAID1: .WORD 0                         ;FIRST WORD TO SEND TO UDASA
024342  024362                          .WORD UDAIR2                    ;SECOND WORD RESPONSE CHECK ROUTINE
024344  000000                  UDAID2: .WORD 0                         ;SECOND WORD TO SEND TO UDASA
024346  024402                          .WORD UDAIR3                    ;THIRD WORD RESPONSE CHECK ROUTINE
024350  100000                  UDAID3: .WORD SA.TST                    ;THIRD WORD TO SEND TO UDASA
024352  024420                          .WORD UDAIR4                    ;FOURTH WORD RESPONSE CHECK ROUTINE

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

024354  012701  004400          UDAIR1: MOV #SA.S1+SA.DI,R1             ;SET STEP ONE BIT
024360  000422                          BR UDAIRC                       ;NOW COMPARE

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

024362  013701  024340          UDAIR2: MOV UDAID1,R1                   ;GET WORD SENT TO UDASA
024366  000301                          SWAB R1                         ;GET HIGH 8 BI.S
024370  042701  177400                  BIC #177400,R1
024374  052701  010000                  BIS #SA.S2,R1                   ;SET STEP 2 BIT
024400  000412                          BR UDAIRC                       ;NOW COMPARE

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

024402  013701  024340          UDAIR3: MOV UDAID1,R1                   ;GET WORD SENT TO UDASA
024406  042701  177400                  BIC #177400,R1                  ;JUST LOW 8 BITS
024412  052701  020000                  BIS #SA.S3,R1                   ;SET STEP 3 BIT
024416  000403                          BR UDAIRC                       ;NOW COMPARE

                                        ;RESPONSE CHECK FOR FOURTH WORD FROM UDASA
                                        ;CHECK FOR ECHO OF PURGE AND LFAIL BITS

024420  010201                  UDAIR4: MOV R2,R1                       ;GET RESPONSE FROM UDA
024422  042701  137400                  BIC #^C<SA.S4+SA.MCV>,R1        ;KEEP MICROCODE VERSION AND STEP 4

                                        ;COMPARE EXPECTED DATA IN R1 WITH ACTUAL DATA IN R2

024426  020102                  UDAIRC: CMP R1,R2                       ;COMPARE THE DATA
024430  001405                          BEQ UDAIRX                      ;EXIT IF COMPARED CORRECTLY
024432                                  ERRDF 25,,ERR025                ;REPORT ERROR
024432  104455                                                                  TRAP    C$ERDF
024434  000031                                                                  .WORD   25
024436  000000                                                                  .WORD   0
024440  013614                                                                  .WORD   ERR025
024442  000261                          SEC
024444  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

024446                          UDARSP: PUSH R1
024446  010146                                                                  MOV R1,-(SP)
024450  052737  100000  024604          BIS #SA.ERR,UDARSD          ;SET ERROR BIT IN MASK WORD
024456  012700  000012                  MOV #10.,R0                 ;SET UP FOR 10 SECOND TIMEOUT
024462  010501                          MOV R5,R1                   ;POINT TO COUNTER IN CONTROLLER TABLE
024464  062701  000040                  ADD #C.TO,R1
024470  004737  023604                  CALL SETTO
024474                                  POP R1
024474  012601                                                                  MOV (SP)+,R1
024476  033764  024604  000002  UDARS1: BIT UDARSD,2(R4)             ;LOOK AT ERROR AND STEP BIT
024504  001024                          BNE UDARS2                  ;BRANCH IF EITHER SET
024506                                  BREAK
024506  104422                                                                  TRAP    C$BRK
024510  005737  002354                  TST KW.CSR                  ;SEE IF CLOCK ON SYSTEM
024514  001770                          BEQ UDARS1
024516  023765  002366  000042          CMP KW.EL+2,C.TOH(R5)       ;CHECK IF TIME OUT OCCURRED
024524  101005                          BHI 1$
024526  001363                          BNE UDARS1
024530  023765  002364  000040          CMP KW.EL,C.TO(R5)
024536  103757                          BLO UDARS1
024540  016402  000002          1$:     MOV 2(R4),R2                ;GET REGISTER CONTENTS
024544                                  ERRDF 22.,ERR022            ;REPORT TIME OUT ERROR
024544  104455                                                                  TRAP    C$ERDF
024546  000026                                                                  .WORD   22
024550  000000                                                                  .WORD   0
024552  013446                                                                  .WORD   ERR022
024554  000407                          BR UDARSE
```

```
                                        ;CHECK IF ERROR BIT SET

024556  016402  000002      UDARS2: MOV 2(R4),R2            ;GET REGISTER CONTENTS
024562  100006                      BPL UDARSX              ;EXIT IF ERROR NOT SET
024564                              ERRDF 21,,ERR021        ;REPORT ERROR INFO
024564  104455                                                      TRAP    C$ERDF
024566  000025                                                      .WORD   21
024570  000000                                                      .WORD   0
024572  013414                                                      .WORD   ERR021
024574  000261      UDARSE: SEC
024576  000207              RETURN

                                        ;NORMAL EXIT

024600  000241      UDARSX: CLC                             ;CLEAR CARRY AS NO ERROR INDICATION
024602  000207              RETURN

                                        ;LOCATION FOR STEP BIT MASK

024604  000000      UDARSD: .WORD 0                         ;LOAD BY CALLING ROUTINE
```

```
      1                                 ;CLOG
      2                                 ;
      3                                 ;COMPUTE LOGARITHMIC VALUE OF NUMBER TO BASE 2.
      4                                 ;
      5                                 ;INPUTS:
      6                                 ;       R0 - LOGARITHM TO BE CONVERTED
      7                                 ;OUTPUTS:
      8                                 ;       R1 - VALUE OF 2 RAISED TO POWER OF INPUT NUMBER
      9
     10 024606                          CLOG:   PUSH R0
        024606  010046                                                          MOV R0,-(SP)
     11 024610  005001                          CLR R1                  ;SET UP ZERO START VALUE
     12 024612  000261                          SEC                     ;WITH CARRY READY TO SHIFT IN
     13 024614  006101                  CLOGLP: ROL R1                  ;SHIFT TO LEFT
     14 024616  005300                          DEC R0                  ; UNTIL R0
     15 024620  100375                          BPL CLOGLP              ; GOES NEGATIVE
     16 024622                                  POP R0
        024622  012600                                                          MOV (SP)+,R0
     17 024624  000207                          RETURN
```

```
                                        ;RDDLL
                                        ;
                                        ;READ DISK DRIVE DOWNLINE LOAD PROGRAM INTO MEMORY
                                        ;
                                        ;INPUTS:
                                        ;       DLLNAM - NAME OF PROGRAM IN RAD50 (TWO WORDS)
                                        ;OUTPUTS:
                                        ;       FREE MEMORY CONTAINING PROGRAM
                                        ;       CARRY CLEAR IF NO ERROR, CARRY SET IF PROGRAM NOT FOUND

024626  012701  000005        RDDLL:  MOV #5,R1                       ;TYPE OF PROGRAM IN DATA FILE
024632  004737  024666                CALL RDREC                      ;READ PROGRAM INTO MEMORY
024636  006101                        ROL R1                          ;PRESERVE CARRY STATE IN R1
024640  004737  024650                CALL CLOSEF                     ;  WHILE CLOSING THE DATA FILE
024644  006001                        ROR R1                          ;  AS NORMAL POSITION IS LOST
024646  000207                        RETURN
```

```
      1                                 ;CLOSEF
      2                                 ;
      3                                 ;CLOSE DATA FILE FOR DM PROGRAMS
      4                                 ;
      5                                 ;INPUTS:
      6                                 ;       FILOPN - ZERO IF FILE NOT OPEN
      7                                 ;OUTPUTS:
      8                                 ;       NONE
      9
     10 024650  005737  002260          CLOSEF: TST FILOPN                      ;SEE IF FILE CURRENTLY OPEN
     11 024654  001403                          BEQ 1$
     12 024656                                  CLOSE                           ; IF SO, CLOSE IT
        024656  104435                                                                  TRAP    C$CLOS
     13 024660  005037  002260                  CLR FILOPN                      ;AND MARK AS SO
     14 024664  000207                  1$:     RETURN
```

```
                        ;RDREC
                        ;
                        ;READ A RECORD FROM THE INPUT FILE. PLACE DATA INTO FREE MEMORY.
                        ;
                        ;INPUTS:
                        ;       R1 - FILE TYPE
                        ;               1 - TEST 1 DM PROGRAM
                        ;               2 - TEST 2 DM PROGRAM
                        ;               3 - TEST 3 DM PROGRAM
                        ;               4 - TEST 4 DM PROGRAM
                        ;               5 - DRIVE DIAGNOSTIC DOWNLINE LOAD PROGRAM
                        ;       DLLNAM - IF R1 CONTAINS 5, TWO WORDS AT THIS ADDRESS CONTAIN
                        ;               NAME OF PROGRAM IN RAD50.
                        ;OUTPUTS:
                        ;       DATA FROM RECORD IN MEMORY
                        ;       CARRY CLEAR IF NO ERROR, CARRY SET IF ERROR

024666  -               RDREC:  PUSH <R0,R1,R2,R3,R4,R5>
024666  010046                                                            MOV R0,-(SP)
024670  010146                                                            MOV R1,-(SP)
024672  010246                                                            MOV R2,-(SP)
024674  010346                                                            MOV R3,-(SP)
024676  010446                                                            MOV R4,-(SP)
024700  010546                                                            MOV R5,-(SP)
024702  005737  002260                  TST FILOPN              ;SEE IF FILE ALREADY OPEN
024706  001005                          BNE RDSTS
024710                                  OPEN #FNAME             ;IF NOT, OPEN FILE NOW
024710  012700  002242                                                    MOV     #FNAME,R0
024714  104434                                                            TRAP    C$OPEN
024716  005237  002260                  INC FILOPN              ;AND MARK AS OPEN
024722  005005          RDSTS:  CLR R5                          ;CLEAR LOAD ADDRESS (SEARCH MODE)
024724          RDST:   BREAK                                   ;ALLOW PROGRAM TO BE INTERRUPTED
024724  104422                                                            TRAP    C$BRK
                                                                ;GETBYTE CALLS DON'T SEEM TO BREAK ON CONTROL-C!
024726                                  GETBYTE R4              ;GET A BYTE
024726  104426                                                            TRAP    C$GETB
024730  110004                                                            MOVB    R0,R4
024732  005704                          TST R4                  ;IF ZERO
024734  001773                          BEQ RDST                ; KEEP READING
024736  022704  000001                  CMP #1,R4               ;WHEN NOT ZERO
024742  001153                          BNE RWRDE1              ; IT BETTER BE A ONE
024744                                  GETBYTE R0              ; AND THE NEXT BYTE
024744  104426                                                            TRAP    C$GETB
024746  060004                          ADD R0,R4
024750  005700                          TST R0                  ; IF ZERO, PROCESS DATA
024752  001432                          BEQ RDDAT
```

```
 1 024754  020001                          CMP R0,R1                    ;CHECK IF TYPE OF FILE LOOKING FOR
 2 024756  103430                          BLO RDDAT                    ;IF TOO SOON IN FILE, KEEP SEARCHING
 3 024760  101132                          BHI RDERR                    ;IF PAST TYPE, GIVE ERROR RETURN
 4 024762  004737  025224                  CALL FWORD                   ;GET NEXT TWO WORDS
 5 024766  013702  002256                  MOV FDATA,R2
 6 024772  004737  025224                  CALL FWORD
 7 024776                                  GETBYTE R0                   ;GET CHECKSUM
   024776  104426                                                               TRAP    C$GETB
 8 025000  060004                          ADD R0,R4                    ;ADD TO COMPUTED SUM
 9 025002  105704                          TSTB R4                      ;SEE IF THIS SUM IS ZERO
10 025004  001132                          BNE RWRDE1                   ;  IF NOT, REPORT CHECKSUM ERROR
11 025006  020127  000005                  CMP R1,#5                    ;IF FILE TYPE IS A 5
12 025012  001007                          BNE 1$
13 025014  023702  002432                  CMP DLLNAM,R2                ;  MATCH THE PROGRAM NAME
14 025020  001341                          BNE RDST                     ;KEEP SEARCHING IF NOT DESIRED PROGRAM
15 025022  023737  002434  002256          CMP DLLNAM+2,FDATA
16 025030  001335                          BNE RDST
17 025032  013705  002176          1$:     MOV FFREE,R5                 ;GET STORAGE ADDRESS
18 025036  000732                          BR RDST                      ;SWITCH FROM SEARCH TO STORE MODE
```

```
                     025040  004737  025224          RDDAT:  CALL FWORD              ;READ BYTE COUNT
                     025044  013703  002256                  MOV FDATA,R3           ;SAVE IN R3
                     025050  004737  025224                  CALL FWORD             ;READ LOAD ADDRESS
                     025054  162703  000006                  SUB #6,R3              ;SUBTRACT BYTES ALREADY READ FROM BYTE COUNT
                     025060  001443                          BEQ RWORDT             ;IF RESULT IS ZERO, THIS IS A
                                                                                    ;TRANSFER BLOCK
                     025062  005705                          TST R5                 ;IF IN SEARCH MODE,
                     025064  001425                          BEQ 3$                 ;  BYPASS TRANSFER ADDRESS COMPUTATION
                     025066  013701  002256                  MOV FDATA,R1           ;GET LOAD ADDRESS
                     025072  060301                          ADD R3,R1              ;ADD BYTES IN RECORD
                     025074  162701  001000                  SUB #DMFRST,R1
                     025100  060501                          ADD R5,R1              ;COMPUTE STORAGE ADDRESS
                     025102  032701  000001                  BIT #1,R1              ;CHECK IF ODD BYTE ADDRESS
                     025106  001401                          BEQ 1$                 ;IF SO,
                     025110  005201                          INC R1                 ;  INCREMENT
                     025112  163701  002176          1$:     SUB FFREE,R1           ;SEE IF MORE MEMORY NEEDS TO BE ALLOCATED
                     025116  101403                          BLOS 2$
                     025120  006001                          ROR R1                 ;REDUCE TO WORDS
                     025122  004737  014420                  CALL ALOCM             ;ALLOCATE THE MEMORY
                     025126  013702  002256          2$:     MOV FDATA,R2           ;GET LOAD ADDRESS
                     025132  162702  001000                  SUB #DMFRST,R2
                     025136  060502                          ADD R5,R2
                     025140                          3$:     GETBYTE R0             ;GET DATA BYTE
                     025140  104426                                                         TRAP    C$GETB
                     025142  005705                          TST R5                 ;IF IN SEARCH MODE,
                     025144  001401                          BEQ 4$                 ;  BYPASS DATA STORAGE
                     025146  110022                          MOVB R0,(R2)+          ;STORE IN MEMORY
                     025150  060004                  4$:     ADD R0,R4              ;UPDATE CHECKSUM
                     025152  005303                          DEC R3                 ;COUNT THE BYTE
                     025154  001371                          BNE 3$                 ;GET THEM ALL
                     025156                                  GETBYTE R0             ;GET CHECKSUM
                     025156  104426                                                         TRAP    C$GETB
                     025160  060004                          ADD R0,R4              ;ADD
                     025162  105704                          TSTB R4                ;IF CHECKSUM CORRECT,
                     025164  001657                          BEQ RDST               ;  THEN GO READ NEXT RECORD
                     025166  000441                          BR RWRDE1              ;  ELSE REPORT ERROR
```

```
      1 025170                          RWORDT: GETBYTE R0              ;READ CHECKSUM BYTE
        025170  104426                                                                  TRAP    C$GETB
      2 025172  060004                          ADD R0,R4               ;ADD TO COMPUTED CHECKSUM
      3 025174  105704                          TSTB R4                 ;CHECK LOW BYTE OF SUM
      4 025176  001035                          BNE RWRDE1              ;BRANCH IF CHECKSUM ERROR
      5 025200  005705                          TST R5                  ;IF IN SEARCH MODE,
      6 025202  001650                          BEQ RDST                ;  KEEP ON SEARCHING
      7 025204                                  POP <R5,R4,R3,R2,R1,R0>
        025204  012605                                                                  MOV (SP)+,R5
        025206  012604                                                                  MOV (SP)+,R4
        025210  012603                                                                  MOV (SP)+,R3
        025212  012602                                                                  MOV (SP)+,R2
        025214  012601                                                                  MOV (SP)+,R1
        025216  012600                                                                  MOV (SP)+,R0
      8 025220  000241                          CLC
      9 025222  000207                          RETURN
     10
     11 025224                          FWORD:  GETBYTE R0              ;READ A BYTE FROM FILE
        025224  104426                                                                  TRAP    C$GETB
     12 025226  060004                          ADD R0,R4               ;UPDATE CHECKSUM ERROR
     13 025230  110037  002256                  MOVB R0,FDATA           ;START TO BUILD WORD
     14 025234                                  GETBYTE R0              ;READ ANOTHER BYTE FROM FILE
        025234  104426                                                                  TRAP    C$GETB
     15 025236  060004                          ADD R0,R4               ;UPDATE CHECKSUM
     16 025240  110037  002257                  MOVB R0,FDATA+1         ;COMPLETE WORD
     17 025244  000207                          RETURN
```

GLOBAL SUBROUTINES SECTION

```
      1 025246  004737  024650          RDERR:  CALL CLOSEF                     ;CLOSE FILE AS POSITION IS LOST
      2 025252                                  POP <R5,R4,R3,R2,R1,R0>
        025252  012605                                                          MOV (SP)+,R5
        025254  012604                                                          MOV (SP)+,R4
        025256  012603                                                          MOV (SP)+,R3
        025260  012602                                                          MOV (SP)+,R2
        025262  012601                                                          MOV (SP)+,R1
        025264  012600                                                          MOV (SP)+,R0
      3 025266  000261                          SEC                           ;ERROR RETURN, FILE NOT FOUND
      4 025270  000207                          RETURN
      5
      6 025272                          RWRDE1: ERRSF 5,,ERR005
        025272  104454                                                          TRAP    C$ERSF
        025274  000005                                                         .WORD   5
        025276  000000                                                         .WORD   0
        025300  013326                                                         .WORD   ERR005
      7 025302                                  DOCLN
        025302  104444                                                         TRAP    C$DCLN
```

```
                                        ;KW11I
                                        ;
                                        ;CLOCK INTERRUPT SERVICE ROUTINE
                                        ;
 025304                                 BGNSRV KW11I
 025304                                                                 KW11I::
 025304  062737  000001  002364                 ADD #1,KW.EL           ;COUNT THE INTERRUPT
 025312  005537  002366                         ADC KW.EL+2
 025316  012777  000105  155030                 MOV #KWOUT.,@KW.CSR    ;RESTART THE CLOCK
 025324                                 ENDSRV
 025324                                                                 L10040:
 025324  000002                                                                RTI
                                        ;
 025326                                         BGNSRV  INTSRV         ; UDA INTERRUPT SERVER
 025326                                                                 INTSRV::
 025326  005237  002240                         INC     INTRCV         ; FLAG INTERRUPT AS RECEIVED
 025332                                         ENDSRV
 025332                                                                 L10041:
 025332  000002                                                                RTI
```

```
                                        ;RESET
                                        ;RESET ALL UNIBUS DEVICES THEN RESTART THE CLOCK IF IT IS PRESENT
                                        ;
                                        ;INPUTS:
                                        ;       KW.CSR - ADDRESS OF CLOCK REGISTER. ZERO IF NO CLOCK PRESENT.
                                        ;       KWOUT. = DATA TO SEND TO CLOCK REGISTER TO RESTART IT.
                                        ;OUTPUTS:
                                        ;       NONE

025334                                  RESET:  BREAK
025334  104422                                                                  TRAP    C$BRK
025336                                          BRESET                  ;RESET ALL DEVICES
025336  104433                                                                  TRAP    C$RESET
025340  005737  002354                          TST KW.CSR              ;SEE IF A CLOCK IS PRESENT
025344  001403                                  BEQ RESETX
025346  012777  000105  155000                  MOV #KWOUT.,@KW.CSR     ;START UP THE CLOCK
025354  000207                          RESETX: RETURN
```

```
                                ;RNTIME
                                ;
                                ;PRINT RUNTIME
                                ;
                                ;INPUTS:
                                ;       KW.EL - CONTAINS ELAPSED TIME
                                ;       KW.HZ - HERTZ OF CLOCK
                                ;OUTPUTS:
                                ;       IF CLOCK ON SYSTEM:
                                ;          '' RNTIME HH:MM:SS '' PRINTED
                                ;       IF NO CLOCK: ONE SPACE IS PRINTED
                                
025356  005737  002354        RNTIME: TST KW.CSR                      ;CHECK IF A CLOCK PRESENT
025362  001465                        BEQ RNTIMX                      ;BRANCH IF NOT
025364                              PUSH <R0,R3,R4,R5>
025364  010046                                                              MOV R0,-(SP)
025366  010346                                                              MOV R3,-(SP)
025370  010446                                                              MOV R4,-(SP)
025372  010546                                                              MOV R5,-(SP)
025374  013703  002364                  MOV KW.EL,R3                   ;GET ELAPSED TIME
025400  013704  002366                  MOV KW.EL+2,R4
025404  013700  002362                  MOV KW.HZ,R0                   ;GET SPEED OF CLOCK
025410  004737  021344                  CALL DIVIDE                    ;COMPUTE SECONDS OF ELAPSED TIME
025414  012700  000074                  MOV #60.,R0                    ;NOW DIVIDE BY 60
025420  004737  021344                  CALL DIVIDE                    ; TO COMPUTE MINUTES
025424                                  PUSH R5                        ;SAVE REMAINDER AS SECONDS
025424  010546                                                              MOV R5,-(SP)
025426  004737  021344                  CALL DIVIDE                    ;DIVIDE BY 60 AGAIN
025432                                  PNT RNTIM,R3                   ;PRINT HOURS
025432  010346                                                              MOV R3,-(SP)
025434  004137  022324                                                      JSR R1,LPNT
025440  003646                                                              .WORD RNTIM
025442  000002                                                              .WORD PNT.CT
025444  020527  000011                  CMP R5,#9.                     ;IF MINUTES 9 OR LESS
025450  003004                          BGT 1$
025452                                  PRINT #'0                      ;PRINT A LEADING ZERO
025452  112700  000060                                                      MOVB #'0,R0
025456  004737  022114                                                      CALL CPNT
025462                          1$:     PNT RNTIM1,R5                  ;NOW PRINT MINUTES
025462  010546                                                              MOV R5,-(SP)
025464  004137  022324                                                      JSR R1,LPNT
025470  003671                                                              .WORD RNTIM1
025472  000002                                                              .WORD PNT.CT
025474                                  POP R5                         ;GET SECONDS
025474  012605                                                              MOV (SP)+,R5
025476  020527  000011                  CMP R5,#9.                     ;IF 9 OR LESS
025502  003004                          BGT 2$
025504                                  PRINT #'0                      ;PRINT A LEADING ZERO
025504  112700  000060                                                      MOVB #'0,R0
025510  004737  022114                                                      CALL CPNT
025514                          2$:     PNT RNTIM2,R5                  ;NOW PRINT SECONDS
025514  010546                                                              MOV R5,-(SP)
025516  004137  022324                                                      JSR R1,LPNT
025522  003677                                                              .WORD RNTIM2
025524  000002                                                              .WORD PNT.CT
025526                                  POP <R5,R4,R3,R0>              ;HOURS IN R3
025526  012605                                                              MOV (SP)+,R5
```

```
                                                                                MOV (SP)+,R4
                                                                                MOV (SP)+,R3
                                                                                MOV (SP)+,R0
     35 025536                          RNTIMX: PRINT <#' >          ;PRINT A SPACE
        025536  112700  000040                                                  MOVB #' ,R0
        025542  004737  022114                                                  CALL CPNT
     36 025546  000207                          RETURN
     37
     38 025550                          ENDMOD
```

REPORT CODING SECTION

```
                                .SBTTL  REPORT CODING SECTION

 025550                                 BGNMOD

                                ;++
                                ; THE REPORT CODING SECTION CONTAINS THE
                                ; "PRINTS" CALLS THAT GENERATE STATISTICAL REPORTS.
                                ;--

 025550                                 BGNRPT
 025550                                                                  L$RPT::

 025550                                 PUSH    <R0,R1,R2,R3,R4,R5>
 025550  010046                                                                MOV R0,-(SP)
 025552  010146                                                                MOV R1,-(SP)
 025554  010246                                                                MOV R2,-(SP)
 025556  010346                                                                MOV R3,-(SP)
 025560  010446                                                                MOV R4,-(SP)
 025562  010546                                                                MOV R5,-(SP)
 025564                                 PNTS RPTMSG,TNUM                ;PRINT TEST NUMBER
 025564  013746  002230                                                        MOV TNUM,-(SP)
 025570  004137  022316                                                        JSR R1,LPNTS
 025574  026224                                                              .WORD RPTMSG
 025576  000002                                                              .WORD PNT.CT
 025600  004737  025356                 CALL RNTIME                     ;GET RUNTIME PARAMETERS
 025604                                 PRINT #CR                       ;END THE LINE
 025604  112700  000015                                                        MOVB #CR,R0
 025610  004737  022114                                                        CALL CPNT
 025614  012701  002370                 MOV #STIME,R1                   ;AT 15 MINUTES FROM NOW
 025620  012700  001604                 MOV #15.*60.,R0                 ;SET TIME FOR NEXT REPORT
 025624  004737  023604                 CALL SETTO
```

```
      4 025630  023727  002230  000004          CMP TNUM,#4                     ;IF NOT TEST 4
      6 025636  001402                          BEQ 1$                          ;
      7 025640  000137  026136                  JMP RPTXX                       ;  THAT IS ALL
      8 025644                          1$:     PNTS RPTMSH
        025644  004137  022316                                                            JSR R1,LPNTS
        025650  026260                                                                    .WORD RPTMSH
        025652  000000                                                                    .WORD PNT.CT
      9 025654  013705  002206                  MOV CTABS,R5                    ;GET ADDRESS OF FIRST CONTROLLER TABLE
     10 025660                          RPTCT:
     11 025660  005765  000002                  TST C.UNIT(R5)                  ;SEE IF CONTROLLER AVAILABLE FOR TESTING
     13 025664  100520                          BMI RPTCTN
     14 025666                                        ASSUME CT.AVL EQ BIT15
     20 025666  010504                          MOV R5,R4                       ;COMPUTE ADDRESS OF DRIVE TABLE POINTERS
     21 025670  062704  000020                  ADD #C.DRO,R4
     22 025674  012703  000010                  MOV #8.,R3                      ;GET COUNT OF DRIVES
     23 025700  012401                  RPTDT:  MOV (R4)+,R1                    ;LOOK AT POINTER
     24 025702  001511                          BEQ RPTCTN                      ;GO TO NEXT IF NO TABLE
     25 025704  005761  000002                  TST D.UNIT(R1)                  ;SEE IF DRIVE AVAILABLE
     27 025710  100504                          BMI RPTDTN
     28 025712                                        ASSUME DT.AVL EQ BIT15
```

REPORT CODING SECTION

```
      1 025712                                  PUSH <R3,R4,R5,R1>
        025712  010346                                                  MOV R3,-(SP)
        025714  010446                                                  MOV R4,-(SP)
        025716  010546                                                  MOV R5,-(SP)
        025720  010146                                                  MOV R1,-(SP)
      2 025722  012700  002262                  MOV #TEMP,R0            ;PLACE 18 SPACE CHARACTERS INTO
      3 025726  012701  000022                  MOV #18.,R1             ;  TEMP STORAGE
      4 025732  112720  000040        1$:      MOVB #' ,(R0)+
      5 025736  005301                          DEC R1
      6 025740  001374                          BNE 1$
      7 025742  005010                          CLR (R0)                ;THEN A NULL CHARACTER
      8 025744  011605                          MOV (SP),R5             ;GET DRIVE TABLE STORAGE ADDRESS
      9 025746  016501  000200                  MOV D.SERN(R5),R1       ;GET SERIAL NUMBER
     10 025752  016502  000202                  MOV D.SERN+2(R5),R2
     11 025756  016503  000204                  MOV D.SERN+4(R5),R3
     12 025762  005004                          CLR R4
     13 025764  004737  0<6156        2$:      CALL DIV10              ;DIVIDE BY 10
     14 025770  062705  000060                  ADD #'0,R5              ;CONVERT TO ASCII CHARACTER
     15 025774  110540                          MOVB R5,-(R0)           ;PUT DIGIT INTO TEMP STORAGE
     16 025776  010146                          MOV R1,-(SP)
     17 026000  050216                          BIS R2,(SP)             ;SEE IF QUOTIENT IS ZERO
     18 026002  050316                          BIS R3,(SP)
     19 026004  050426                          BIS R4,(SP)+
     20 026006  001366                          BNE 2$                  ;IF NOT, DIVIDE AGAIN
     21 026010                                  POP R1
        026010  012601                                                  MOV (SP)+,R1
     22 026012                                  PRINTS #RPTMSD,D.UNIT(R1),(R1),#TEMP,D.SEEK(R1),D.XFRR(R1),D.XFRW(R1)
        026012  016146  000164                                          MOV     D.XFRW(R1),-(SP)
        026016  016146  000166                                          MOV     D.XFRR(R1),-(SP)
        026022  016146  000174                                          MOV     D.SEEK(R1),-(SP)
        026026  012746  002262                                          MOV     #TEMP,-(SP)
        026032  011146                                                  MOV     (R1),-(SP)
        026034  016146  000002                                          MOV     D.UNIT(R1),-(SP)
        026040  012746  026476                                          MOV     #RPTMSD,-(SP)
        026044  012746  000007                                          MOV     #7,-(SP)
        026050  010600                                                  MOV     SP,R0
        026052  104416                                                  TRAP    C$PNTS
        026054  062706  000020                                          ADD     #20,SP
     23 026060                                          ASSUME D.DRV EQ 0
     24 026060                                  PRINTS #RPTMD2,D.HERR(R1),D.SERR(R1),D.ECCC(R1)
        026060  016146  000176                                          MOV     D.ECCC(R1),-(SP)
        026064  016146  000172                                          MOV     D.SERR(R1),-(SP)
        026070  016146  000170                                          MOV     D.HERR(R1),-(SP)
        026074  012746  026545                                          MOV     #RPTMD2,-(SP)
        026100  012746  000004                                          MOV     #4,-(SP)
        026104  010600                                                  MOV     SP,R0
        026106  104416                                                  TRAP    C$PNTS
        026110  062706  000012                                          ADD     #12,SP
     48 026114                                  POP <R5,R4,R3>
        026114  012605                                                  MOV (SP)+,R5
        026116  012604                                                  MOV (SP)+,R4
        026120  012603                                                  MOV (SP)+,R3
```

```
  1 026122  005303                  RPTDTN: DEC R3                          ;COUNT THE DRIVE TABLES
  2 026124  003265                          BGT RPTDT                       ;REPEAT FOR ALL DRIVE TABLES
  3 026126  062705  000046          RPTCTN: ADD #C.SIZE,R5                  ;GO TO NEXT CONTROLLER TABLE
  4 026132  005715                          TST (R5)
  9 026134  001251                          BNE RPTCT
 11 026136                          RPTXX:  POP     <R5,R4,R3,R2,R1,R0>
    026136  012605                                                                  MOV (SP)+,R5
    026140  012604                                                                  MOV (SP)+,R4
    026142  012603                                                                  MOV (SP)+,R3
    026144  012602                                                                  MOV (SP)+,R2
    026146  012601                                                                  MOV (SP)+,R1
    026150  012600                                                                  MOV (SP)+,R0
 12 026152                                  EXIT    RPT
    026152  000167                                                                  .WORD   J$JMP
    026154  000412                                                                  .WORD   L10042-2-.
 13
 14 026156                          DIV10:  PUSH R0                         ;DIVIDEND IS IN <R4,R3,R2,R1>
    026156  010046                                                                  MOV R0,-(SP)
 15 026160  012700  000100                  MOV #64.,R0                     ;SET UP SHIFT COUNT
 16 026164  005005                          CLR R5                          ;START WITH ZERO REMAINDER
 17 026166  006301                  1$:     ASL R1
 18 026170  006102                          ROL R2                          ;SHIFT LEFT INTO R5
 19 026172  006103                          ROL R3
 20 026174  006104                          ROL R4
 21 026176  006105                          ROL R5
 22 026200  022705  000012                  CMP #10.,R5                     ;SILL DIVISOR GO INTO REMAINDER?
 23 026204  101003                          BHI 2$                          ;ONLY SUBTRACT IF IT WILL
 24 026206  162705  000012                  SUB #10.,R5                     ;SUBTRACT DIVISOR
 25 026212  005201                          INC R1                          ;PUT A ONE INTO QUOTIENT
 26 026214  005300                  2$:     DEC R0                          ;COUNT THE SHIFTS
 27 026216  001363                          BNE 1$
 28 026220                                  POP R0                          ;RETURN WITH QUOTIENT IN
    026220  012600                                                                  MOV (SP)+,R0
 29 026222  000207                          RETURN                          ;  <R4,R3,R2,R1> AND REMAINDER IN R5
 30
 31 026224      116     042     124  RPTMSG: .ASCIZ\N''TEST ''D3'' IN PROGRESS.  ''\
 32 026260      116     042     125  RPTMSH: .ASCII\N''UNIT DRIVE      SERIAL-NUMBER SEEKS MBYTES  MBYTES  HARD   SOFT    ECC''N\
 33 026372      042     040     040          .ASCIZ \''                                X1000  READ  WRITTEN ERRORS ERRORS''N\
 34 026476      045     123     062  RPTMSD: .ASCIZ\%S2%D2%S3%D3%S1%T%S1%D5%S2%D5%S3%D5%S2\
 35 026545      045     104     065  RPTMD2: .ASCIZ\%D5%S2%D5%S1%D5%N\
 41                                         .EVEN
 42
 43 026570                                  ENDRPT
    026570                                                                  L10042:
    026570  104425                                                                  TRAP    C$RPT
```

```
                                .SBTTL  PROTECTION TABLE
                                ;++
                                ; THIS TABLE IS USED BY THE RUNTIME SERVICES
                                ; TO PROTECT THE LOAD MEDIA.
                                ;--
                                        BGNPROT
026572                                                                  L$PROT::
026572
                                        -1                      ;OFFSET INTO P-TABLE FOR CSR ADDRESS
                                        -1                      ;OFFSET INTO P-TABLE FOR MASSBUS ADDRESS
                                        -1                      ;OFFSET INTO P-TABLE FOR DRIVE NUMBER

                                        ENDPROT
```

```
                                .SBTTL  INITIALIZE SECTION

                                ;++
                                ; THE INITIALIZE SECTION CONTAINS THE CODING THAT IS PERFORMED
                                ; AT THE BEGINNING OF EACH PASS.
                                ;--

026600                                  BGNINIT
026600                                                                  L$INIT::

                                .REM &
                                    IF HERE FROM CONTINUE COMMAND
                                        THEN
                                            SET ICONT BIT IN IFLAGS
                                    ENDIF
                                    IF HERE FROM RESTART COMMAND
                                        THEN
                                            SET IREST BIT IN IFLAGS
                                    ENDIF
                                    IF HERE FROM POWER FAIL RESTART
                                        THEN
                                            RESET ALL UNITS
                                            PRINT STATISTICAL REPORT
                                    ENDIF
                                    IF HERE FROM START COMMAND
                                        THEN
                                            RESET ALL UNITS
                                            ESTABLISH FREE MEMORY
                                            CLEAR TNUM
                                            SET ISTRT BIT IN IFLAGS, CLEAR OTHER BITS
                                            INITIALIZE CLOCK
                                            BUILD TABLES
                                        ELSE
                                            CHECK TABLES FOR ADDED OR DROPPED UNITS
                                    .ENDF
                                &
```

```
      1 026600                                    READEF & '.CONTINUE     ;HERE FROM CONTINUE COMMAND?
        026600  012700  000036                                                MOV     #EF.CONTINUE,R0
        026604  104447                                                        TRAP    C$REFG
      2 026606                                    BNCOMPLETE INIT1        ;JUMP IF NOT
        026606  103006                                                        BCC     INIT1
      3 026610  042737  000020  002226            BIC #ISTRTH,IFLAGS
      4 026616  052737  000002  002226            BIS #ICONT,IFLAGS       ;SET CONTINUE BIT IN FLAG RECORD
      5 026624                              INIT1:  READEF #EF.RESTART      ;LOOK AT EVENT FLAGS
        026624  012700  000037                                                MOV     #EF.RESTART,R0
        026630  104447                                                        TRAP    C$REFG
      6 026632                                    BNCOMPLETE INIT1A       ;SET IREST BIT IN IFLAGS
        026632  103003                                                        BCC     INIT1A
      7 026634  052737  000004  002226            BIS #IREST,IFLAGS       ;  IF HERE FROM RESTART COMMAND
      8 026642                              INIT1A: READEF #EF.PWR          ;HERE FROM POWER RESTART?
        026642  012700  000034                                                MOV     #EF.PWR,R0
        026646  104447                                                        TRAP    C$REFG
      9 026650                                    BNCOMPLETE INIT2        ;JUMP IF SET
        026650  103003                                                        BCC     INIT2
     10 026652  004737  025334                    CALL RESET              ;RESET ALL UNITS
     11 026656                                    DORPT                   ;PRINT A STATISTICAL REPORT
        026656  104424                                                        TRAP    C$DRPT
     12 026660                              INIT2:  READEF #EF.START        ;HERE FROM START COMMAND?
        026660  012700  000040                                                MOV     #EF.START,R0
        026664  104447                                                        TRAP    C$REFG
     13 026666                                    BCOMPLETE INIT3         ;JUMP IF NOT
        026666  103467                                                        BCS     INIT3
```

```
                                        ;SET NOT AVAILABLE BITS IN ALL CONTROLLER AND DRIVE TABLES

026670  013705  002206                  MOV CTABS,R5                    ;GET FIRST CONTROLLER TABLE ADDRESS

026674  052765  100000  000002  INITC1: BIS #CT.AVL,C.UNIT(R5)         ;SET BIT IN CONTROLLER TABLE
026702  010502                          MOV R5,R2                       ;GET POINTER TO DRIVE TABLES
026704  062702  000020                  ADD #C.DRO,R2
026710  012703  000010                  MOV #8.,R3                      ;GET COUNT OF DRIVE TABLES
026714  012200                  INITC2: MOV (R2)+,R0                    ;CHECK IF ANY MORE DRIVE TABLES
026716  001405                          BEQ INITC3
026720  052760  100000  000002          BIS #DT.AVL,D.UNIT(R0)          ;SET BIT IN DRIVE TABLE
026726  005303                          DEC R3
026730  003371                          BGT INITC2
026732  062705  000046          INITC3: ADD #C.SIZE,R5                  ;MOVE TO NEXT CONTROLLER TABLE
026736  005715                          TST (R5)                        ;IS THERE A NEXT ONE?
026740  001355                          BNE INITC1                      ;IF SO, CLEAR THE BITS THERE

                                        ;NOW GET EACH P-TABLE AND CLEAR NOT AVAILABLE BITS

026742  005003                          CLR R3                          ;START WITH UNIT 0
026744                          INITC4: GPHARD R3,R0                    ;GET HW P-TABLE
026744  010300                                                                  MOV     R3,R0
026746  104442                                                                  TRAP    C$GPHRD
026750                                  BNCOMPLETE INITC7               ;GO AROUND IF NOT AVAILABLE
026750  103030                                                                  BCC     INITC7
026752  013705  002206                  MOV CTABS,R5                    ;GET FIRST CONTROLLER TABLE
026756  021015                  INITC5: CMP (R0),(R5)                   ;COMPARE UDA ADDRESSES
026760  001411                          BEQ INITCC
026762  062705  000046                  ADD #C.SIZE,R5                  ;LOOK AT NEXT CONTROLLER TABLE
026766  005715                          TST (R5)                        ;IF THERE IS ANY
026770  001372                          BNE INITC5
026772                          INITE1: ERRSF 6,,ERR006
026772  104454                                                                  TRAP    C$ERSF
026774  000006                                                                  .WORD   6
026776  000000                                                                  .WORD   0
027000  013340                                                                  .WORD   ERR006
027002                                  DOCLN
027002  104444                                                                  TRAP    C$DCLN
027004  016001  000010          INITCC: MOV HO.LDR(R0),R1
027010  004737  020734                  CALL GTDRVT
027014  001366                          BNE INITE1
027016  042765  100000  000002  INITC6: BIC #CT.AVL,C.UNIT(R5)         ;CLEAR BIT IN CONTROLLER TABLE
027024  042764  100000  000002          BIC #DT.AVL,D.UNIT(R4)          ;CLEAR BIT IN DRIVE TABLE
027032  005203                  INITC7: INC R3                          ;INCREMENT UNIT NUMBER
027034  023703  002012                  CMP L$UNIT,R3                   ;CHECK IF GOT ALL TABLES
027040  003341                          BGT INITC4                      ;IF NOT, GO GET ANOTHER
027042  000137  030040                  JMP INITXX                      ;EXIT THE INIT CODE
```

INITIALIZE SECTION

```
      1 027046                          INIT3:  BRESET                  ;RESET ALL UNITS
        027046  104433                                                                  TRAP    C$RESET
      2 027050                                  MEMORY FFREE            ;RESET START OF FREE MEMORY
        027050  104431                                                                  TRAP    C$MEM
        027052  010037  002176                                                          MOV     R0,FFREE
      3 027056  017737  153114  002200          MOV @FFREE,FSIZE        ;RESET SIZE OF FREE MEMORY
      4 027064  005037  002230                  CLR TNUM                ;INITIALIZE TEST NUMBER TO NO TEST RUNNING
      5 027070  012737  000010  002226          MOV #ISTRT,IFLAGS       ;SET START FLAG FOR TEST 4
      6
      7                                 ;INITIALIZE CLOCK
      8
      9         000105                           KWOUT.=105             ;DATA TO SEND TO KW11 TO START CLOCK
     10 027076  005037  002364                  CLR KW.EL               ;CLEAR ELAPSED TIME
     11 027102  005037  002366                  CLR KW.EL+2
     12 027106                                  CLOCK L,R0              ;SEE IF AN L CLOCK PRESENT
        027106  012700  000114                                                          MOV     #'L,R0
        027112  104462                                                                  TRAP    C$CLCK
     13 027114                                  BCOMPLETE KYES
        027114  103413                                                                  BCS     KYES
     14 027116                                  CLOCK P,R0              ;SEE IF A P CLOCK PRESENT
        027116  012700  000120                                                          MOV     #'P,R0
        027122  104462                                                                  TRAP    C$CLCK
     15 027124                                  BCOMPLETE KYES
        027124  103407                                                                  BCS     KYES
     16 027126  005037  002354                  CLR KW.CSR              ;IF NEITHER, CLEAR CSR STORAGE WORD
     17 027132                                  PNTF NOCLOCK
        027132  004137  022266                                                          JSR R1,LPNTF
        027136  006055                                                                  .WORD NOCLOCK
        027140  000000                                                                  .WORD PNT.CT
     18 027142  000434                          BR KNO
     19 027144  012037  002354          KYES:   MOV (R0)+,KW.CSR        ;STORE DATA RETURNED
     20 027150  012037  002356                  MOV (R0)+,KW.BRL
     21 027154  012037  002360                  MOV (R0)+,KW.VEC
     22 027160  012037  002362                  MOV (R0)+,KW.HZ
     23 027164                                  SETVEC KW.VEC,#KW11I,KW.BRL     ;SET THE VECTOR
        027164  013746  002356                                                          MOV     KW.BRL,-(SP)
        027170  012746  025304                                                          MOV     #KW11I,-(SP)
        027174  013746  002360                                                          MOV     KW.VEC,-(SP)
        027200  012746  000003                                                          MOV     #3,-(SP)
        027204  104437                                                                  TRAP    C$SVEC
        027206  062706  000010                                                          ADD     #10,SP
     24 027212  012777  000105  153134          MOV #KWOUT.,@KW.CSR     ;START THE CLOCK
     25 027220  012701  002370                  MOV     #STIME,R1
     29 027224  012700  001604                  MOV #15.*60.,R0         ;SET TIME FOR NEXT REPORT
     30 027230  004737  023604                  CALL SETTO
     32 027234                          KNO:
```

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

027234  013737  002176  002206                MOV FFREE,CTABS                 ;STORE START OF CONTROLLER TABLES
027242  005077  152740                        CLR @CTABS                      ;ZEROS MARKS END CONTROLLER TABLES
027246  005037  002210                        CLR CTRLRS                      ;CLEAR CONTROLLER COUNT

                                        ;GET A P-TABLE FROM DRS

027252  005002                        INIT4:  CLR R2                          ;LOGICAL UNIT NUMBER IN R2
027254                                        GPHARD R2,R0                    ;GET POINTER TO A P-TABLE
027254  010200                                                                        MOV     R2,R0
027256  104442                                                                        TRAP    C$GPHRD
027260                                        BNCOMPLETE NXTTAB               ;IGNORE IF NO TABLE RETURNED
027260  103075                                                                        BCC     NXTTAB

                                        ;SEE IF A CONTROLLER TABLE ALREADY EXISTS FOR CONTROLLER IN P-TABLE

027262  013703  002206                        MOV CTABS,R3                    ;GET ADDRESS OF CONTROLLER TABLES
027266  005713                        INIT5:  TST (R3)                        ;CHECK IF ANY MORE TABLES
027270  001416                                BEQ NEWTAB                      ;BUILD NEW TABLE IF FOUND ZERO WORD
027272  021013                                CMP (R0),(R3)                   ;CHECK IF SAME UNIBUS ADDRESS
027274                                                ASSUME C.UADR EQ 0
027274                                                ASSUME HO.UBA EQ 0
027274  001450                                BEQ SAMTAB                      ;CHECK TABLE IF ALREADY EXISTS
027276  016301  000004                        MOV     C.VEC(R3),R1            ;GET VECTOR FROM EXISING CONTROLLER TABLE
027302  042701  177000                        BIC     #^C<CT.VEC>,R1
027306  026001  000002                        CMP     HO.VEC(R0),R1           ;SEE IF DEFFERENT VECTOR
027312  001002                                BNE     1$
027314  000137  030166                        JMP     SAMVEC                  ;ERROR, CAN'T HAVE TWO UDA'S WITH SAME VECTOR
027320  062703  000046                1$:     ADD #C.SIZE,R3                  ;MOVE TO NEXT TABLE
027324  000760                                BR INIT5
```

```
                                        ;BUILD A CONTROLLER TABLE

027326  012701  000023   NEWTAB: MOV #C.SIZE/2,R1        ;GET WORDS IN CONTROLLER TABLE
027332  004737  014420           CALL ALOCM              ;ALLOCATE SPACE FOR IT
027336  011021                   MOV (R0),(R1)+          ;STORE UNIBUS ADDRESS
027340  010221                   MOV R2,(R1)+            ;UNIT NUMBER
027342  016004  000004           MOV H0.BRL(R0),R4       ;GET BR LEVEL
027346  000304                   SWAB R4                 ;SWAP TO HIGH BYTE
027350  006104                   ROL R4                  ;SHIFT ONE MORE TO LEFT
027352  056004  000002           BIS H0.VEC(R0),R4       ;ADD VECTOR ADDRESS
027356  010421                   MOV R4,(R1)+            ;  TO TABLE
027360  016021  000006           MOV H0.BST(R0),(R1)+
027364  012721  004037           MOV #4037,(R1)+         ;PUT [JSR R0,UDASRV]
027370  012721  023574           MOV #UDASRV,(R1)+       ;  INTO TABLE
027374  012703  000015           MOV #13.,R3             ;CLEAR POINTERS TO DRIVE TABLES,
027400  005021           INIT7:  CLR (R1)+               ; TIMEOUT COUNTER, FLAGS, REF. NUMBER
027402  005303                   DEC R3
027404  001375                   BNE INIT7               ;LOOP TIL ALL CLEARED
027406  005237  002210           INC CTRLRS              ;COUNT THE CONTROLLER
027412  005011                   CLR (R1)                ;CLEAR TABLE END MARKER
027414  000417                   BR NXTTAB               ;NOW GO TO NEXT P-TABLE
```

```
                                        ;SHOULD BE SAME CONTROLLER, CHECK THAT OTHER PARAMETERS MATCH

027416  016004  000004          SAMTAB: MOV HO.BRL(R0),R4               ;GET BR LEVEL FROM P-TABLE
027422  000304                          SWAB R4                         ;SWAP TO HIGH BYTE
027424  006104                          ROL R4                          ;SHIFT ONE MORE TO LEFT
027426  056004  000002                  BIS HO.VEC(R0),R4               ;ADD VECTOR ADDRESS
027432  020463  000004                  CMP R4,C.VEC(R3)                ;COMPARE WITH CONTROLLER TABLE
027436  001004                          BNE 1$
027440  026063  000006  000006        CMP HO.BST(R0),C.BST(R3)         ;COMPARE BURST RATES
027446  001402                          BEQ NXTTAB
027450  000137  030116          1$:     JMP CTABER                      ;FATAL ERROR IF NOT SAME

                                        ;GET NEXT P-TABLE

027454  005202                  NXTTAB: INC R2                          ;INCREMENT LOGICAL UNIT NUMBER
027456  023702  002012                  CMP L$UNIT,R2                   ;CHECK IF GOT ALL TABLES
027462  003274                          BGT INIT4                       ;IF NOT, GO BACK FOR NEXT

027464  012701  000001                  MOV #1,R1                       ;ALLOCATE SPACE FOR ZERO END WORD
027470  004737  014420                  CALL ALO M                      ;AFTER CONTROLLER TABLES
```

```
                                        ;NOW BUILD DRIVE TABLES
                                        
                                                CLR R5                  ;CLEAR CUSTOMER DATA FLAG
                                                CLR R2                  ;LOGICAL UNIT NUMBER IN R2
                                        INIT8:  GPHARD R2,R0            ;GET POINTER TO A P-TABLE
                                                                                MOV     R2,R0
                                                                                TRAP    C$GPHRD
                                                BNCOMPLETE INIT14       ;IF NOT AVAILABLE, GO GET NEXT
                                                                                BCC     INIT14
                                        
                                        ;FIND CONTROLLER TABLE
                                        
                                                MOV CTABS,R3            ;GET ADDRESS OF CONTROLLER TABLES
                                        INIT10: CMP (R0),(R3)           ;CHECK IF SAME UNIBUS ADDRESS
                                                BEQ INIT11              ;BRANCH IF TABLE FOUND
                                                ADD #C.SIZE,R3          ;MOVE TO NEXT TABLE
                                                BR INIT10
```

1				
2				
3	027474	005005		
4	027476	005002		
5	027500			
	027500	010200		
	027502	104442		
6	027504			
	027504	103060		
7				
8				
9				
10	027506	013703	002206	
11	027512	021013		
12	027514	001403		
13	027516	062703	000046	
14	027522	000773		

```
                                        ;BUILD DRIVE TABLE

027524  012701  000103       INIT11: MOV #D.SIZE/2,R1                ;GET SIZE OF DRIVE TABLE
027530  004737  014420               CALL ALOCM                      ;ALLOCATE SPACE FROM FREE MEMORY
                               ;       R0 POINTS TO P-TABLE
                               ;       R1 POINTS TO DRIVE TABLE
                               ;       R3 POINTS TO CONTROLLER TABLE
                               ;       R2 IS UNIT NUMBER
027534  010337  002262               MOV R3,TEMP                     ;SAVE CONTROLLER TABLE ADDRESS
                                                                       ;IN CASE AN ERROR IS DETECTED
027540  062703  000020               ADD #C.DR0,R3                   ;BUILD POINTER TO C.DR ENTRY IN CONTROLLER TABLE
027544  012704  000010               MOV #8.,R4                      ;GET MAX COUNT OF DRIVES ON ONE CONTROLLER
027550  005713               INIT12: TST (R3)                        ;CHECK IF ENTRY CONTAINS POINTER TO DRIVE TABLE
027552  001411                       BEQ INIT13
027554  026033  000010               CMP HO.LDR(R0),@(R3)+           ;CHECK DRIVE NUMBER IN DRIVE TABLE
027560  001002                       BNE 1$
027562  000137  030132               JMP MLDRER                      ;IF SAME, TWO P-TABLES POINT TO SAME DRIVE
027566  005304               1$:     DEC R4                          ;COUNT DRIVES
027570  001367                       BNE INIT12                      ;IF EIGHT DRIVE TABLES EXIST,
027572  000137  030150               JMP TOOMER                      ;  THEN REPORT ERROR
027576  010113               INIT13: MOV R1,(R3)                     ;LOAD DRIVE TABLE POINTER
027600  016021  000010               MOV HO.LDR(R0),(R1)+            ;LOAD DRIVE NUMBER
027604  010221                       MOV R2,(R1)+                    ;LOAD UNIT NUMBER
027606  016011  000012               MOV HO.PRM(R0),(R1)             ;GET TEST AREA BIT
027612  051105                       BIS (R1),R5                     ;SAVE "OR" OF BIT FROM ALL DRIVES
027614  005111                       COM (R1)                        ;COMPLIMENT IT
027616                               AND HM.CYL,(R1)
027616  042711  157777                                                                BIC #^C<HM.CYL>,(R1)
027622  052721  011012               BIS #DDEF,(R1)+                 ;LOAD DEFAULT PARAMETER BITS
027626  012703  000100               MOV #<D.SIZE/2-3>,R3            ;CLEAR REST OF TABLE
027632  005021               INIT3L: CLR (R1)+
027634  005303                       DEC R3
027636  003375                       BGT INIT3L
027640  012761  177777  177754       MOV #-1,<D.ECYL+2-D.SIZE>(R1)   ;MARK CYLINDERS AT TEST ALL
```

```
                                        ;GO TO NEXT DRIVE TABLE
                                        
027646  005202                  INIT14: INC R2                          ;INCREMENT LOGICAL UNIT NUMBER
027650  023702  002012                  CMP L$UNIT,R2                   ;CHECK IF GOT ALL TABLES
027654  003311                          BGT INIT8                       ;IF NOT, GET NEXT TABLE
                                        
                                        ;IF ANY DRIVE SELFCTED FOR EXERCISE IN CUSTOMER DATA AREA
                                        ;GIVE WARNING
                                        
027656  032705  020000                  BIT #HM.CYL,R5                  ;CHECK IF BIT EVER SET
027662  001460                          BEQ INIT15                      ;BYPASS IF NOT
027664                                  PNTF INITWA                     ;PRINT WARNING HEADER
027664  004137  022266                                                          JSR R1,LPNTF
027670  004255                                                                  .WORD INITWA
027672  000000                                                                  .WORD PNT.CT
027674  013705  002206                  MOV CTABS,R5                    ;GET FIRST CONTROLLER TABLE
027700  010504                  INITW1: MOV R5,R4                       ;GET ADDRESS OF POINTER TO DRIVE TABLE
027702  062704  000020                  ADD #C.DRO,R4
027706  012701  000010                  MOV #8.,R1                      ;GET COUNT OF DRIVE TABLES
027712  012403                  INITW2: MOV (R4)+,R3                    ;GET ADDRESS OF DRIVE TABLE
027714  001422                          BEQ INITW4
027716  032763  020000  000004          BIT #D.DCY,D.PRM(R3)            ;CHECK IF CUSTOMER DATA SELECTED
027724  001014                          BNE INITW3
027726                                  PRINTF #INITWB,D.UNIT(R3),(R5),(R3)     ;PRINT NUMBERS
027726  011346                                                                  MOV     (R3),-(SP)
027730  011546                                                                  MOV     (R5),-(SP)
027732  016346  000002                                                          MOV     D.UNIT(R3),-(SP)
027736  012746  004361                                                          MOV     #INITWB,-(SP)
027742  012746  000004                                                          MOV     #4,-(SP)
027746  010600                                                                  MOV     SP,R0
027750  104417                                                                  TRAP    C$PNTF
027752  062706  000012                                                          ADD     #12,SP
037 027756  005301              INITW3: DEC R1                          ;COUNT THE DRIVE TABLES
038 027760  001354                      BNE INITW2                      ;LOOK AT ALL OF THEM
039 027762  062705  000046      INITW4: ADD #C.SIZE,R5                  ;MOVE TO NEXT CONTROLLER TABLE
040 027766  005715                      TST (R5)                        ;SEE IF ANOTHER TABLE AND
041 027770  001343                      BNE INITW1                      ;  LOOK AT IT
```

INITIALIZE SECTION

```
                                        ;GET CONFIRMATION TO PROCEED
                                        
030024  013737  002176  002202 INIT15: MOV FFREE,FMEM                ;SAVE START ADDRESS
030032  013737  002200  002204         MOV FSIZE,FMEMS               ;SAVE SIZE
                                        
030040                         INITXX: SETPRI  #PRI00                ; SET RUNNING PRIORITY TO ZERO
030040  012700  000000                                                MOV     #PRI00,R0
030044  104441                                                        TRAP    C$SPRI
030046  005037  002414                 CLR DLL                       ;ERASE DOWNLINE LOAD DATA
030052  004737  024650                 CALL CLOSEF                   ;MAKE SURE DATA FILE IS CLOSED
030056                                 READEF #EF.START
030056  012700  000040                                                MOV     #EF.START,R0
030062  104447                                                        TRAP    C$REFG
030064                                 BCOMPLETE INITIM
030064  103404                                                        BCS     INITIM
030066                                 READEF #EF.RESTART
030066  012700  000037                                                MOV     #EF.RESTART,R0
030072  104447                                                        TRAP    C$REFG
030074                                 BNCOMPLETE KPRI
030074  103006                                                        BCC     KPRI
030076  012701  002370         INITIM: MOV     #STIME,R1             ;AT 15 MINUTES FROM NOW
030102  012700  001604                 MOV #15.*60.,R0               ;SET TIME FOR NEXT REPORT
030106  004737  023604                 CALL SETTO
030112                         KPRI:   EXIT INIT
030112  104432                                                        TRAP    C$EXIT
030114  000066                                                        .WORD   L10044-.
```

```
                                ;DIFFERENT VECTORS, BR LEVELS OR BURST RATES FOR ONE CONTROLLER
030116  010305                  CTABER: MOV R3,R5                       ;GET CONTROLLER ADDRESS
030120                                  ERRSF 1,,ERR001
030120  104454                                                                 TRAP    C$ERSF
030122  000001                                                                 .WORD   1
030124  000000                                                                 .WORD   0
030126  013242                                                                 .WORD   ERR001
030130                                  DOCLN
030130  104444                                                                 TRAP    C$DCLN

                                ;TWO P-TABLES FOR SAME DRIVE
030132  013705  002262          MLDRER: MOV TEMP,R5                     ;GET CONTROLLER ADDRESS
030136                                  ERRSF 2,,ERR002
030136  104454                                                                 TRAP    C$ERSF
030140  000002                                                                 .WORD   2
030142  000000                                                                 .WORD   0
030144  013260                                                                 .WORD   ERR002
030146                                  DOCLN
030146  104444                                                                 TRAP    C$DCLN

                                ;MORE THAN EIGHT DRIVES SELECTED ON ONE CONTROLLER

03015J  ^13705  002262          TOOMER: MOV TEMP,R5                     ;GET CONTROLLER ADDRESS
030154                                  ERRSF 3,,ERR003
030154  104454                                                                 TRAP    C$ERSF
030156  000003                                                                 .WORD   3
030160  000000                                                                 .WORD   0
030162  013276                                                                 .WORD   ERR003
030164                                  DOCLN
030164  104444                                                                 TRAP    C$DCLN

                                ;TWO UDA'S USE THE SAME VECTOR

030166  010305                  SAMVEC: MOV     R3,R5                   ;GET CONTROLLER ADDRESS
030170                                  ERRSF   8,,ERR008
030170  104454                                                                 TRAP    C$ERSF
030172  000010                                                                 .WORD   8
030174  000000                                                                 .WORD   0
030176  013364                                                                 .WORD   ERR008
030200                                  DOCLN
030200  104444                                                                 TRAP    C$DCLN

030202                                  ENDINIT
030202                                                                  L10044:
030202  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.
                                ;--

030204                                  BGNAUTO
030204                                                                  L$AUTO::

030204                                  ENDAUTO
030204                                                                  L10045:
030204  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.
                                ;--

030206                                  BGNCLN
030206                                                                          L$CLEAN::

030206  004737  024650                  CALL CLOSEF                     ;CLOSE DATA FILE

030212  022737  000004  002230          CMP     #4,TNUM                 ; ARE WE DOING TEST #4?
030220  001402                          BEQ     1$                      ; IF SO, DON'T RESET BUS
030222  004737  025334                  CALL    RESET
030226                          1$:

030226                                  ENDCLN
030226                                                                  L10046:
030226  104412                                                                  TRAP    C$CLEAN

030230                                  ENDMOD
```

```
                                .SBTTL  TEST 1: UNIBUS ADDRESSING TEST

030230                                  BGNMOD

030230                                  BGNTST
030230                                                                          T1::
030230  012701  000001                  MOV     #1,R1                   ; INITIALIZE TEST PARAMETERS
030234  004737  014504                  CALL    TINIT
030240  013737  002206  002212          MOV     CTABS,TSTTAB            ; GET ADDRESS OF FIRST CONTROLLER TABLE
030246  013705  002212          T1NEXT: MOV     TSTTAB,R5               ; GET CONTROLLER TABLE ADDRESS
030252  116537  000002  002074          MOVB    C.UNIT(R5),L$LUN        ; CHECK IF UNIT AVAILABLE FOR TESTING
030260  005765  000002                  TST     C.UNIT(R5)
030264  100010                          BPL     T1NOW                   ; TEST IF AVAILABLE
030266                                  ASSUME CT.AVL EQ BIT15
030266  062737  000046  002212  T1SKIP: ADD     #C.SIZE,TSTTAB          ; MOVE TO NEXT CONTROLLER
030274  005777  151712                  TST     @TSTTAB                 ; CHECK IF ANOTHER CONTROLLER TABLE
030300  001362                          BNE     T1NEXT
030302                                  EXIT TST
030302  104432                                                          TRAP    C$EXIT
030304  000776                                                          .WORD   L10047-.

030306  004737  025334          T1NOW:  CALL    RESET                   ; RESET ALL UNITS
```

```
      1 030312                          BGNSUB: 1
        030312
        030312  104402
      2 030314  005037  002374                  CLR NXMAD
      3 030320                                  SETVEC #4,#NXMI,#PRI07
        030320  012746  000340
        030324  012746  023564
        030330  012746  000004
        030334  012746  000003
        030340  104437
        030342  062706  000010
      4 030346  011504                          MOV (R5),R4
      5 030350  005714                          TST (R4)
      6 030352  005764  000002                  TST 2(R4)
      7 030356                                  CLRVEC  #4
        030356  012700  000004
        030362  104436
      8 030364  005737  002374                  TST NXMAD
      9 030370  001406                          BEQ T1GOOD
     10 030372                                  ERRDF 38,,ERR038
        030372  104455
        030374  000046
        030376  000000
        030400  014042
     11 030402                                  CKLOOP
        030402  104406
     12 030404  000730                          BR T1SKIP
     13 030406                          T1GOOD:
     14 030406                          ENDSUB
        030406
        030406  104403
```

```
                                   T1.1:
                                           TRAP    C$BSUB
;CLEAR MEMORY ERROR FLAG
                                           MOV     #PRI07,-(SP)
                                           MOV     #NXMI,-(SP)
                                           MOV     #4,-(SP)
                                           MOV     #3,-(SP)
                                           TRAP    C$SVEC
                                           ADD     #10,SP
;GET ADDRESS OF UDAIP REGISTER
;READ UDAIP
;READ UDASA
;GIVE UP VECTOR
                                           MOV     #4,R0
                                           TRAP    C$CVEC
;CHECK FLAG

                                           TRAP    C$ERDF
                                           .WORD   38
                                           .WORD   0
                                           .WORD   ERR038

                                           TRAP    C$CLP1
;END TEST NOW

                                   L10050:
                                           TRAP    C$ESUB
```

```
      1 030410                          BGNSUB: 2
        030410                                                                T1.2:
        030410  104402                                                                TRAP    C$BSUB
      2 030412                          DIATST:
      3                                 ;
      4                                 ;       MAKE SURE UDA PASSES INTERNAL DIAGNOSTIC
      5                                 ;       MAKE SURE UDA CAN SENSE STEP 1 AND 2
      6                                 ;
      7 030412  005014                          CLR     (R4)                    ; INIT UDA
      8 030414  012737  004000  024604          MOV     #SA.S1,UDARSD           ; STEP 1 ASSERTED?
      9 030422  004737  024446                  CALL    UDARSP                  ; WAIT FOR RESPONSE
     10 030426  103410                          BCS     1$                      ; IF FAIL, EXIT
     11 030430  012764  100000  000002          MOV     #SA.STP,2(R4)           ; SEND STEP 1
     12 030436  012737  010000  024604          MOV     #SA.S2,UDARSD           ; STEP 2 ASSERTED?
     13 030444  004737  024446                  CALL    UDARSP
     14 030450                          1$:
     15 030450                          ENDSUB
        030450                                                                L10051:
        030450  104403                                                                TRAP    C$ESUB
```

```
      1 030452                          BGNSUB; 3
        030452                                                                  T1.3:
        030452  104402                                                                  TRAP    C$BSUB
      2 030454                          PORTST:
      3                                 ;
      4                                 ;       TEST THE DIAGNOSTIC LOOP MODE OF ALL UDA'S ON THE SYSTEM
      5                                 ;
      6 030454  011504                          MOV     (R5),R4                 ; R4 POINTS TO UDAIP REGISTER
      7 030456                                  ASSUME C.UADR EQ 0
      8 030456  005014                          CLR     (R4)                    ; INITIALIZE THE UDA
      9 030460  012737  004000  024604          MOV     #SA.S1,UDARSD           ; LOOK FOR STEP 1
     10 030466  004737  024446                  CALL    UDARSP                  ; WAIT FOR RESPONSE
     11 030472  103444                          BCS     3$                      ; IF ERROR, BRANCH
     12 030474  016437  000002  031400          MOV     2(R4),WCHNGD            ; MOVE OLD PORT CONTENTS TO STORAGE
     13 030502  012764  140000  000002          MOV     #<SA.STP+SA.WRP>,2(R4)  ; INITIALIZE FOR PORT WRAP
     14 030510  004737  031304                  CALL    WCHNG                   ; WAIT FOR THE PORT TO CHANGE
     15 030514  001433                          BEQ     3$                      ; IF ERROR, BRANCH
     16 030516  022764  140000  000002          CMP     #<SA.STP+SA.WRP>,2(R4)  ; COMPARE WITH DATA WRITTEN
     17 030524  001017                          BNE 5$
     18 030526  012702  000001          4$:     MOV     #1,R2                   ; SET UP FOR SHIFTING '1'
     19 030532  012703  000020                  MOV     #16.,R3                 ; SET UP LOOP COUNT
     20 030536  016437  000002  031400  1$:     MOV     2(R4),WCHNGD            ; SAVE OLD PORT CONTENTS
     21 030544  010264  000002                  MOV     R2,2(R4)                ; WRITE PATTERN TO UDASA FOR LOOP
     22 030550  004737  031304                  CALL    WCHNG                   ; WAIT FOR UDASA TO CHANGE
     23 030554  001413                          BEQ     3$                      ; IF ERROR, BRANCH
     24 030556  020264  000002                  CMP     R2,2(R4)                ; COMPARE R0 WITH WHAT WAS ECHOED
     25 030562  001405                          BEQ     2$                      ; IF MATCH, BRANCH
     26 030564                          5$:     ERRDF   26.,ERR026              ; REPORT ERROR
        030564  104455                                                                  TRAP    C$ERDF
        030566  000032                                                                  .WORD   26
        030570  000000                                                                  .WORD   0
        030572  013632                                                                  .WORD   ERR026
     27 030574  000403                          BR      3$                      ; BRANCH
     28 030576  006302                  2$:     ASL     R2                      ; MOVE THE SHIFTING ONE LEFT BY 1
     29 030600  005303                          DEC     R3                      ; DECREMENT COUNT
     30 030602  001355                          BNE     1$                      ; IF LOOP INCOMPLETE, BRANCH
     31 030604                          3$:
     32 030604                          ENDSUB
        030604                                                                  L10052:
        030604  104403                                                                  TRAP    C$ESUB
```

```
                                BGNSUB: 4
                                                                                T1.4:
                                                                                        TRAP    C$BSUB
                                INTEST:
                                ;
                                ;       TEST THE INTERRUPTS VECTOR AND BR LEVEL
                                        MOV     (R5),R4                 ; R4 POINTS TO UDAIP REGISTER
                                        ASSUME C.UADR EQ 0
                                        MOV     C.VEC(R5),R3            ; GET VECTOR AND BRANCH LEVEL
                                        MOV     R3,R2                   ; COPY TO R2 FOR BR LEVEL
                                        BIC     #^CCT.VEC,R3            ; CLEAR UNUSED VECTOR BITS
                                        BIC     #^CCT.BRL,R2            ; CLEAR UNUSED BRANCH LEVEL BITS
                                        MOV     #9.,R1                  ; SET UP TO SHIFT BR LEVEL
                                1$:     ASR     R2                      ; SHIFT BY ONE BIT
                                        DEC     R1                      ; COUNT SHIFTS
                                        BNE     1$                      ; IF INCOMPLETE, BRANCH
                                        MOV     R2,BRLEV                ; SAVE THE BRANCH LEVEL
                                        PNTX    INTST0,(R5),R3          ; PRINT BEGINNING OF INTERRUPT MESSAGE
                                                                                        MOV R3,-(SP)
                                                                                        MOV (R5),-(SP)
                                                                                        JSR R1,LPNTX
                                                                                        .WORD INTST0
                                                                                        .WORD PNT.CT
                                        ASSUME C.UADR EQ 0
                                        SETVEC  R3,#INTSRV,#PRI00       ; SET UP INTERRUPT ROUTINE
                                                                                        MOV     #PRI00,-(SP)
                                                                                        MOV     #INTSRV,-(SP)
                                                                                        MOV     R3,-(SP)
                                                                                        MOV     #3,-(SP)
                                                                                        TRAP    C$SVEC
                                                                                        ADD     #10,SP
                                        SETPRI  #PRI00                  ; SET PRIORITY TO 0 TO CHECK INTERRUPTS
                                                                                        MOV     #PRI00,R0
                                                                                        TRAP    C$SPRI
                                        ASR     R3                      ; DIVIDE VECTOR BY 4 FOR UDA INITIALIZATION
                                        ASR     R3                      ; DIVIDE VECTOR BY 4 FOR UDA INITIALIZATION
                                        BIS     #<SA.STP+SA.INT>,R3     ; SET OTHER BITS FOR UDA INITIALIZATION
                                        CLR     INTRCV                  ; FLAG AS NO INTERRUPTS RECEIVED
                                        CLR     (R4)                    ; INIT UDA
                                        MOV     #SA.S1,UDARSD           ; LOOK FOR STEP 1 COMPLETION
                                        CALL    UDARSP                  ; WAIT FOR COMPLETION
                                        MOV     R3,2(R4)                ; MOVE STEP 1 DATA TO UDA
                                        MOV #10.,R0                     ;SET UP TIMEOUT OF 10 SECONDS
                                        MOV R5,R1
                                        ADD #C.TO,R1                    ;POINT TO CONTROLLER TABLE
                                        CALL SETTO
                                9$:     TST     INTRCV                  ; SEE IF INTERRUPTED
                                        BNE     11$                     ; IF SO, EVERYTHING'S OK, SO BRANCH
                                        BREAK
                                                                                        TRAP    C$BRK
```

TEST 1: UNIBUS ADDRESSING TEST

```
      1 030776  005737  002354                    TST KW.CSR                      ;SEE IF CLOCK ON SYSTEM
      2 031002  001771                            BEQ 9$
      3 031004  023765  002366  000042            CMP KW.EL+2,C.TOH(R5)           ;SEE IF TIME ELAPSED
      4 031012  101041                            BHI 3$
      5 031014  001364                            BNE 9$
      6 031016  023765  002364  000040            CMP KW.EL,C.TO(R5)
      7 031024  103760                            BLO 9$
      8 031026  000433                            BR      3$                      ; BRANCH
      9 031030  005037  002240          11$:      CLR     INTRCV                  ; FLAG AS NO INTERRUPTS RECEIVED
     10 031034                                    SETPRI  #PRI07                  ; SET PRIORITY AS HIGHEST PRIORITY
        031034  012700  000340                                                            MOV     #PRI07,R0
        031040  104441                                                                     TRAP    C$SPRI
     11 031042  005064  000002                    CLR     2(R4)                   ; WRITE SECOND STEP TO UDA
     12 031046  012702  000144                    MOV     #100.,R2                ; SET UP DELAY SO WE KNOW WE'RE INTERRUPTED
     13 031052  005302                  12$:      DEC     R2                      ; DECREMENT COUNT
     14 031054  001376                            BNE     12$                     ; IF INCOMPLETE, BRANCH
     15 031056  012701  000007                    MOV     #7.,R1                  ; R1 IS PROCESS PRIORITY LEVEL
     16 031062                            2$:     PUSH    R1                      ; SAVE PRIORITY
        031062  010146                                                                     MOV R1,-(SP)
     17 031064  012702  000005                    MOV     #5.,R2                  ; SET UP FOR SHIFTING PRIORITY
     18 031070  006301                  10$:      ASL     R1                      ; SHIFT PRIORITY
     19 031072  005302                            DEC     R2                      ; DECREMENT SHIFT COUNT
     20 031074  001375                            BNE     10$                     ; IF INCOMPLETE, BRANCH
     21 031076                                    SETPRI  R1                      ; SET RUNNING PRIORITY TO R1
        031076  010100                                                                     MOV     R1,R0
        031100  104441                                                                     TRAP    C$SPRI
     22 031102                                    POP     R1                      ; RESTORE R1
        031102  012601                                                                     MOV (SP)+,R1
     23 031104  005737  002240                    TST     INTRCV                  ; SEE IF INTERRUPT RECEIVED
     24 031110  001007                            BNE     4$                      ; IF SO, BRANCH
     25 031112  005301                            DEC     R1                      ; DECREMENT PRIORITY LEVEL
     26 031114  100362                            BPL     2$                      ; IF ALL LEVELS UNTESTED, BRANCH
     27 031116                            3$:     ERRDF   28.,ERR028              ; REPORT NO INTERRUPTS ERROR
        031116  104455                                                                     TRAP    C$ERDF
        031120  000034                                                                     .WORD   28
        031122  000000                                                                     .WORD   0
        031124  013670                                                                     .WORD   ERR028
     28 031126  000420                            BR      6$                      ; BRANCH
```

```
      1 031130                          4$:     SETPRI  #PRI00          ; SET RUNNING PRIORITY TO 0
        031130  012700  000000                                                  MOV     #PRI00,R0
        031134  104441                                                          TRAP    C$SPRI
      2 031136  005201                          INC     R1              ; SO PRIORITY = BR LEVEL
      3 031140  023701  031402                  CMP     BRLEV,R1        ; SEE IF BR LEVEL MATCHES PRIORITY
      4 031144  001405                          BEQ     5$              ; IF SO, BRANCH
      5 031146                                  ERRDF   29,,ERR029      ; REPORT ERROR
        031146  104455                                                          TRAP    C$ERDF
        031150  000035                                                          .WORD   29
        031152  000000                                                          .WORD   0
        031154  013702                                                          .WORD   ERR029
      6 031156  000404                          BR      6$              ; BRANCH
      7 031160                          5$:     PNTX    INTST1          ; PRINT TESTING COMPLETED
        031160  004137  022306                                                  JSR R1,LPNTX
        031164  004240                                                          .WORD INTST1
        031166  000000                                                          .WORD PNT.CT
      8 031170  016503  000004          6$:     MOV     C.VEC(R5),R3    ; GET VECTOR ADDRESS
      9 031174  042703  177000                  BIC     #^CCT.VEC,R3    ; CLEAR UNUSED BITS
     10 031200                                  CLRVEC  R3              ; CLEAR VECTOR
        031200  010300                                                          MOV     R3,R0
        031202  104436                                                          TRAP    C$CVEC
     11 031204                          ENDSUB                                      L10053:
        031204                                                                  TRAP    C$ESUB
        031204  104403
```

```
      1 031206                          BGNSUB; 5
        031206                                                          T1.5:
        031206  104402                                                          TRAP    C$BSUB
      2 031210  005004                          CLR     R4          ; INITIALIZE UDA WITH SMALLEST
      3 031212  004737  023666                  CALL    UDAINT      ; RING BUFFER AND INTERRUPTS DISABLED
      4 031216                          ENDSUB
        031216                                                          L10054:
        031216  104403                                                          TRAP    C$ESUB
```

```
      1 031220                          BGNSUB: 6
        031220                                                                          T1.6:
        031220  104402                                                                          TRAP    C$BSUB
      2 031222  012704  126400                  MOV     #<SA.STP+<5*SA.MS1>+<5*SA.CM1>>,R4      ;INITIALIZE UDA WITH RING BUFFER
      3 031226  004737  023666                  CALL    UDAINT                          ; LARGE ENOUGH TO COVER NORMAL HOST COMM AREA
      4                                                                                 ; PACKET AND BUFFER SPACE (A 5 IN MES
      5                                                                                 ; LENGTH AND A 5 IN CMD LENGTH)
      6 031232                          ENDSUB
        031232                                                                          L10055:
        031232  104403                                                                          TRAP    C$ESUB
```

```
      1 031234                          BGNSUB; 7
        031234
        031234  104402                                                    T1.7:
                                                                                  TRAP    C$BSUB
      2 031236                                  PUSH    FFREE       ; SAVE FREE MEMORY PARAMETERS
        031236  013746  002176                                                   MOV FFREE,-(SP)
      3 031242                                  PUSH    FSIZE
        031242  013746  002200                                                   MOV FSIZE,-(SP)
      4 031246  012701  000001                  MOV     #1,R1       ; RUN DM PROGRAM IN
      5 031252  004737  014632                  CALL    RUNDM       ; ONE CONTROLLER ONLY
      6 031256  001402                          BEQ 1$
      7 031260  004737  014726                  CALL RESPDM
      8 031264                          1$:     POP     FSIZE
        031264  012637  002200                                                   MOV (SP)+,FSIZE
      9 031270                                  POP     FFREE
        031270  012637  002176                                                   MOV (SP)+,FFREE
     10 031274                          ENDSUB
        031274                                                          L10056:
        031274  104403                                                           TRAP    C$ESUB
     11
     12 031276  000137  030266                  JMP T1SKIP
     13
     14 031302                          ENDTST
        031302                                                          L10047:
        031302  104401                                                           TRAP    C$ETST
```

```
                                        ;WCHNG
                                        ;
                                        ;       WAIT UNTIL UDASA CHANGES FROM WHAT IS IN WCHNGD
                                        
031304  012700  000012          WCHNG:  MOV #10.,R0                      ;SET TIMEOUT FOR 10 SECONDS
031310  010501                          MOV R5,R1                       ;POINT TO CONTROLLER TABLE
031312  062701  000040                  ADD #C.TO,R1
031316  004737  023604                  CALL SETTO
031322  026437  000002  031400  1$:     CMP 2(R4),WCHNGD                ;SEE IF CHANGED
031330  001022                          BNE 2$
031332                                  BREAK
031332  104422                                                          TRAP    C$BRK
031334  005737  002354                  TST KW.CSR                      ;SEE IF CLOCK ON SYSTEM
031340  001770                          BEQ 1$
031342  023765  002366  000042          CMP KW.EL+2,C.TOH(R5)           ;CHECK IF TIME OUT OCCURRED
031350  101005                          BHI 3$
031352  001363                          BNE 1$
031354  023765  002364  000040          CMP KW.EL,C.TO(R5)
031362  103757                          BLO 1$
031364                          3$:     ERRDF   27,,ERR027              ; REPORT ERROR
031364  104455                                                          TRAP    C$ERDF
031366  000033                                                          .WORD   27
031370  000000                                                          .WORD   0
031372  013652                                                          .WORD   ERR027
031374  000264                          SEZ                             ; FLAG AS ERROR
031376  000207                  2$:     RETURN                          ; RETURN TO CALLING PROGRAM

031400                          WCHNGD: .BLKW   1                       ; OLD PORT CONTENTS
031402                          BRLEV:  .BLKW   1                       ; WORD FOR BRANCH LEVEL STORAGE
```

```
                                .SBTTL  TEST 2: DISK RESIDENT DIAGNOSTIC TEST

                                        BGNTST
                                                                                T2::

                                        MOV #2,R1                       ;INIT TEST PARAMETERS
                                        CALL TINIT

                                        MOV CTABS,TSTTAB                ;GET POINTER TO FIRST CONTROLLER TABLE

                                T2NEXT: CALL RESET                      ;RESET ALL UNITS
                                        PUSH FFREE                      ;SAVE FREE MEMORY PARAMETERS
                                                                                MOV FFREE,-(SP)
                                        PUSH FSIZE
                                                                                MOV FSIZE,-(SP)
                                        MOV #1,R1                       ;RUN DM PROGRAM IN
                                        CALL RUNDM                      ; ONE CONTROLLER ONLY
                                        BEQ 1$
                                        CALL RESPDM
                                1$:     POP FSIZE
                                                                                MOV (SP)+,FSIZE
                                        POP FFREE
                                                                                MOV (SP)+,FFREE

                                        ADD #C.SIZE,TSTTAB              ;MOVE TO NEXT CONTROLLER
                                        TST @TSTTAB                     ;CHECK IF ANY MORE CONTROLLER TABLES
                                        BNE T2NEXT

                                        ENDTST

                                                                        L10057:
                                                                                TRAP    C$ETSI
```

```
                                .SBTTL  TEST 3: DISK FUNCTION TEST

                                        BGNTST
                                                                                T3::
031502  012701  000003                  MOV #3,R1                     ;INITIALIZE TEST PARAMETERS
031506  004737  014504                  CALL TINIT
031512  013737  002206  002212          MOV CTABS,TSTTAB              ;GET FIRST TABLE ADDRESS
031520  013701  002210                  MOV CTRLRS,R1                 ;RUN DM PROGRAM ON ALL CONTROLLERS
031524  004737  014632                  CALL RUNDM                    ;  AT ONCE
031530  001402                          BEQ 1$
031532  004737  014726                  CALL RESPDM
031536                          1$:
031536                                  ENDTST
                                                                        L10060:
031536  104401                                                                  TRAP    C$ETST
```

```
                                .SBTTL  TEST 4: DISK EXERCISER

                                        BGNTST
                                                                        T4::
                                        CMP #4,TNUM             ;CHECK IF TEST 4 WAS IN PROGRESS
                                        BNE T4STRT              ;BRANCH IF NOT
                                        CMP #ICONT,IFLAGS       ;CHECK IF HERE BY CONTINUE COMMAND
                                        BNE T4STRT              ;BRANCH IF NOT
                                        CLR IFLAGS              ;CLEAR FLAGS FOR NEXT TIME HERE
                                        MOV LBUFS,R4            ;GET LOG BUFFER POINTER
                                        BEQ LOGCHK              ;  IF ZERO, NONE EXISTS
                                        PNTF LOGM1              ;INTRODUCE ERROR LOG
                                                                        JSR R1,LPNTF
                                                                        .WORD LOGM1
                                                                        .WORD PNT.CT
                                        CLR LBUFS               ;CLEAR START ADDRESS TO ERASE BUFFER
LOGOUT:                 MOV (R4)+,R5    ;GET CONTROLLER TABLE ADDRESS
                                        CALL PNTERR             ;PRINT ERROR REPORT
                                        ADD #<HC.BSZ-2>,R4      ;BUMP POINTER TO NEXT ENTRY
                                        CMP R4,LBUFN            ;CHECK IF AT END
                                        BLO LOGOUT              ;PRINT ALL ENTRIES
                                        PNTF LOGM2
                                                                        JSR R1,LPNTF
                                                                        .WORD LOGM2
                                                                        .WORD PNT.CT
                                        BR T4CON

LOGCHK:                 BIT #SM.LOG,SFPTBL+SO.BIT       ;CHECK IF LOG ENABLED
                                        BEQ T4CON
                                        PNTF LOGM3              ;REPORT LOG EMPTY
                                                                        JSR R1,LPNTF
                                                                        .WORD LOGM3
                                                                        .WORD PNT.CT
T4CON:                  TST URNING      ;CHECK IF ANY CONTROLLERS STILL RUNNING
                                        BEQ T4STRT              ;RESTART IF NOT
                                        CALL RESPDM             ;CONTINUE BY RESPONDING TO REQUESTS
                                        JMP T4WAIT              ;END OF TEST WHEN DONE
```

```
                                        ;START TEST 4
                                        
031676  032737  000014  002226  T4STRT: BIT #ISTRT+IREST,IFLAGS          ;HERE FROM OPERATOR COMMAND?
031704  001534                          BEQ T4RUN                       ;RUN WITH PREVIOUS PARAMETERS IF NEW PASS
031706  032737  000200  002160          BIT #SM.MAN,SFPTBL+SO.BIT       ;MANUAL INTERVENTION MODE?
031714  001476                          BEQ T4DEF                       ;IF NOT, SET UP DEFAULT PARAMETERS
031716                                  MANUAL                          ;MANUAL INTERVENTION ALLOWED?
031716  104450                                                                  TRAP    C$MANI
031720                                  BNCOMPLETE T4DEFW               ;IF NOT, GIVE WARNING
031720  103070                                                                  BCC     T4DEFW
                                        
                                        ;INPUT PARAMETERS
                                        
031722  005037  002236                  CLR UCNT                        ;CLEAR COUNT OF UNITS USING PATTERN 16
031726  013705  002206                  MOV CTABS,R5                    ;GET FIRST CONTROLLER TABLE
031732  012702  000010          T4PRM1: MOV #8.,R2                      ;GET COUNT OF DRIVE TABLES
031736  010504                          MOV R5,R4                       ;GET FIRST DRIVE TABLE POINTER
031740  062704  000020                  ADD #C.DRO,R4
031744  012403                  T4PRM2: MOV (R4)+,R3                    ;GET DRIVE TABLE ADDRESS
031746  001416                          BEQ T4PRM4                      ;GO TO NEXT CONTROLLER IF NONE
031750  032763  100000  000002          BIT #DT.AVL,D.UNIT(R3)          ;SEE IF TO BE TESTED
031756  001010                          BNE T4PRM3
031760  004737  032266                  CALL T4QUEST                    ;ASK QUESTIONS
031764  022763  000020  000006          CMP #16.,D.PAT(R3)
031772  001002                          BNE T4PRM3
031774  005237  002236                  INC UCNT
032000  005302                  T4PRM3: DEC R2                          ;COUNT DRIVE TABLES
032002  001360                          BNE T4PRM2                      ;GO LOOK AT NEXT
032004  062705  000046          T4PRM4: ADD #C.SIZE,R5                  ;GO TO NEXT CONTROLLER
032010  005715                          TST (R5)                        ;  IF THERE IS ONE
032012  001347                          BNE T4PRM1
```

```
      1                                 ;NOW GET DATA PATTERN 16 IF SELECTED BY ANY DRIVE
      2
      3 032014                                GMANID T4DPC,PAT16C,D,-1,1,16.,YES      ;COUNT OF WORDS
        032014  104443                                                                 TRAP    C$GMAN
        032016  000406                                                                 BR      10000$
        032020  002312                                                                 .WORD   PAT16C
        032022  000052                                                                 .WORD   T$CODE
        032024  003507                                                                 .WORD   T4DPC
        032026  177777                                                                 .WORD   -1
        032030  000001                                                                 .WORD   T$LOLIM
        032032  000020                                                                 .WORD   T$HILIM
        032034                                                                      10000$:
      4 032034  013701  002312                MOV PAT16C,R1                   ;GET COUNT OF WORDS
      5 032040  012704  002314                MOV #PAT16W,R4                  ;GET ADDRESS OF STORAGE
      6 032044  011437  002262          T4PRM5: MOV (R4),TEMP
      7 032050                                GMANID T4DPD,TEMP,0,-1,0,-1,YES ;DATA WORD
        032050  104443                                                                 TRAP    C$GMAN
        032052  000406                                                                 BR      10001$
        032054  002262                                                                 .WORD   TEMP
        032056  000032                                                                 .WORD   T$CODE
        032060  003552                                                                 .WORD   T4DPD
        032062  177777                                                                 .WORD   -1
        032064  000000                                                                 .WORD   T$LOLIM
        032066  177777                                                                 .WORD   T$HILIM
        032070                                                                      10001$:
      8 032070  013724  002262                MOV TEMP,(R4)+
      9 032074  005301                        DEC R1                          ;COUNT THE WORDS
     10 032076  001362                        BNE T4PRM5
     11 032100  000436                        BR T4RUN
     12
     13                                 ;GIVE WARNING MANUAL INTERVENTION NOT ALLOWED
     14
     15 032102                          T4DEFW: PNTF T4WARN
        032102  004137  022266                                                       JSR R1,LPNTF
        032106  004406                                                               .WORD T4WARN
        032110  000000                                                               .WORD PNT.CT
```

TEST 4: DISK EXERCISER

```
                                        ;SET UP DEFAULT PARAMETERS
                                        
032112  013705  002206          T4DEF:  MOV CTABS,R5                    ;GET FIRST CONTROLLER TABLE
032116  012702  000010          T4DEFA: MOV #8.,R2                      ;GET COUNT OF DRIVE TABLES
032122  010504                          MOV R5,R4                       ;GET FIRST DRIVE TABLE POINTER
032124  062704  000020                  ADD #C.DR0,R4
032130  012403                  T4DEFB: MOV (R4)+,R3                    ;GET DRIVE TABLE ADDRESS
032132  001415                          BEQ T4DEFE                      ;GO TO NEXT CONTROLLER IF NONE
032134  062703  000004                  ADD #D.PRM,R3
032140                                  AND D.DCY,(R3)                  ;INITIALIZE ALL PARAMETER BITS
032140  042713  157777                                                                  BIC #^C<D.DCY>,(R3)
032144  052723  011012                  BIS #DDEF,(R3)+
032150  012700  000067                  MOV #55.,R0
032154  005023                  T4DEFC: CLR (R3)+
032156  005300                          DEC R0
032160  001375                          BNE T4DEFC
032162  005302                  T4DEFD: DEC R2                          ;COUNT DRIVE TABLES
032164  001361                          BNE T4DEFB                      ;GO LOOK AT NEXT
032166  062705  000046          T4DEFE: ADD #C.SIZE,R5                  ;GO TO NEXT CONTROLLER
032172  005715                          TST (R5)                        ;  IF THERE IS ONE
032174  001350                          BNE T4DEFA
                                        
                                        ;START TEST 4
                                        
032176  006137  002226          T4RUN:  ROL IFLAGS                      ;CLEAR FLAGS FOR NEXT TIME HERE
032202                                  AND ISTRTH,IFLAGS               ;HOLD START FOR T4UPRM REQUEST
032202  042737  177757  002226                                                        BIC #^C<ISTRTH>,IFLAGS
032210  012701  000004                  MOV #4,R1                       ;INITIALIZE TEST PARAMETERS
032214  004737  014504                  CALL TINIT
                                        
032220  013737  002206  002212          MOV CTABS,TSTTAB                ;GET FIRST TABLE ADDRESS
032226  013701  002210                  MOV CTRLRS,R1                   ;RUN DM PROGRAM ON ALL CONTROLLERS
032232  004737  014632                  CALL RUNDM                      ;  AT ONCE
032236  001402                          BEQ T4WAIT
032240  004737  014726                  CALL RESPDM
032244  032737  001000  002160  T4WAIT: BIT #SM.LOG,SFPTBL+SO.BIT        ;CHECK IF LOG IS ENABLED
032252  001402                          BEQ T4EXIT                      ;EXIT IF NOT
032254                                  BREAK
032254  104422                                                                      TRAP    C$BRK
032256  000772                          BR T4WAIT                       ;WAIT TILL STOPPED BY CONTROL C
                                        
032260                          T4EXIT: DORPT                           ;PRINT STATISTICS
032260  104424                                                                      TRAP    C$DRPT
032262                                  EXIT TST
032262  104432                                                                      TRAP    C$EXIT
032264  001632                                                                      .WORD   .10061-.
                                        
```

```
                                        ;ASK TEST 4 MANUAL INTERVENTION QUESTIONS
                                        ;
                                        ;INPUTS:
                                        ;       R5 - POINTER TO CONTROLLER TABLE
                                        ;       R3 - POINTER TO DRIVE TABLE
                                        ;       R2 AND R4 MUST BE PRESERVED
                                        ;OUTPUTS:
                                        ;       DRIVE TABLE WITH NEW PARAMETERS
                                        ;       R0 AND R1 CONTENTS DESTROYED
                                        T4QUEST:PUSH <R2,R4>
032266  010246                                                                    MOV R2,-(SP)
032270  010446                                                                    MOV R4,-(SP)
                                                PNTF T4QHED,D.UNIT(R3),(R5),(R3)        ;PRINT HEADER
032272  011346                                                                    MOV (R3),-(SP)
032274  011546                                                                    MOV (R5),-(SP)
032276  016346  000002                                                           MOV D.UNIT(R3),-(SP)
032302  004137  022266                                                           JSR R1,LPNTF
032306  004513                                                                    .WORD T4QHED
032310  000006                                                                    .WORD PNT.CT
032312  016337  000010  002262        MOV D.BB(R3),TEMP
                                        GMANID T4BB,TEMP,D,-1,0,16.,YES ;NUMBER OF BAD BLOCKS
032320  104443                                                                    TRAP    C$GMAN
032322  000406                                                                    BR      10002$
032324  002262                                                                    .WORD   TEMP
032326  000052                                                                    .WORD   T$CODE
032330  002516                                                                    .WORD   T4BB
032332  177777                                                                    .WORD   -1
032334  000000                                                                    .WORD   T$LOLIM
032336  000020                                                                    .WORD   T$HILIM
032340                                                                          10002$:
032340  013763  002262  000010        MOV TEMP,D.BB(R3)
032346  001424                        BEQ T4Q02
                                        ;
032350  010304                        MOV R3,R4               ;GET POINTER TO STORAGE
032352  062704  000012                ADD #D.BB01,R4          ;  FOR BAD BLOCKS
032356  013701  002262                MOV TEMP,R1             ;GET COUNT OF BLOCKS TO INPUT
```

```
      1 032362  004737  021402          T4Q01:  CALL BLD28                       ;BUILD DEFAULT ANSWER
      2 032366                                  GMANID T4BBI,TEMP,A,-1,0,9.,YES ;BAD BLOCK
        032366  104443                                                          TRAP    C$GMAN
        032370  000406                                                          BR      10003$
        032372  002262                                                          .WORD   TEMP
        032374  000152                                                          .WORD   T$CODE
        032376  002633                                                          .WORD   T4BBI
        032400  177777                                                          .WORD   -1
        032402  000000                                                          .WORD   T$LOLIM
        032404  000011                                                          .WORD   T$HILIM
        032406                                                            10003$:
      3 032406  004737  021504                  CALL CNV28                      ;CONVERT TO BINARY
      4 032412  103763                          BCS T4Q01                       ;REPEAT UNTIL RIGHT
      5 032414  005301                          DEC R1                          ;DECREMENT COUNT
      6 032416  001361                          BNE T4Q01                       ;GET ALL NUMBERS
      7 032420                          T4Q02:
      8 032420                                  GMANIL  T4DMN,TEMP,1,YES
        032420  104443                                                          TRAP    C$GMAN
        032422  000404                                                          BR      10004$
        032424  002262                                                          .WORD   TEMP
        032426  000130                                                          .WORD   T$CODE
        032430  002543                                                          .WORD   T4DMN
        032432  000001                                                          .WORD   1
        032434                                                            10004$:
      9 032434  032737  000001  002262          BIT     #1,TEMP
     10 032442  001002                          BNE     1$
     11 032444  000137  034110                  JMP     T4Q30
     12 032450                          1$:
     13 032450  016337  000004  002262          MOV D.PRM(R3),TEMP              ;GET PARAMETER BITS
     14 032456                                  GMANIL T4RO,TEMP,D.RO,YES       ;READ ONLY
        032456  104443                                                          TRAP    C$GMAN
        032460  000404                                                          BR      10005$
        032462  002262                                                          .WORD   TEMP
        032464  000130                                                          .WORD   T$CODE
        032466  002645                                                          .WORD   T4RO
        032470  004000                                                          .WORD   D.RO
        032472                                                            10005$:
     15 032472  032737  004000  002262          BIT #D.RO,TEMP
     16 032500  001404                          BEQ T4Q03                       ;IF NOT READ ONLY, GO TO WRITE ONLY QUESTION
     17 032502  042737  002000  002262          BIC #D.WO,TEMP                  ;ELSE, CLEAR WRITE ONLY BIT
     18 032510  000432                          BR T4Q05                        ; AND BRANCH AROUND WRITE ONLY QUESTION
     19 032512                          T4Q03:
     20 032512                                  GMANIL T4WO,TEMP,D.WO,YES       ;WRITE ONLY
        032512  104443                                                          TRAP    C$GMAN
        032514  000404                                                          BR      10006$
        032516  002262                                                          .WORD   TEMP
        032520  000130                                                          .WORD   T$CODE
        032522  002657                                                          .WORD   T4WO
        032524  002000                                                          .WORD   D.WO
        032526                                                            10006$:
     21 032526                                  GMANIL T4WCA,TEMP,D.WCA,YES     ;CHECK ALL WRITES
        032526  104443                                                          TRAP    C$GMAN
        032530  000404                                                          BR      10007$
        032532  002262                                                          .WORD   TEMP
        032534  000130                                                          .WORD   T$CODE
        032536  002672                                                          .WORD   T4WCA
        032540  000004                                                          .WORD   D.WCA
```

```
            032542                                                                  10007$:
     22     032542  032737  000004  002262          BIT #D.WCA,TEMP                 ;CHECK ANSWER
     23     032550  001007                          BNE T4Q04                       ;BRANCH IF YES
     24     032552                                  GMANIL T4WCR,TEMP,D.WC,YES      ;RANDOMLY CHECK WRITES
            032552  104443                                                                  TRAP    C$GMAN
            032554  000404                                                                  BR      10010$
            032556  002262                                                                  .WORD   TEMP
            032560  000130                                                                  .WORD   T$CODE
            032562  002726                                                                  .WORD   T4WCR
            032564  000010                                                                  .WORD   D.WC
            032566                                                                  10010$:
     25     032566  000403                          BR T4Q05
```

```
      1 032570  052737  000010  002262  T4Q04:  BIS #D.WC,TEMP                  ;BOTH BITS GET SET
      2 032576  013763  002262  000004  T4Q05:  MOV TEMP,D.PRM(R3)              ;PUT PARAM BITS BACK
      3 032604  016337  000006  002262          MOV D.PAT(R3),TEMP
      4 032612                                  GMANID T4DP,TEMP,D,-1,0,16.,YES ;DATA PATTERN
        032612  104443                                                          TRAP    C$GMAN
        032614  000406                                                          BR      10011$
        032616  002262                                                          .WORD   TEMP
        032620  000052                                                          .WORD   T$CODE
        032622  002767                                                          .WORD   T4DP
        032624  177777                                                          .WORD   -1
        032626  000000                                                          .WORD   T$LOLIM
        032630  000020                                                          .WORD   T$HILIM
        032632                                                              10011$:
      5 032632  013763  002262  000006          MOV TEMP,D.PAT(R3)
      6 032640  016337  000004  002262          MOV D.PRM(R3),TEMP              ;GET PARAM BITS AGAIN
      7 032646  032737  004000  002262  T4Q06:  BIT #D.RO,TEMP                  ;BYPASS NEXT 3 IF ONLY WRITING
      8 032654  001010                          BNE T4Q07
      9 032656  032737  002000  002262          BIT #D.WO,TEMP
     10 032664  001404                          BEQ T4Q07
     11 032666  032737  000010  002262          BIT #D.WC,TEMP
     12 032674  001432                          BEQ T4Q09
     13 032676                          T4Q07:  GMANIL T4ECC,TEMP,D.ECC,YES     ;ENABLE ECC
        032676  104443                                                          TRAP    C$GMAN
        032700  000404                                                          BR      10012$
        032702  002262                                                          .WORD   TEMP
        032704  000130                                                          .WORD   T$CODE
        032706  003035                                                          .WORD   T4ECC
        032710  010000                                                          .WORD   D.ECC
        032712                                                              10012$:
     14 032712                                  GMANIL T4DCA,TEMP,D.DCA,YES     ,COMPARE ALL DATA
        032712  104443                                                          TRAP    C$GMAN
        032714  000404                                                          BR      10013$
        032716  002262                                                          .WORD   TEMP
        032720  000130                                                          .WORD   T$CODE
        032722  003070                                                          .WORD   T4DCA
        032724  000001                                                          .WORD   D.DCA
        032726                                                              10013$:
     15 032726  032737  000001  002262          BIT #D.DCA,TEMP                 ;CHECK ANSWER
     16 032734  001007                          BNE T4Q08                       ;BRANCH IF YES
     17 032736                                  GMANIL T4DCR,TEMP,D.DC,YES      ;RANDOMLY CHECK WRITES
        032736  104443                                                          TRAP    C$GMAN
        032740  000404                                                          BR      10014$
        032742  002262                                                          .WORD   TEMP
        032744  000130                                                          .WORD   T$CODE
        032746  003116                                                          .WORD   T4DCR
        032750  000002                                                          .WORD   D.DC
        032752                                                              10014$:
     18 032752  000403                          BR T4Q09
```

```
      032754  052737  000002  002262  T4Q08:  BIS #D.DC,TEMP                    ;BOTH BITS GET SET
      032762                          T4Q09:  GMANIL T4RET,TEMP,D.RET,YES      ;ENABLE RETRIES
      032762  104443                                                                    TRAP    C$GMAN
      032764  000404                                                                    BR      10015$
      032766  002262                                                                    .WORD   TEMP
      032770  000130                                                                    .WORD   T$CODE
      032772  003151                                                                    .WORD   T4RET
      032774  001000                                                                    .WORD   D.RET
      032776                                                                  10015$:
      032776  005137  002262                  COM TEMP
      033002                                  GMANIL T4SEK,TEMP,D.SEQ,YES      ;ENABLE SEEKS
      033002  104443                                                                    TRAP    C$GMAN
      033004  000404                                                                    BR      10016$
      033006  002262                                                                    .WORD   TEMP
      033010  000130                                                                    .WORD   T$CODE
      033012  003170                                                                    .WORD   T4SEK
      033014  000100                                                                    .WORD   D.SEQ
      033016                                                                  10016$:
      033016  005137  002262                  COM TEMP                         ;COMPLIMENTED
      033022  013763  002262  000004          MOV TEMP,D.PRM(R3)

      033030  005037  002262                  CLR TEMP                         ;DETERMINE DEFAULT SELECTION
      033034  032763  000040  000004          BIT #D.BE,D.PRM(R3)              ;IF D.BE SET - LOAD 1
      033042  001403                          BEQ T4Q10                        ;IF D.CYL CLEAR - LOAD 0
      033044  005237  002262                  INC TEMP                         ;IF D.BEC CONTAINS 0 - LOAD 4
      033050  000422                          BR T4Q11                         ;IF D.TR SET - LOAD 2
      033052  032763  000400  000004  T4Q10:  BIT #D.CYL,D.PRM(R3)             ;LOAD 3
      033060  001416                          BEQ T4Q11
      033062  012737  000004  002262          MOV #4,TEMP
      033070  005763  000112                  TST D.BEC(R3)
      033074  001410                          BEQ T4Q11
      033076  005337  002262                  DEC TEMP
      033102  032763  000020  000004          BIT #D.TR,D.PRM(R3)
      033110  001402                          BEQ T4Q11
      033112  005337  002262                  DEC TEMP
```

```
      1 033116                          T4Q11:  PNTF T4OPT1
        033116  004137  022266                                                    JSR R1,LPNTF
        033122  004620                                                            .WORD T4OPT1
        033124  000000                                                            .WORD PNT.CT
      2 033126                                  GMANID T4OPT7,TEMP,D,-1,0,4,YES ;WHICH SELECTION LIMITS
        033126  104443                                                            TRAP    C$GMAN
        033130  000406                                                            BR      10017$
        033132  002262                                                            .WORD   TEMP
        033134  000052                                                            .WORD   T$CODE
        033136  003213                                                            .WORD   T4OPT7
        033140  177777                                                            .WORD   -1
        033142  000000                                                            .WORD   T$LOLIM
        033144  000004                                                            .WORD   T$HILIM
        033146                                                              10017$:
      3 033146  005337  002262                  DEC TEMP                  ;SET UP D.PRM FROM ANSWER
      4 033152  002004                          BGE T4Q12                 ;IF 0 - CLEAR D.BE AND D.CYL
      5 033154  042763  000440  000004         BIC #D.BE+D.CYL,D.PRM(R3)
      6 033162  000467                          BR T4Q19
```

```
      1 033164  005337  002262          T4Q12:  DEC TEMP                         ;IF 1
      2 033170  002013                          BGE T4Q13                       ;  IF D.BE NOT SET
      3 033172  032763  000040  000004          BIT #D.BE,D.PRM(R3)             ;    SET D.BE
      4 033200  001060                          BNE T4Q19                       ;    CLEAR D.CYL
      5 033202  052763  000040  000004          BIS #D.BE,D.PRM(R3)             ;    LOAD 1 IN D.BEC
      6 033210  042763  000400  000004          BIC #D.CYL,D.PRM(R3)            ;    CLEAR BLOCK STORAGE
      7 033216  000436                          BR T4Q16
      8 033220  042763  000040  000004  T4Q13:  BIC #D.BE,D.PRM(R3)            ;IF 2, 3 OR 4
      9                                                                         ;  CLEAR D.BE
     10 033226  022737  000002  002262          CMP #2,TEMP                     ;IF 4
     11 033234  001006                          BNE T4Q14                       ;  SET D.CYL
     12 033236  052763  000400  000004          BIS #D.CYL,D.PRM(R3)            ;  CLEAR D.BEC
     13 033244  005063  000112                  CLR D.BEC(R3)
     14 033250  000434                          BR T4Q19
     15 033252                     T4Q14:  PUSH D.PRM(R3)                      ;IF 2 OR 3
        033252  016346  000004                                                                  MOV D.PRM(R3),-(SP)
     16 033256  052763  000420  000004          BIS #D.CYL+D.TR,D.PRM(R3)       ;  SAVE D.PRM BITS
     17 033264  005337  002262                  DEC TEMP                        ;  SET D.CYL AND D.TR
     18 033270  100403                          BMI T4Q15                       ;  IF 3
     19 033272  042763  000020  000004          BIC #D.TR,D.PRM(R3)             ;    CLEAR D.TR
     20 033300  022663  000004  T4Q15:  CMP (SP)+,D.PRM(R3)                     ;  IF D.CYL OR D.TR CHANGED OR D.BEC = 0
     21 033304  001003                          BNE T4Q16
     22 033306  005763  000112                  TST D.BEC(R3)                   ;    LOAD 1 IN D.BEC
     23 033312  001013                          BNE T4Q19                       ;    CLEAR BLOCK STORAGE
     24 033314  012763  000001  000112  T4Q16:  MOV #1,D.BEC(R3)
     25 033322  010304                T4Q17:  MOV R3,R4
     26 033324  062704  000114                  ADD #D.BGN1,R4
     27 033330  012701  000020                  MOV #16.,R1
     28 033334  005024                T4Q18:  CLR (R4)+
     29 033336  005301                          DEC R1
     30 033340  001375                          BNE T4Q18
```

```
     1 033342  032763  000040  000004  T4Q19:  BIT #D.BE,D.PRM(R3)             ;NOW ASK THE QUESTIONS TO ALLOW THE
     2 033350  001460                          BEQ T4Q22                       ;  NUMBERS TO CHANGE
     3 033352  016337  000112  002262          MOV D.BEC(R3),TEMP
     4 033360                                  GMANID T4BE,TEMP,D,-1,1,4,YES   ;NUMBER OF B/E SETS
       033360  104443                                                                  TRAP    C$GMAN
       033362  000406                                                                  BR      10020$
       033364  002262                                                                  .WORD   TEMP
       033366  000052                                                                  .WORD   T$CODE
       033370  003216                                                                  .WORD   T4BE
       033372  177777                                                                  .WORD   -1
       033374  000001                                                                  .WORD   T$LOLIM
       033376  000004                                                                  .WORD   T$HILIM
       033400                                                                10020$:
     5 033400  013763  002262  000112          MOV TEMP,D.BEC(R3)
     6 033406  013701  002262                  MOV TEMP,R1                     ;GET COUNT OF SETS
     7 033412  010304                          MOV R3,R4                       ;GET POINTER TO STORAGE AREA
     8 033414  062704  000114                  ADD #D.BGN1,R4
     9 033420  004737  021402          T4Q20:  CALL BLD28
    10 033424                                  GMANID T4BEG,TEMP,A,-1,0,9.,YES ;BEGIN BLOCK
       033424  104443                                                                  TRAP    C$GMAN
       033426  000406                                                                  BR      10021$
       033430  002262                                                                  .WORD   TEMP
       033432  000152                                                                  .WORD   T$CODE
       033434  003247                                                                  .WORD   T4BEG
       033436  177777                                                                  .WORD   -1
       033440  000000                                                                  .WORD   T$LOLIM
       033442  000011                                                                  .WORD   T$HILIM
       033444                                                                10021$:
    11 033444  004737  021504                  CALL CNV28
    12 033450  103763                          BCS T4Q20
    13 033452  004737  021402          T4Q21:  CALL BLD28
    14 033456                                  GMANID T4END,TEMP,A,-1,0,9.,YES ;END BLOCK
       033456  104443                                                                  TRAP    C$GMAN
       033460  000406                                                                  BR      10022$
       033462  002262                                                                  .WORD   TEMP
       033464  000152                                                                  .WORD   T$CODE
       033466  003263                                                                  .WORD   T4END
       033470  177777                                                                  .WORD   -1
       033472  000000                                                                  .WORD   T$LOLIM
       033474  000011                                                                  .WORD   T$HILIM
       033476                                                                10022$:
    15 033476  004737  021504                  CALL CNV28
    16 033502  103763                          BCS T4Q21
    17 033504  005301                          DEC R1
    18 033506  001344                          BNE T4Q20
    19 033510  000577                          BR T4Q30
```

```
      033512  032763  000400  000004  T4Q22:  BIT #D.CYL,D.PRM(R3)            ;IF D.CYL CLEAR - ALL DONE
      033520  001573                          BEQ T4Q30
      033522  005763  000112                  TST D.BEC(R3)                   ;IF D.BEC CLEAR - GO RIGHT TO B/E CYLS
      033526  001526                          BEQ T4Q27
      033530  010304                          MOV R3,R4
      033532  062704  000112                  ADD #D.BEC,R4
      033536  032763  000020  000004          BIT #D.TR,D.PRM(R3)             ;LOOK AT D.TR.TO DETERMINE QUESTION
      033544  001434                          BEQ T4Q24
      033546  011437  002262                  MOV (R4),TEMP
      033552                                  GMANID T4TRC,TEMP,D,-1,1,7,YES  ;NUMBER OF TRACKS
      033552  104443                                                          TRAP    C$GMAN
      033554  000406                                                          BR      10023$
      033556  002262                                                          .WORD   TEMP
      033560  000052                                                          .WORD   T$CODE
      033562  003275                                                          .WORD   T4TRC
      033564  177777                                                          .WORD   -1
      033566  000001                                                          .WORD   T$LOLIM
      033570  000007                                                          .WORD   T$HILIM
      033572                                                          10023$:
      033572  013714  002262                  MOV TEMP,(R4)
      033576  012401                          MOV (R4)+,R1                    ;GET COUNT OF TRACKS
      033600  011437  002262          T4Q23:  MOV (R4),TEMP
      033604                                  GMANID T4TRAK,TEMP,D,-1,0,255.,YES      ;TRACK
      033604  104443                                                          TRAP    C$GMAN
      033606  000406                                                          BR      10024$
      033610  002262                                                          .WORD   TEMP
      033612  000052                                                          .WORD   T$CODE
      033614  003326                                                          .WORD   T4TRAK
      033616  177777                                                          .WORD   -1
      033620  000000                                                          .WORD   T$LOLIM
      033622  000377                                                          .WORD   T$HILIM
      033624                                                          10024$:
      033624  013724  002262                  MOV TEMP,(R4)+
      033630  005301                          DEC R1
      033632  001362                          BNE T4Q23
      033634  000433                          BR T4Q26
      033636  011437  002262          T4Q24:  MOV (R4),TEMP
      033642                                  GMANID T4GRC,TEMP,D,-1,1,7,YES  ;NUMBER OF GROUPS
      033642  104443                                                          TRAP    C$GMAN
      033644  000406                                                          BR      10025$
      033646  002262                                                          .WORD   TEMP
      033650  000052                                                          .WORD   T$CODE
      033652  003334                                                          .WORD   T4GRC
      033654  177777                                                          .WORD   -1
      033656  000001                                                          .WORD   T$LOLIM
      033660  000007                                                          .WORD   T$HILIM
      033662                                                          10025$:
      033662  013714  002262                  MOV TEMP,(R4)
      033666  012401                          MOV (R4)+,R1                    ;GET COUNT OF GROUPS
```

```
      1 033670  011437  002262          T4Q25:  MOV (R4),TEMP
      2 033674                                  GMANID T4GRP,TEMP,D,-1,0,255.,YES       ;GROUP
        033674  104443                                                                    TRAP    C$GMAN
        033676  000406                                                                    BR      10026$
        033700  002262                                                                    .WORD   TEMP
        033702  000052                                                                    .WORD   T$CODE
        033704  003365                                                                    .WORD   T4GRP
        033706  177777                                                                    .WORD   -1
        033710  000000                                                                    .WORD   T$LOLIM
        033712  000377                                                                    .WORD   T$HILIM
        033714                                                                  10026$:
      3 033714  013724  002262                  MOV TEMP,(R4)+
      4 033720  005301                          DEC R1
      5 033722  001362                          BNE T4Q25
      6 033724  016337  000162  002262  T4Q26:  MOV D.ECYL+2(R3),TEMP
      7 033732  005137  002262                  COM TEMP
      8 033736                                  GMANIL T4CYL,TEMP,BIT15,YES     ;WISH TO LIMIT CYLINDERS
        033736  104443                                                                    TRAP    C$GMAN
        033740  000404                                                                    BR      10027$
        033742  002262                                                                    .WORD   TEMP
        033744  000130                                                                    .WORD   T$CODE
        033746  003373                                                                    .WORD   T4CYL
        033750  100000                                                                    .WORD   BIT15
        033752                                                                  10027$:
      9 033752  005737  002262                  TST TEMP
     10 033756  100412                          BMI T4Q27
     11 033760  005063  000154                  CLR D.BCYL(R3)
     12 033764  005063  000156                  CLR D.BCYL+2(R3)
     13 033770  005063  000160                  CLR D.ECYL(R3)
     14 033774  012763  177777  000162          MOV #-1,D.ECYL+2(R3)
     15 034002  000442                          BR T4Q30
     16 034004  005763  000162          T4Q27:  TST D.ECYL+2(R3)
     17 034010  002002                          BGE T4Q27A
     18 034012  005063  000162                  CLR D.ECYL+2(R3)
     19 034016  010304                  T4Q27A: MOV R3,R4
     20 034020  062704  000154                  ADD #D.BCYL,R4
     21 034024  004737  021402          T4Q28:  CALL BLD28
     22 034030                                  GMANID T4CYLB,TEMP,A,-1,0,9.,YES        ;STARTING CYLINDER
        034030  104443                                                                    TRAP    C$GMAN
        034032  000406                                                                    BR      10030$
        034034  002262                                                                    .WORD   TEMP
        034036  000152                                                                    .WORD   T$CODE
        034040  003445                                                                    .WORD   T4CYLB
        034042  177777                                                                    .WORD   -1
        034044  000000                                                                    .WORD   T$LOLIM
        034046  000011                                                                    .WORD   T$HILIM
        034050                                                                  10030$:
     23 034050  004737  021504                  CALL CNV28
     24 034054  103763                          BCS T4Q28
```

```
      1 034056  004737  021402          T4Q29:  CALL BLD28
      2 034062                                  GMANID T4CYLE,TEMP,A,-1,0,9.,YES        ;ENDING CYLINDER
        034062  104443                                                                          TRAP    C$GMAN
        034064  000406                                                                          BR      10031$
        034066  002262                                                                          .WORD   TEMP
        034070  000152                                                                          .WORD   T$CODE
        034072  003467                                                                          .WORD   T4CYLE
        034074  177777                                                                          .WORD   -1
        034076  000000                                                                          .WORD   T$LOLIM
        034100  000011                                                                          .WORD   T$HILIM
        034102                                                                        10031$:
      3 034102  004737  021504                  CALL CNV28
      4 034106  103763                          BCS T4Q29
      5 034110                          T4Q30:  POP <R4,R2>
        034110  012604                                                                          MOV (SP)+,R4
        034112  012602                                                                          MOV (SP)+,R2
      6 034114  000207                          RETURN
      7 034116                                  ENDTST
        034116                                                                        L10061:
        034116  104401                                                                          TRAP    C$ETST
      9 034120                                  ENDMOD
```

```
                                .SBTTL  HARDWARE PARAMETER CODING SECTION
                                
034120                                  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.
                                ;--
                                
034120                                  BGNHRD
034120  000032                                                          .WORD L10062-L$HARD/2
034122                                                          L$HARD::
                                
                                ;FORMAT OF HARDWARE P-TABLE IS AS FOLLOWS:
                                
034122                          TABLE                                   ;START A TEBLE DEFINITION
                                
034122                          ITEM HO.UBA     2                       ; UNIBUS ADDRESS
034122                          ITEM HO.VEC     2                       ; UDA VECTOR
034122                          ITEM HO.BRL     2                       ; BR LEVEL
034122                          ITEM HO.BST     2                       ; BURST RATE
034122                          ITEM HO.LDR     2                       ; DRIVE NUMBER
034122                          ITEM HO.PRM     2                       ; PROGRAM PARAMETERS
        020000                          HM.CYL  ==      BIT13           ; TEST CUSTOMER DATA AREA
034122                          END
```

HARDWARE PARAMETER CODING SECTION

```
      1 034122                                  GPRMA   H.UBA,HO.UBA,0,160000,177774,YES        ;BUS ADDRESS
        034122  000031                                                                                .WORD   T$CODE
        034124  034206                                                                                .WORD   H.UBA
        034126  160000                                                                                .WORD   T$LOLIM
        034130  177774                                                                                .WORD   T$HILIM
      2 034132                                  GPRMA   H.VEC,HO.VEC,0,4,774,YES        ; VECTOR
        034132  001031                                                                                .WORD   T$CODE
        034134  034234                                                                                .WORD   H.VEC
        034136  000004                                                                                .WORD   T$LOLIM
        034140  000774                                                                                .WORD   T$HILIM
      3 034142                                  GPRMD   H.BRL,HO.BRL,D,-1,4.,7.,YES     ; BR LEVEL
        034142  002052                                                                                .WORD   T$CODE
        034144  034243                                                                                .WORD   H.BRL
        034146  177777                                                                                .WORD   -1
        034150  000004                                                                                .WORD   T$LOLIM
        034152  000007                                                                                .WORD   T$HILIM
      4 034154                                  GPRMD   H.BST,HO.BST,D,-1,0.,63.,YES     ; BURST RATE
        034154  003052                                                                                .WORD   T$CODE
        034156  034254                                                                                .WORD   H.BST
        034160  177777                                                                                .WORD   -1
        034162  000000                                                                                .WORD   T$LOLIM
        034164  000077                                                                                .WORD   T$HILIM
      5 034166                                  GPRMD   H.LDR,HO.LDR,D,-1,0.,255.,YES    ; DRIVE SELECT NUMBER
        034166  004052                                                                                .WORD   T$CODE
        034170  034276                                                                                .WORD   H.LDR
        034172  177777                                                                                .WORD   -1
        034174  000000                                                                                .WORD   T$LOLIM
        034176  000377                                                                                .WORD   T$HILIM
      7 034200                                  GPRML   H.CST,HO.PRM,HM.CYL,YES ; USE CUSTOMER DATA AREA
        034200  005130                                                                                .WORD   T$CODE
        034202  034313                                                                                .WORD   H.CST
        034204  020000                                                                                .WORD   HM.CYL
      9 034206                                  ENDHRD
                                                                                                      .EVEN
        034206                                                                          L10062:
     10
     11 034206      125     116     111  H.UBA:  .ASCIZ  \UNIBUS ADDRESS OF UDA\
     12 034234      126     105     103  H.VEC:  .ASCIZ  \VECTOR\
     13 034243      102     122     040  H.BRL:  .ASCIZ  \BR LEVEL\
     14 034254      125     116     111  H.BST:  .ASCIZ  \UNIBUS BURST RATE\
     15 034276      104     122     111  H.LDR:  .ASCIZ  \DRIVE NUMBER\
     17 034313      105     130     105  H.CST:  .ASCIZ  \EXERCISE ON CUSTOMER DATA AREA IN TEST 4\
     19                                          .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.
                                ;--

034364                                  BGNSFT
034364  000030                                                          .WORD L10063-L$SOFT/2
034366                                                          L$SOFT::

                                ;FORMAT OF SOFTWARE P-TABLE IS AS FOLLOWS:

034366                          TABLE                           ;START A TABLE DEFINITION

034366                          ITEM SO.EL      2               ;ERROR LIMIT
034366                          ITEM SO.XL      2               ;DATA TRANSFER LIMIT (MEGABITS)
034366                          ITEM SO.BIT     2               ;SINGLE BIT ANSWERS
        000200                          SM.MAN==BIT07           ;  MANUAL INTERVENTION MODE
        000400                          SM.SSF==BIT08           ;  SUPPRESS SOFT ERRORS
        001000                          SM.LOG==BIT09           ;  ERROR LOG ENABLED
        040000                          SM.IW== BIT14           ;  INITIAL WRITE

034366                          END
```

```
      1 034366                                  GPRML S.MAN,SO.BIT,SM.MAN,YES   ;MANUAL INTERVENTION MODE
        034366  002130                                                                  .WORD   T$CODE
        034370  034446                                                                  .WORD   S.MAN
        034372  000200                                                                  .WORD   SM.MAN
      4 034374                                  DISPLAY S.MES                   ;MESSAGE ON NEXT QUESTIONS
        034374  000003                                                                  .WORD   T$CODE
        034376  034533                                                                  .WORD   S.MES
      6 034400                                  GPRMD S.EL,SO.EL,D,-1,1.,-1.,YES        ;ERROR LIMIT
        034400  000052                                                                  .WORD   T$CODE
        034402  034616                                                                  .WORD   S.EL
        034404  177777                                                                  .WORD   -1
        034406  000001                                                                  .WORD   T$LOLIM
        034410  177777                                                                  .WORD   T$HILIM
      7 034412                                  GPRMD S.XL,SO.XL,D,-1,0.,-1.,YES        ;TRANSFER LIMIT
        034412  001052                                                                  .WORD   T$CODE
        034414  034632                                                                  .WORD   S.XL
        034416  177777                                                                  .WORD   -1
        034420  000000                                                                  .WORD   T$LOLIM
        034422  177777                                                                  .WORD   T$HILIM
      8 034424                                  GPRML S.SSF,SO.BIT,SM.SSF,YES   ;SUPPRESS SOFT ERRORS
        034424  002130                                                                  .WORD   T$CODE
        034426  034714                                                                  .WORD   S.SSF
        034430  000400                                                                  .WORD   SM.SSF
      9 034432                                  GPRML S.IW,SO.BIT,SM.IW,YES     ;INITIAL WRITE
        034432  002130                                                                  .WORD   T$CODE
        034434  034752                                                                  .WORD   S.IW
        034436  040000                                                                  .WORD   SM.IW
     10 034440                                  GPRML S.LOG,SO.BIT,SM.LOG,YES   ;ERROR LOG
        034440  002130                                                                  .WORD   T$CODE
        034442  035004                                                                  .WORD   S.LOG
        034444  001000                                                                  .WORD   SM.LOG
     15 034446                                  ENDSFT
                                                                                        .EVEN
        034446                                                                  L10063:
     16
     17 034446      105     116     124  S.MAN:  .ASCIZ\ENTER MANUAL INTERVENTION MODE FOR SPECIAL DIAGNOSIS\
     20 034533      122     105     115  S.MES:  .ASCIZ\REMAINING SOFTWARE QUESTIONS APPLY TO TEST 4 ONLY\
     22 034615      000                         .BYTE 0
     23 034616      105     122     122  S.EL:   .ASCIZ\ERROR LIMIT\
     24 034632      122     105     101  S.XL:   .ASCIZ\READ TRANSFER LIMIT IN MEGABYTES - 0 FOR NO LIMIT\
     25 034714      123     125     120  S.SSF:  .ASCIZ\SUPPRESS PRINTING SOFT ERRORS\
     26 034752      104     117     040  S.IW:   .ASCIZ\DO INITIAL WRITE ON START\
     27 035004      105     116     101  S.LOG:  .ASCIZ\ENABLE ERROR LOG\
     32                                         .EVEN
     33
```

PATCH AREA

```
                                        .SBTTL  PATCH AREA

035026                          $PATCH::
        000050                          .REPT 40.
                                        .WORD 0
                                        .ENDR

035146                                  LASTAD
                                                                .EVEN
035146  035172                                                  .WORD T$FREE
035150  000010                                                  .WORD T$SIZE
035152                          L$LAST::

035152                                  ENDMOD
```

```
PATCH AREA

      1 035152                                  BGNSETUP        1
      2
      3 035152                                  BGNPTAB
        035152  000000                                                  .WORD   0
        035154  000006                                                  .WORD   L10066-./2-1
        035156                                                  L10064:
      4
      5 035156  172150                          .WORD   172150          ; UNIBUS ADDRESS
      6 035160  000154                          .WORD   154             ; VECTOR ADDRESS
      7 035162  000005                          .WORD   5.              ; BR LEVEL
      8 035164  000077                          .WORD   63.             ; UNIBUS BURST RATE
      9 035166  000000                          .WORD   0.              ; LOGICAL DRIVE NUMBER
     10 035170  000000                          .WORD   0               ; CUSTOMER DATA AREA
     11
     12 035172                                  ENDPTAB
        035172                                                  L10066:
     13
     14 035172                                  ENDSETUP
     15
     16
     17
     18
     19
     20
     21
     22          000001                  .END
ERRORS DETECTED:  0

VIRTUAL MEMORY USED:  29952 WORDS  ( 117 PAGES)
DYNAMIC MEMORY AVAILABLE FOR  70 PAGES
ZUDCB0.BIC,A:ZUDCB0/C=[20,0]SVC34R.MLB/P:1,ZUDCB0.DOC,ZUDCB0.MAC
```

CROSS REFERENCE TABLE (CREF V04.00)

```
BOE     116-10#
BRLEV   264-16* 266-3   270-25#
C$AU    112-12#
C$AUTO  112-12# 258-12
C$BRK   112-12# 149-43  216-26  225-13  228-27  233-24  239-10  264-35  270-11  276-40
C$BSEG  112-12#
C$BSUB  112-12# 261-1   262-1   263-1   264-1   267-1   268-1   269-1
C$CEFG  112-12#
C$CLCK  112-12# 249-12  249-14
C$CLEA  112-12# 259-21
C$CLOS  112-12# 232-12
C$CLP1  112-12# 261-11
C$CVEC  112-12# 225-27  261-7   266-10
C$DCLN  112-12# 143-8   147-22  237-7   248-30  256-9   257-4   257-9   257-15  257-21
C$DODU  112-12#
C$DRPT  112-12# 150-10  247-11  276-43
C$DU    112-12#
C$EDIT  112-12# 112-42
C$ERDF  112-12# 149-22  149-40  151-21  152-11  195-24  212-3   216-34  217-5   223-18  223-40  225-30  227-44  228-36
        229-5   261-10  263-26  265-27  266-5   270-19
C$ERHR  112-12#
C$ERRO  112-12# 207-41
C$ERSF  112-12# 143-7   147-21  237-6   248-29  257-3   257-8   257-14  257-20
C$ERSO  112-12#
C$ESCA  112-12#
C$ESEG  112-12#
C$ESUB  112-12# 261-14  262-15  263-32  266-11  267-4   268-6   269-10
C$ETST  112-12# 269-14  271-24  272-14  286-7
C$EXIT  112-12# 256-31  260-18  276-44
C$GETB  112-12# 233-26  233-31  234-7   235-23  235-30  236-1   236-11  236-14
C$GETW  112-12#
C$GMAN  112-12# 163-3   256-6   275-3   275-7   277-14  278-2   278-8   278-14  278-20  278-21  278-24  279-4   279-13
        279-14  279-17  280-2   280-4   281-2   283-4   283-10  283-14  284-10  284-14  284-20  285-2   285-8   285-22
        286-2
C$GPHR  112-12# 248-21  250-10  253-5
C$GPLO  112-12#
C$GPRI  112-12#
C$INIT  112-12# 257-23
C$INLP  112-12#
C$MANI  112-12# 160-32  256-4   274-7
C$MEM   112-12# 249-2
C$MSG   112-12# 140-16  140-20  140-24  140-28  140-32  140-36  140-40  140-44  140-48  140-57  140-63  140-77  140-81
        140-85  140-89  140-93  140-97  140-101 140-105 140-109 140-114 140-118 140-122 140-127 140-131 140-135 140-139
        141-22
C$OPEN  112-12# 233-21
C$PNTB  112-12# 205-14
C$PNTF  112-12# 205-12  255-36
C$PNTS  112-12# 205-18  243-22  243-24
C$PNTX  112-12# 140-62  205-16
C$QIO   112-12#
C$RDBU  112-12#
C$REFG  112-12# 247-1   247-5   247-8   247-12  256-20  256-22
C$RESE  112-12# 112-12# 239-11  249-1
C$REVI  112-12# 112-42
C$RFLA  112-12# 173-49  175-38  177-44
C$RPT   112-12# 244-43
```

CROSS REFERENCE TABLE (CREF V04.00)

```
C$SEFG 112-12#
C$SPRI 112-12#  256-17  264-20  265-10  265-21  266-1
C$SVEC 112-12#  208-32  225-24  249-23  261-3   264-19
C$TPRI 112-12#
C.BST  127-19#  224-12  252-9
C.DRO  127-34#  174-19  195-15  242-21  248-7   254-11  255-30  274-16  276-6
C.DR1  127-35#
C.DR2  127-36#
C.DR3  127-37#
C.DR4  127-38#
C.DR5  127-39#
C.DR6  127-40#
C.DR7  127-41#
C.FLG  127-22#  148-26*  149-9   149-12  149-14  150-21*  151-6   151-26  152-29*  152-30  152-37*  152-40*  173-53*  175-63*
       179-18*  209-19*  209-20*  211-27*  214-27*  216-17  217-1*
C.JAD  127-21#
C.JSR  127-20#  208-31
C.REF  127-44#  151-19  214-16*  214-17
C.RING 127-33#  140-155  145-17*  149-8   213-16  214-15
C.SIZE 127-46#  148-35  150-14  244-3   248-14  248-26  250-27  251-3   253-13  255-39  260-15  271-20  274-27  276-18
C.TO   127-42#  149-38  152-45  216-14  216-32  228-22  228-33  264-31  265-6   270-7   270-17
C.TOH  127-43#  149-35  216-29  228-30  265-3   270-14
C.UADR 127-12#  141-9   225-22  250-19  263-7   264-7   264-18
C.UNIT 127-13#  148-28  148-29  149-11  207-16  242-11  248-5*  248-34*  260-11  260-12
C.VEC  127-16#  208-28  250-22  252-7   264-8   266-8
CALR1  184-3    186-4#  188-10
CALR2  184-4    187-4#
CALR3  184-5    188-9#
CALR4  184-6    189-5#
CALR5  184-7    190-5#
CALR6  184-8    191-4#
CALR7  184-9    192-4#
CALR8  184-10   193-4#
CALR9  184-11   194-3#
CF.576 123-39#
CF.ATN 123-34#
CF.MSC 123-35#
CF.OTH 123-36#
CF.SHD 123-38#
CF.THS 123-37#
CLOG   222-26   222-34  230-10#
CLOGLP 230-13#  230-15
CLOSEF 231-14   232-10#  237-1   256-19  259-10
CLRBFL 215-22#  215-24
CLRBUF 152-17   152-36  215-16#
CNV28  201-15#  278-3   283-11  283-15  285-23  286-3
CON.A  182-12#  185-21
CON.A1 182-13#  182-15  187-19
CON.A2 182-17   182-19#
CON.D  182-23#  185-21
CON.H  182-29#  185-21
CON.N  183-9#   185-21
CON.N1 183-10#  183-12
CON.O  183-3#   185-21
CON.QU 182-3#   182-7   185-21
CON.QX 182-5    182-8#
```

CROSS REFERENCE TABLE (CREF V04.00)

```
D.HERR  129-14#  177-41*  177-42   243-24
D.IW    128-14#  128-33   167-19
D.PAT   128-34#  167-21   274-22   279-3    279-5*
D.PRM   128-13#  167-13   167-35   255-34   276-9    278-13   279-2*   279-6    280-6*   280-9    280-13   280-19   281-5*   282-3
        282-5*   282-6*   282-8*   282-12*  282-15   282-16*  282-19*  282-20   283-1    284-1    284-7
D.RET   128-19#  128-31   280-2
D.RO    128-17#  278-14   278-15   279-7
D.SEEK  129-16#  172-15*  243-22
D.SEQ   128-21#  280-4
D.SERN  129-18#  167-5*   167-6*   167-7*   243-9    243-10   243-11
D.SERR  129-15#  171-20*  243-24
D.SIZE  129-24#  174-28   254-3    254-29   254-33*
D.TR    128-23#  280-19   282-16   282-19   284-7
D.UNIT  128-10#  161-1    173-22   173-54   174-23   178-8    179-23   179-25   195-29   207-22   242-25   243-22   248-11*  248-35*
        255-36   274-19   277-12
D.WC    128-24#  128-31   278-24   279-1    279-11
D.WCA   128-25#  278-21   278-22
D.WO    128-18#  278-17   278-20   279-9
D.XFRR  129-13#  173-43*  173-47   243-22
D.XFRW  129-12#  173-44*  174-27   174-28   243-22
D.ZERO  128-33#  167-14
DDEF    128-31#  254-28   276-11
DFPTBL  114-10#
DIAG    120-33#  213-23
DIAGMC  112-12   112-12
DIATST  262-2#
DIV10   243-13   244-14#
DIVIDE  197-39   198-7    199-16#  200-13   240-19   240-21   240-23
DLL     134-26#  158-37*  159-9*   159-10*  174-35   256-18*
DLLADR  134-31#  159-4*   159-5*   159-13   159-14
DLLDR   134-28#  158-38*  174-37   174-38
DLLNAM  134-33#  158-41*  158-42*  174-38   234-.3   234-15
DLLR    134-30#  158-40*
DLLSIZ  134-32#  159-6*   159-11   159-12*  159-13*
DLLV    134-29#  158-39*
DMEND   132-21#  146-20   147-17*
DMENDS  132-22#  146-21   147-18*
DMFRST  129-31#  235-11   235-21
DMMAIN  129-30#  210-5    210-7    210-30
DMOVRL  129-29#
DMPROG  132-20#  141-15   141-16   147-14*  179-30   179-31   186-7    186-8    209-5    209-8    209-10   209-11   210-4    210-6
DMTRLN  129-28#
DONE    153-17   180-13#
DSPSIZ  152-9    153-19#
DT.AVL  128-12#  173-24   174-25   242-28   248-11   248-35   274-19
DT.UNT  128-11#
DU.DFL  126-22#
DU.FTL  126-25#
DU.INF  126-23#
DU.QUE  126-21#
DU.SPC  126-26#  152-5
DU.TER  126-24#
DUP     120-34#  213-20
E$END   112-12#
E$LOAD  112-12#  112-42
EF.BBR  123-27#
```

CROSS REFERENCE TABLE (CREF V04.00)

CROSS REFERENCE TABLE (CREF V04.00)

CROSS REFERENCE TABLE (CREF V04.00)

```
FWORD   234-4    234-6    235-1    235-3    236-11#
G$CNTO  112-12#
G$DELM  112-12#
G$DISP  112-12#  290-4
G$EXCP  112-12#
G$HILI  112-12#
G$LOLI  112-12#
G$NO    112-12#  163-3    256-6
G$OFFS  112-12#  163-3    256-6    275-3    275-7    277-14   278-2    278-8    278-14   278-20   278-21   278-24   279-4    279-13
        279-14   279-17   280-2    280-4    281-2    283-4    283-10   283-14   284-10   284-14   284-20   285-2    285-8    285-22
        286-2    288-1    288-2    288-3    288-4    288-5    288-7    290-1    290-6    290-7    290-8    290-9    290-10
G$OFSI  112-12#  163-3    256-6    275-3    275-7    277-14   278-2    278-8    278-14   278-20   278-21   278-24   279-4    279-13
        279-14   279-17   280-2    280-4    281-2    283-4    283-10   283-14   284-10   284-14   284-20   285-2    285-8    285-22
        286-2    288-1    288-2    288-3    288-4    288-5    288-7    290-1    290-6    290-7    290-8    290-9    290-10
G$PRMA  112-12#  288-1    288-2
G$PRMD  112-12#  163-3    275-3    275-7    277-14   278-2    279-4    281-2    283-4    283-10   283-14   284-10   284-14   284-20
        285-2    285-22   286-2    288-3    288-4    288-5    290-6    290-7
G$PRML  112-12#  256-6    278-8    278-14   278-20   278-21   278-24   279-13   279-14   279-17   280-2    280-4    285-8    288-7
        290-1    290-8    290-9    290-10
G$RADA  112-12#  163-3    278-2    283-10   283-14   285-22   286-2
G$RADB  112-12#
G$RADD  112-12#  275-3    277-14   279-4    281-2    283-4    284-10   284-14   284-20   285-2    288-3    288-4    288-5    290-6
        290-7
G$RADL  112-12#  256-6    278-8    278-14   278-20   278-21   278-24   279-13   279-14   279-17   280-2    280-4    285-8    288-7
        290-1    290-8    290-9    290-10
G$RADO  112-12#  275-7    288-1    288-2
G$XFER  112-12#
G$YES   112-12#  275-3    275-7    277-14   278-2    278-8    278-14   278-20   278-21   278-24   279-4    279-13   279-14   279-17
        280-2    280-4    281-2    283-4    283-10   283-14   284-10   284-14   284-20   285-2    285-8    285-22   286-2    288-1
        288-2    288-3    288-4    288-5    288-7    290-1    290-6    290-7    290-8    290-9    290-10
GETCDN  196-16   196-18   196-28#
GETCNT  182-12   183-9    183-17   183-29   196-13#  197-15
GETCNX  196-15#  196-27
GETCXX  196-29   196-31#
GTDRVT  160-39   167-3    169-23   170-16   171-18   172-13   173-20   177-36   179-21   195-13#  207-20   248-32
H.BRL   288-3    288-13#
H.BST   288-4    288-14#
H.CST   288-7    288-17#
H.LDR   288-5    288-15#
H.UBA   288-1    288-11#
H.VEC   288-2    288-12#
HC.BF1  120-24#  120-25   152-16
HC.BF2  120-25#  120-27   140-156  152-3    152-7*   152-8    152-35
HC.BSZ  120-13#  120-25   120-27   152-19   176-10   176-14   210-10   210-16   215-19   215-21   273-20
HC.CCT  120-19#  214-25*
HC.CEV  120-22#  120-23   213-18
HC.CMD  120-18#  120-19   120-20   145-21*
HC.CPK  120-23#  120-24   140-143  145-20   209-8*   209-9*   209-10*  209-11*  211-18*  211-19*  211-20*  211-21*  213-29*  214-17*
        215-18*  215-19*
HC.ESZ  120-11#  120-21   120-23   214-20
HC.INT  120-15#  120-16
HC.ISZ  120-9#   120-16   222-37
HC.MCT  120-17#  214-24*
HC.MEV  120-20#  120-21   214-18
HC.MPK  120-21#  120-22   140-145  145-18   145-20   151-9    151-14   151-19   209-17   211-25
HC.MSG  120-16#  120-17   120-18   145-19*  225-18
```

CROSS REFERENCE TABLE (CREF V04.00)

```
HC.PSZ  120-12#  120-22   120-24   213-19   213-25   214-20
HC.RSZ  120-10#  120-18   120-20
HC.SIZ  120-27#  145-14
HCOMM   145-14#  208-38
HM.CYL  254-27   255-25   287-26#  288-7
HO.BRL  251-7    252-3    287-22#  288-3    288-3    288-3
HO.BST  251-12   252-9    287-23#  288-4    288-4    288-4
HO.LDR  248-31   254-15   254-22   287-24#  288-5    288-5    288-5
HO.PRM  254-24   287-25#  288-7    288-7    288-7
HO.UBA  250-20   287-20#  288-1    288-1    288-1
HO.VEC  25[illegible]4   251-10   252-6    287-21#  288-2    288-2    288-2
HOE     11[illegible]10#
I$AU    112-12#
I$AUTO  112-12#  258-10#  258-12#
I$CLN   112-12#  259-8#   259-21#
I$DU    112-12#
I$HRD   287-14#  288-9#   290-4
I$INIT  112-12#  246-8#   256-31   257-23#
I$MOD   112-12#  112-33   112-33#  115-21   115-21#  116-3    116-3#   240-38   240-38#  241-3    241-3#   259-23   259-23#  260-3
        260-3#   286-9    286-9#   287-3    287-3#   291-10   291-10#
I$MSG   112-12#  140-14#  140-16#  140-18#  140-20#  140-22#  140-24#  140-26#  140-28#  140-30#  140-32#  140-34#  140-36#  140-38#
        140-40#  140-42#  140-44#  140-46#  140-48#  140-50#  140-57#  140-59#  140-63#  140-65#  140-77#  140-79#  140-81#  140-83#
        140-85#  140-87#  140-89#  140-91#  140-93#  140-95#  140-97#  140-99#  140-101#  140-103#  140-105#  140-107#  140-109#  140-111#
        140-114#  140-116#  140-118#  140-120#  140-122#  140-124#  140-127#  140-129#  140-131#  140-133#  140-135#  140-137#  140-139#  141-1#
        141-22#
I$PROT  112-12#  245-8#
I$PTAB  112-12#  292-3    292-3#   292-12   292-12#
I$PWR   112-12#
I$RPT   112-12#  241-10#  244-43#
I$SEG   112-12#  260-6    261-1    262-1    263-1    264-1    267-1    268-1    269-1    271-3    272-3    273-3
I$SETU  112-12#  292-1    292-1#   292-3    292-14   292-14#
I$SFT   289-12#  290-4    290-15#
I$SRV   112-12#  219-10#  219-14#  220-18#  220-21#  238-5#   238-9#   238-11#  238-13#
I$SUB   112-12#  260-6    261-1    261-1#   261-14   261-14#  261-14#  262-1    262-1#   262-15   262-15#  262-15#  263-1    263-1#
        263-32   263-32#  263-32#  264-1    264-1#   266-11   266-11#  266-11#  267-1    267-1#   267-4    267-4#   267-4#   268-1
        268-1#   268-6    268-6#   268-6#   269-1    269-1#   269-10   269-10#  269-10#  271-3    272-3    273-3
I$TST   112-12#  260-6    260-6#   260-18   261-1    262-1    263-1    264-1    267-1    268-1    269-1    269-14   269-14#  269-14#
        271-3    271-3#   271-24   271-24#  271-24#  272-3    272-3#   272-14   272-14#  272-14#  273-3    273-3#   276-44   286-7
        286-7#   286-7#
IBE     116-10#
ICONT   132-28#  247-4    273-11
IDU     116-10#  173-50   175-39   177-45
IER     116-10#
IFLAGS  132-27#  167-15   247-3*   247-4*   247-7*   249-5*   273-11   273-13*  274-3    276-24*  276-25*
INIT1   247-2    247-5#
INIT10  253-11#  253-14
INIT11  253-12   254-3#
INIT12  254-13#  254-19
INIT13  254-14   254-21#
INIT14  253-6    255-3#
INIT15  255-26   256-5    256-8    256-14#
INIT1A  247-6    247-8#
INIT2   247-9    247-12#
INIT3   247-13   249-1#
INIT3L  254-30#  254-32
INIT4   250-10#  252-17
```

CROSS REFERENCE TABLE (CREF V04.00)

CROSS REFERENCE TABLE (CREF V04.00)

```
L$DESC 112-42   135-17#
L$DESP 112-42#
L$DEVP 112-42#
L$DISP 112-42   113-9#
L$DLY  112-42#
L$DTP  112-42#
L$DTYP 112-42#
L$DUT  112-42#
L$DVTY 112-42   135-12#
L$EF   112-42#
L$ENVI 112-42#
L$ERRT 112-42   132-8#
L$ETP  112-42#
L$EXP1 112-42#
L$EXP4 112-42#
L$EXP5 112-42#
L$HARD 112-42   287-14   287-14#
L$HIME 112-42#  157-5
L$HPCP 112-42#
L$HPTP 112-42#
L$HW   112-42   114-10   114-10#
L$ICP  112-42#
L$INIT 112-42   246-8#
L$LADP 112-42#
L$LAST 112-42   291-8#   292-14
L$LOAD 112-42#
L$LUN  112-42#  148-28*  149-11*  195-29*  207-16*  260-11*
L$MREV 112-42#
L$NAME 112-42#
L$PRIO 112-42#
L$PROT 112-42   245-8#
L$PRT  112-42#
L$REPP 112-42#
L$REV  112-42#
L$RPT  112-42   241-10#
L$SOFT 112-42   289-12   289-12#
L$SPC  112-42#
L$SPCP 112-42#
L$SPTP 112-42#
L$STA  112-42#
L$SW   112-42   115-10   115-10#
L$TEST 112-42#
L$TIML 112-42#
L$UNIT 112-42#  248-37   252-16   255-4
L10000 114-10   114-18#
L10001 115-10   115-19#
L10002 140-16#
L10003 140-20#
L10004 140-24#
L10005 140-28#
L10006 140-32#
L10007 140-36#
L10010 140-40#
L10011 140-44#
L10012 140-48#
L10013 140-57#
```

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```
L10014 140-63#
L10015 140-77#
L10016 140-81#
L10017 140-85#
L10020 140-89#
L10021 140-93#
L10022 140-97#
L10023 140-101#
L10024 140-105#
L10025 140-109#
L10026 140-114#
L10027 140-118#
L10030 140-122#
L10031 140-127#
L10032 140-131#
L10033 140-135#
L10034 140-139#
L10035 141-22#
L10036 219-14#
L10037 220-21#
L10040 238-9#
L10041 238-13#
L10042 244-12    244-43#
L10044 256-31    257-23#
L10045 258-12#
L10046 259-21#
L10047 260-18    269-14#
L10050 261-14#
L10051 262-15#
L10052 263-32#
L10053 266-11#
L10054 267-4#
L10055 268-6#
L10056 269-10#
L10057 271-24#
L10060 272-14#
L10061 276-44    286-7#
L10062 287-14    288-9#
L10063 289-12    290-15#
L10064 292-3#
L10066 292-3     292-12#
LBUFE   134-22#  176-8*    176-11
LBUFN   134-21#  176-5*    176-9     176-10*  176-11    176-19*  273-21
LBUFS   134-20#  146-15*   176-1     176-4*   273-14    273-17*
LDDM    148-22#  148-37
LDNEXT  148-30   148-33    148-35#
LOAD    210-23   211-15#
LOADB   209-6#   210-31
LOADDM  148-32   208-14#
LOADE1  209-18   211-26    212-3#
LOADER  208-37   210-24    211-24    212-4#
LOADT1  209-3    210-4#
LOE     116-10#
LOG     120-32#
LOGCHK  273-1    273-26#
LOGM1   137-38#  273-16
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CROSS REFERENCE TABLE (CREF V04.00)

```
NEWTAB 250-17   251-3#
NOCLOC 137-37#  249-17
NXMAD  134-10#  219-12*  225-23*  225-28   261-2*   261-8
NXMI   219-10#  225-24   261-3
NXTTAB 250-11   251-21   252-10   252-15#
O$APTS 112-12#  112-42
O$AU   112-12#  112-42
O$BGNR 112-12#  112-39#  112-42
O$BGNS 112-12#  112-39#  112-42
O$DU   112-12#  112-42
O$ERRT 112-12#  112-39#  112-42
O$GNSW 112-12#  112-39#  112-42
O$POIN 112-12#  112-39   112-39#  112-39#  112-39#  112-39#  112-42
O$SETU 112-12#  112-39#  112-42   291-8
OP.ABO 122-3#
OP.ACC 122-4#
OP.AVA 122-22#
OP.AVL 122-5#
OP.CCD 122-6#
OP.CMP 122-7#
OP.DUP 122-23#
OP.ELP 122-29#
OP.END 122-20#  151-5    151-8
OP.ERS 122-8#
OP.ESP 122-28#  209-6
OP.FLU 122-9#
OP.GCS 122-10#
OP.GSS 122-27#
OP.GUS 122-11#
OP.MRD 122-18#
OP.MWR 122-19#  211-16   213-21
OP.ONL 122-12#
OP.RD  122-13#
OP.RLC 122-25#
OP.RPL 122-14#
OP.RSD 122-31#  151-8    152-33
OP.SCC 122-15#
OP.SEX 122-21#
OP.SHC 122-24#
OP.SSD 122-30#  151-5    152-14
OP.SUC 122-16#
OP.WR  122-17#
OSTRE  181-34   181-41   181-46#
OSTRNG 141-21   179-35   181-33#  181-45   186-9    191-6    192-6    193-6    206-17
P.BCNT 124-21#  125-9#   209-9*   211-19*  215-19*
P.BUFF 124-22#
P.CMST 125-14#
P.CNCL 125-48#
P.CNTF 124-40#  125-46#
P.CNTI 125-49#
P.CPSP 124-34#
P.CRF  124-17#  125-4#   151-19   214-17*
P.CTMO 125-47#
P.CYL  125-26#
P.DMDT 124-50#
P.ELGF 124-32#
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CROSS REFERENCE TABLE (CREF V04.00)

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P.FBBK 125-10#
P.FLGS 125-7#
P.GRP  125-25#
P.HSTI 124-31#  125-19#  125-35#
P.HTMO 124-41#
P.LBN  124-24#
P.MEDI 125-21#  125-37#
P.MLUN 125-17#  125-33#
P.MOD  124-20#
P.OPCD 124-19#  125-6#   151-9    213-29*
P.OTRF 124-27#  125-13#
P.OVRL 124-51#  209-10*  209-11*
P.RBN  124-36#
P.RBNS 125-28#
P.RCTC 125-29#
P.RCTS 125-27#
P.RGID 124-46#  211-21*
P.RGOF 124-47#  211-20*
P.SHST 125-23#  125-39#
P.SHUN 124-33#  125-22#  125-38#
P.STS  125-8#   151-14   209-17   211-25
P.TIME 124-43#
P.TRCK 125-24#
P.UADR 124-23#  209-8*   211-18*  215-18*
P.UNCL 125-40#
P.UNFL 124-30#  125-18#  125-34#
P.UNIT 124-18#  125-5#
P.UNSZ 125-41#
P.UNTI 125-20#  125-36#
P.USEF 124-42#
P.VRSN 124-39#  125-45#
P.VSER 125-42#
PAT16C 133-12#  165-19   275-3    275-4
PAT16W 133-13#  275-5
PB     205-14#  206-7
PF     132-10   205-12#  206-5
PNT    116-10#
PNT.CT 140-15   140-15   140-15#  140-15#  140-19   140-19   140-19#  140-19#  140-23   140-23   140-23#  140-23#  140-27   140-27#
       140-31   140-31#  140-35   140-35#  140-39   140-39#  140-43   140-43   140-43#  140-43#  140-47   140-47#  140-56   140-56
       140-56   140-56#  140-56#  140-56#  140-61   140-61   140-61   140-61#  140-61#  140-61#  140-66   140-66   140-66   140-66#
       140-66#  140-66#  140-70   140-70   140-70   140-70#  140-70#  140-70#  140-76   140-76#  140-80   140-80   140-80#  140-80#
       140-84   140-84   140-84   140-84#  140-84#  140-84#  140-88   140-88   140-88   140-88#  140-88#  140-88#  140-92   140-92
       140-92#  140-92#  140-96   140-96#  140-100  140-100  140-100#  140-100#  140-104  140-104  140-104#  140-104#  140-108  140-108#
       140-112  140-112#  140-125  140-125#  140-130  140-130#  140-134  140-134  140-134#  140-134#  140-138  140-138#  140-141  140-141#
       140-147  140-147  140-147  140-147  140-147  140-147#  140-147#  140-147#  140-147#  140-147#  140-154  140-154#  140-158  140-158
       140-158  140-158  140-158  140-158  140-158  140-158  140-158#  140-158#  140-158#  140-158#  140-158#  140-158#  140-158#  140-158#
       141-8    141-8    141-8    141-8    141-8    141-8    141-8    141-8    141-8#   141-8#   141-8#   141-8#   141-8#   141-8#
       141-8#   141-8#   160-34   160-34#  161-1    161-1    161-1    161-1    161-1#   161-1#   161-1#   161-1#   164-32   164-32#
       173-54   173-54   173-54   173-54   173-54#  173-54#  173-54#  173-54#  173-56   173-56#  178-8    178-8    178-8#   178-8#
       179-25   179-25   179-25   179-25   179-25#  179-25#  179-25#  179-25#  181-40   181-40#  183-23   183-23#  189-5    189-5
       189-5    189-5    189-5    189-5#   189-5#   189-5#   189-5#   189-5#   190-5    190-5    190-5    190-5    190-5    190-5
       190-5#   190-5#   190-5#   190-5#   190-5#   190-5#   202-1    202-1#   202-5    202-5#   240-24   240-24   240-24#  240-24#
       240-28   240-28   240-28#  240-28#  240-33   240-33   240-33#  240-33#  241-13   241-13   241-13#  241-13#  242-8    242-8#
       249-17   249-17#  255-27   255-27#  264-17   264-17   264-17   264-17#  264-17#  264-17#  266-7    266-7#   273-16   273-16#
       273-23   273-23#  273-28   273-28#  275-15   275-15#  277-12   277-12   277-12   277-12   277-12#  277-12#  277-12#  277-12#
       281-1    281-1#
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PNTERR 175-70   207-13#  273-19
PNTNUM 182-24   182-30   183-4    197-14#
PNTNUS 187-11   197-16#
PNTPKL 140-147# 140-151
PNTPKT 140-117  140-121  140-141#
PORTST 263-2#
PRI    116-10#
PRI00  116-10#  256-17   264-19   264-20   266-1
PRI01  116-10#
PRI02  116-10#
PRI03  116-10#
PRI04  116-10#
PRI05  116-10#
PRI06  116-10#
PRI07  112-42   116-10#  208-32   225-24   261-3    265-10
PS     205-18#  206-11
PTYPE  132-10#  141-20*  189-8*   190-8*   205-11   206-5*   206-7*   206-9*   206-11*
PX     141-20   189-8    190-8    205-16#  206-9
RDDAT  233-34   234-2    235-1#
RDDLL  159-7    231-11#
RDERR  234-3    237-1#
RDREC  147-15   231-12   233-18#
RDST   233-24#  233-28   234-14   234-16   234-18   235-33   236-6
RDSTS  233-20   233-23#
READDM 146-24   147-14#
README 147-16   147-21#
RESET  146-14   239-10#  247-10   259-17   260-20   271-10
RESETX 239-13   239-15#
RESPCT 149-8#   150-16
RESPDM 149-6#   150-17   159-19   269-7    271-16   272-12   273-31   276-37
RG.FLG 120-4#   214-24
RG.OWN 120-3#   214-24   214-25
RNTIM  137-5#   240-24
RNTIM1 137-6#   240-28
RNTIM2 137-7#   240-33
RNTIME 141-10   173-55   179-26   189-6    190-6    240-13#  241-14
RNTIMX 240-14   240-35#
RPTCT  242-10#  244-9
RPTCTN 242-13   242-24   244-3#
RPTDT  242-23#  244-2
RPTDTN 242-27   244-1#
RPTMD2 243-24   244-35#
RPTMSD 243-22   244-34#
RPTMSG 241-13   244-31#
RPTMSH 242-8    244-32#
RPTXX  242-7    244-11#
RSPDRP 149-23   149-41   150-21#  151-22   152-12   152-24
RSPDSP 152-23   153-3#   153-19
RSPERR 151-10   151-15   151-21#
RSPIN  149-13   151-5#
RSPMWR 151-7    151-9#
RSPNRP 150-4    150-7    150-9    150-14#
RSPNTO 149-34   149-37   149-39   149-42#
RSPNXT 149-10   150-3#   150-23   152-47
RSPOU  149-15   151-27#
RSPOU2 152-31   152-40#
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RSPOU3 152-38   152-41#
RSPOUT 151-27   152-29#
RSPPT2 152-3#
RSPPT3 152-10   152-14#
RSPPTW 151-20   151-26#
RSPRPT 150-6    150-10#
RSPTM  149-21   149-27#
RSPTMO 149-36   149-40#
RUNDM  148-15#  159-17  269-5   271-14  272-10  276-35
RWORDT 235-5    236-1#
RWRDE1 233-30   234-10  235-34  236-4   237-6#
S$LSYM 112-12#  114-18#  115-19#  140-16#  140-20#  140-24#  140-28#  140-32#  140-36#  140-40#  140-44#  140-48#  140-57#  140-63#
       140-77#  140-81#  140-85#  140-89#  140-93#  140-97#  140-101#  140-105#  140-109#  140-114#  140-118#  140-122#  140-127#  140-131#
       140-135#  140-139#  141-22#  163-3  163-3  163-3  163-3#  219-14#  220-21#  238-9#  238-13#  244-43#  256-6  256-6
       256-6  256-6#  257-23#  258-12#  259-21#  261-14#  262-15#  263-32#  266-11#  267-4#  268-6#  269-10#  269-14#  271-24#
       272-14#  275-3  275-3  275-3  275-3#  275-7  275-7  275-7  275-7#  277-14  277-14  277-14  277-14#  278-2
       278-2  278-2  278-2#  278-8  278-8  278-8  278-8#  278-14  278-14  278-14  278-14#  278-20  278-20  278-20
       278-20#  278-21  278-21  278-21  278-21#  278-24  278-24  278-24  278-24#  279-4  279-4  279-4  279-4#  279-13
       279-13  279-13  279-13#  279-14  279-14  279-14  279-14#  279-17  279-17  279-17  279-17#  280-2  280-2  280-2
       280-2#  280-4  280-4  280-4  280-4#  281-2  281-2  281-2  281-2#  283-4  283-4  283-4  283-4#  283-10
       283-10  283-10  283-10#  283-14  283-14  283-14  283-14#  284-10  284-10  284-10  284-10#  284-14  284-14  284-14
       284-14#  284-20  284-20  284-20  284-20#  285-2  285-2  285-2  285-2#  285-8  285-8  285-8  285-8#  285-22
       285-22  285-22  285-22#  286-2  286-2  286-2  286-2#  286-7#  288-9#  290-15#
S.EL   290-6    290-23#
S.IW   290-9    290-26#
S.LOG  290-10   290-27#
S.MAN  290-1    290-17#
S.MES  290-4    290-20#
S.SSF  290-8    290-25#
S.XL   290-7    290-24#
SA.A2  118-18#
SA.BST 119-22#
SA.CM1 118-32#  268-2
SA.CMD 118-27#
SA.CME 118-37#
SA.CTP 118-40#
SA.DI  118-19#  227-14
SA.ERC 118-13#
SA.ERR 118-9#   140-60  228-19
SA.GO  119-20#  224-15
SA.INE 119-4#
SA.INT 118-25#  264-23
SA.LFC 119-21#
SA.MCV 119-15#  227-38
SA.MS1 118-31#  268-2
SA.MSE 118-36#
SA.MSG 118-26#
SA.NV  118-17#
SA.NVE 119-5#
SA.PRG 118-44#
SA.S1  118-5#   226-3   227-14  262-8   263-9   264-26
SA.S2  118-6#   227-23  262-12
SA.S3  118-7#   227-31
SA.S4  118-8#   226-13  227-38
SA.STE 118-39#
SA.STP 118-29#  225-15  262-11  263-13  263-16  264-23  268-2
```

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SA.TST 119-11#  227-8
SA.VCE 119-3#
SA.VEC 118-24#
SA.WRP 118-28#  263-13  263-16
SAMTAB 250-21   252-3#
SAMVEC 250-26   257-19#
SEKERE 172-14   172-17#
SETOO  221-45#  221-50
SETO1  221-46   221-48#
SETO2  221-54#  221-57
SETTO  152-46   216-15  221-27#  228-23  241-21  249-30  256-29  264-32  270-8
SFPTBL 115-10#  160-29  167-17   173-45  173-47  175-60  175-68  177-42  273-26  274-5  276-38
SM.IW  167-17   289-24#  290-9
SM.LOG 175-68   273-26  276-38   289-23#  290-10
SM.MAN 160-29   274-5   289-21#  290-1
SM.SSF 175-60   289-22#  290-8
SNDC1  214-21#  214-23
SNDCMD 152-42   209-15  211-22   214-14#
SO.BIT 160-29   167-17  175-60   175-68  273-26  274-5   276-38  289-20#  290-1  290-1  290-1  290-8  290-8  290-8
       290-9    290-9   290-9    290-10  290-10  290-10
SO.EL  177-42   289-18#  290-6   290-6   290-6
SO.XL  173-45   173-47  289-19#  290-7   290-7   290-7
ST.ABO 126-7#
ST.AVL 126-9#
ST.CMD 126-6#
ST.CMP 126-12#
ST.CNT 126-15#
ST.DAT 126-13#
ST.DIA 126-17#
ST.DRV 126-16#
ST.HST 126-14#
ST.MFE 126-10#
ST.MSK 126-3#   151-14  209-17   211-25
ST.OFL 126-8#
ST.SUB 126-4#
ST.SUC 126-5#
ST.WPR 126-11#
STIME  134-8#   150-5   150-8    241-16  249-25  256-24
SVCGBL 112-12#  112-17#  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42
       112-42   112-42   112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42
       112-42   112-42   112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42
       114-10   115-10   115-10  132-8   135-12  135-17  140-11#  140-14  140-14  140-14  140-18  140-18  140-18  140-22
       140-22   140-22   140-26  140-26  140-26  140-30  140-30  140-30  140-34  140-34  140-34  140-38  140-38  140-38
       140-42   140-42   140-42  140-46  140-46  140-46  140-50  140-50  140-50  140-59  140-59  140-59  140-65  140-65
       140-65   140-79   140-79  140-79  140-83  140-83  140-83  140-87  140-87  140-87  140-91  140-91  140-91  140-95
       140-95   140-95   140-99  140-99  140-99  140-103  140-103  140-103  140-107  140-107  140-107  140-111  140-111  140-111
       140-116  140-116  140-116  140-120  140-120  140-120  140-124  140-124  140-124  140-129  140-129  140-129  140-133  140-133
       140-133  140-137  140-137  140-137  141-1  141-1  141-1  142-4#  219-10  220-18  238-5  238-11  241-10  245-8
       246-8    258-10   259-8   287-14  289-12  291-8  291-8  291-8  291-8#
SVCINS 112-12#  112-14#  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42
       112-42   112-42   112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42
       112-42   112-42   112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42
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       112-42   112-42   112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42
       112-42   112-42   112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42  112-42
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112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42
112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42
112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42
112-42	112-42	112-42	113-9	113-9	113-9	113-9	113-9	113-9	113-9	113-9	113-9	113-9	113-9
113-9	113-9	113-9	113-9	114-10	114-10	114-10	115-10	115-10	115-10	135-12	135-12	135-12	135-12
135-12	135-12	135-17	135-17	135-17	135-17	135-17	135-17	140-8#	140-16	140-20	140-24	140-28	140-32
140-36	140-40	140-44	140-48	140-57	140-62	140-62	140-62	140-62	140-62	140-63	140-77	140-81	140-85
140-89	140-93	140-97	140-101	140-105	140-109	140-114	140-118	140-122	140-127	140-131	140-135	140-139	141-22
142-1#	143-7	143-7	143-7	143-7	143-7	143-7	143-7	143-7	143-7	143-7	143-7	143-7	143-8
143-8	143-8	147-21	147-21	147-21	147-21	147-21	147-21	147-21	147-21	147-21	147-21	147-21	147-21
147-22	147-22	147-22	149-22	149-22	149-22	149-22	149-22	149-22	149-22	149-22	149-22	149-22	149-22
149-22	149-40	149-40	149-40	149-40	149-40	149-40	149-40	149-40	149-40	149-40	149-40	149-40	149-43
149-43	149-43	150-10	150-10	150-10	151-21	151-21	151-21	151-21	151-21	151-21	151-21	151-21	151-21
151-21	151-21	151-21	152-11	152-11	152-11	152-11	152-11	152-11	152-11	152-11	152-11	152-11	152-11
152-11	160-32	160-32	160-32	160-33	160-33	160-33	163-3	163-3	163-3	163-3	163-3	163-3	163-3
163-3	163-3	163-3	163-3	163-3	163-3	163-3	163-3	163-3	163-3	163-3	163-3	163-3	163-3
163-3	163-3	163-3	173-49	173-49	173-49	175-38	175-38	175-38	177-44	177-44	177-44	195-24	195-24
195-24	195-24	195-24	195-24	195-24	195-24	195-24	195-24	195-24	195-24	205-12	205-12	205-12	205-12
205-12	205-12	205-12	205-12	205-12	205-12	205-12	205-12	205-12	205-12	205-12	205-12	205-12	205-12
205-14	205-14	205-14	205-14	205-14	205-14	205-14	205-14	205-14	205-14	205-14	205-14	205-14	205-14
205-14	205-14	205-14	205-14	205-16	205-16	205-16	205-16	205-16	205-16	205-16	205-16	205-16	205-16
205-16	205-16	205-16	205-16	205-16	205-16	205-16	205-16	205-18	205-18	205-18	205-18	205-18	205-18
205-18	205-18	205-18	205-18	205-18	205-18	205-18	205-18	205-18	205-18	205-18	205-18	207-41	207-41
207-41	208-32	208-32	208-32	208-32	208-32	208-32	208-32	208-32	208-32	208-32	208-32	208-32	208-32
208-32	208-32	208-32	208-32	208-32	212-3	212-3	212-3	212-3	212-3	212-3	212-3	212-3	212-3
212-3	212-3	212-3	216-26	216-26	216-26	216-34	216-34	216-34	216-34	216-34	216-34	216-34	216-34
216-34	216-34	216-34	216-34	217-5	217-5	217-5	217-5	217-5	217-5	217-5	217-5	217-5	217-5
217-5	217-5	219-14	219-14	219-14	220-21	220-21	220-21	223-18	223-18	223-18	223-18	223-18	223-18
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233-26	233-26	233-31	233-31	233-31	234-7	234-7	234-7	235-23	235-23	235-23	235-30	235-30	235-30
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	290-15	291-8	291-8	291-8	291-8	291-8	291-8	291-8	291-8	291-8	292-3	292-3	292-3	292-3
	292-3	292-3												
SVCSUB	112-12#	112-16#	140-10#	142-3#	261-1	262-1	263-1	264-1	267-1	268-1	269-1			
SVCTAG	112-12#	112-18#	114-18	115-19	140-12#	140-16	140-16	140-16	140-20	140-20	140-20	140-24	140-24	140-24
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	140-81	140-81	140-85	140-85	140-85	140-89	140-89	140-89	140-93	140-93	140-93	140-97	140-97	140-97
	140-101	140-101	140-101	140-105	140-105	140-105	140-109	140-109	140-109	140-114	140-114	140-114	140-118	140-118
	140-118	140-122	140-122	140-122	140-127	140-127	140-127	140-131	140-131	140-131	140-135	140-135	140-135	140-139
	140-139	140-139	141-22	141-22	141-22	142-5#	163-3	219-14	220-21	238-9	238-13	244-43	256-6	257-23
	258-12	259-21	261-14	262-15	263-32	266-11	267-4	268-6	269-10	269-14	271-24	272-14	275-3	275-7
	277-14	278-2	278-8	278-14	278-20	278-21	278-24	279-4	279-13	279-14	279-17	280-2	280-4	281-2
	283-4	283-10	283-14	284-10	284-14	284-20	285-2	285-8	285-22	286-2	286-7	288-9	290-15	292-3
	292-12													
SVCTST	112-12#	112-15#	140-9#	142-2#	260-6	271-3	272-3	273-3						
TS$AUT	258-10#	258-12												
TS$CLE	259-8#	259-21												
TS$DAT	292-3	292-3#	292-12											
TS$HAR	287-14	287-14#	288-9											
TS$HW	114-10	114-10#	114-18											
TS$INI	246-8#	256-31	257-23											
TS$MSG	140-14#	140-16	140-18#	140-20	140-22#	140-24	140-26#	140-28	140-30#	140-32	140-34#	140-36	140-38#	140-40
	140-42#	140-44	140-46#	140-48	140-50#	140-57	140-59#	140-63	140-65#	140-77	140-79#	140-81	140-83#	140-85
	140-87#	140-89	140-91#	140-93	140-95#	140-97	140-99#	140-101	140-103#	140-105	140-107#	140-109	140-111#	140-114
	140-116#	140-118	140-120#	140-122	140-124#	140-127	140-129#	140-131	140-133#	140-135	140-137#	140-139	141-1#	141-22
TS$PC	292-1#	292-14												
TS$PRO	245-8#													
TS$PTA	292-1#	292-3	292-3#											
TS$RPT	241-10#	244-12	244-43											
TS$SOF	289-12	289-12#	290-15											
TS$SRV	219-10#	219-14	220-18#	220-21	238-5#	238-9	238-11#	238-13						
TS$SUB	261-1#	261-14	262-1#	262-15	263-1#	263-32	264-1#	266-11	267-1#	267-4	268-1#	268-6	269-1#	269-10
TS$SW	115-10	115-10#	115-19											
TS$TES	260-6#	260-18	269-14	271-3#	271-24	272-3#	272-14	273-3#	276-44	286-7				
TSARGC	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42	112-42#	112-42#	112-42#
	112-42#	112-42#	112-42#	140-62	140-62	140-62#	205-12	205-12	205-12	205-12#	205-12#	205-14	205-14	205-14
	205-14#	205-14#	205-16	205-16	205-16	205-16#	205-16#	205-18	205-18	205-18	205-18#	205-18#	243-22	243-22

CROSS REFERENCE TABLE (CREF V04.00)

	243-22	243-22	243-22	243-22	243-22	243-22	243-22#	243-22#	243-22#	243-22#	243-22#	243-22#	243-22#	243-24
	243-24	243-24	243-24	243-24	243-24#	243-24#	243-24#	243-24#	255-36	255-36	255-36	255-36	255-36	255-36#
	255-36#	255-36#	255-36#											
T$CODE	163-3	163-3	163-3	163-3#	163-3#	163-3#	256-6	256-6	256-6	256-6#	256-6#	256-6#	275-3	275-3
	275-3	275-3#	275-3#	275-3#	275-7	275-7	275-7	275-7#	275-7#	275-7#	277-14	277-14	277-14	277-14#
	277-14#	277-14#	278-2	278-2	278-2	278-2#	278-2#	278-2#	278-8	278-8	278-8	278-8#	278-8#	278-8#
	278-14	278-14	278-14	278-14#	278-14#	278-14#	278-20	278-20	278-20	278-20#	278-20#	278-20#	278-21	278-21
	278-21	278-21#	278-21#	278-21#	278-24	278-24	278-24	278-24#	278-24#	278-24#	279-4	279-4	279-4	279-4#
	279-4#	279-4#	279-13	279-13	279-13	279-13#	279-13#	279-13#	279-14	279-14	279-14	279-14#	279-14#	279-14#
	279-17	279-17	279-17	279-17#	279-17#	279-17#	280-2	280-2	280-2	280-2#	280-2#	280-2#	280-4	280-4
	280-4	280-4#	280-4#	280-4#	281-2	281-2	281-2	281-2#	281-2#	281-2#	283-4	283-4	283-4	283-4#
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	284-20	284-20#	284-20#	284-20#	285-2	285-2	285-2	285-2#	285-2#	285-2#	285-8	285-8	285-8	285-8#
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	288-3	288-3#	288-3#	288-3#	288-4	288-4	288-4	288-4#	288-4#	288-4#	288-5	288-5	288-5	288-5#
	288-5#	288-5#	288-7	288-7	288-7	288-7#	288-7#	288-7#	290-1	290-1	290-1	290-1#	290-1#	290-1#
	290-4	290-4#	290-6	290-6	290-6	290-6#	290-6#	290-6#	290-7	290-7	290-7	290-7#	290-7#	290-7#
	290-8	290-8	290-8	290-8#	290-8#	290-8#	290-9	290-9	290-9	290-9#	290-9#	290-9#	290-10	290-10
	290-10	290-10#	290-10#	290-10#										
T$ERRN	112-12#	143-7	143-7#	147-21	147-21#	149-22	149-22#	149-40	149-40#	151-21	151-21#	152-11	152-11#	195-24
	195-24#	212-3	212-3#	216-34	216-34#	217-5	217-5#	223-18	223-18#	223-40	223-40#	225-30	225-30#	227-44
	227-44#	228-36	228-36#	229-5	229-5#	237-6	237-6#	248-29	248-29#	257-3	257-3#	257-8	257-8#	257-14
	257-14#	257-20	257-20#	261-10	261-10#	263-26	263-26#	265-27	265-27#	266-5	266-5#	270-19	270-19#	
T$EXCP	163-3	163-3#	275-3	275-3#	275-7	275-7#	277-14	277-14#	278-2	278-2#	279-4	279-4#	281-2	281-2#
	283-4	283-4#	283-10	283-10#	283-14	283-14#	284-10	284-10#	284-14	284-14#	284-20	284-20#	285-2	285-2#
	285-22	285-22#	286-2	286-2#	288-1	288-1#	288-2	288-2#	288-3	288-3#	288-4	288-4#	288-5	288-5#
	290-6	290-6#	290-7	290-7#										
T$FLAG	244-12	244-12#	244-12#	256-31	256-31	256-31#	256-31#	260-18	260-18	260-18#	260-18#	276-44	276-44	276-44#
	276-44#													
T$FREE	291-8	292-14#												
T$GMAN	112-12#	163-3	163-3#	163-3#	275-3#	275-3#	275-7#	275-7#	277-14#	277-14#	278-2	278-2#	278-2#	279-4#
	279-4#	281-2#	281-2#	283-4#	283-4#	283-10	283-10#	283-10#	283-14	283-14#	283-14#	284-10#	284-10#	284-14#
	284-14#	284-20#	284-20#	285-2#	285-2#	285-22	285-22#	285-22#	286-2	286-2#	286-2#			
T$HILI	163-3	163-3#	275-3	275-3#	275-7	275-7#	277-14	277-14#	278-2	278-2#	279-4	279-4#	281-2	281-2#
	283-4	283-4#	283-10	283-10#	283-14	283-14#	284-10	284-10#	284-14	284-14#	284-20	284-20#	285-2	285-2#
	285-22	285-22#	286-2	286-2#	288-1	288-1#	288-2	288-2#	288-3	288-3#	288-4	288-4#	288-5	288-5#
	290-6	290-6#	290-7	290-7#										
T$LAST	112-12#	291-8#	292-1											
T$LOLI	163-3	163-3#	275-3	275-3#	275-7	275-7#	277-14	277-14#	278-2	278-2#	279-4	279-4#	281-2	281-2#
	283-4	283-4#	283-10	283-10#	283-14	283-14#	284-10	284-10#	284-14	284-14#	284-20	284-20#	285-2	285-2#
	285-22	285-22#	286-2	286-2#	288-1	288-1#	288-2	288-2#	288-3	288-3#	288-4	288-4#	288-5	288-5#
	290-6	290-6#	290-7	290-7#										
T$LSYM	112-12	112-12#	114-18	115-19	140-16	140-20	140-24	140-28	140-32	140-36	140-40	140-44	140-48	140-57
	140-63	140-77	140-81	140-85	140-89	140-93	140-97	140-101	140-105	140-109	140-114	140-118	140-122	140-127
	140-131	140-135	140-139	141-22	219-14	220-21	238-9	238-13	244-43	257-23	258-12	259-21	261-14	262-15
	263-32	266-11	267-4	268-6	269-10	269-14	271-24	272-14	286-7	288-9	290-15			
T$LTNO	291-8#													
T$NEST	112-12#	112-33	112-33	112-33#	114-10	114-10	114-10#	114-18	114-18	114-18	114-18#	115-10	115-10	115-10#
	115-19	115-19	115-19	115-19#	115-21	115-21	115-21	115-21#	116-3	116-3	116-3#	140-14	140-14	140-14#
	140-16	140-16	140-16	140-16#	140-18	140-18	140-18#	140-20	140-20	140-20	140-20#	140-22	140-22	140-22#
	140-24	140-24	140-24	140-24#	140-26	140-26	140-26#	140-28	140-28	140-28	140-28#	140-30	140-30	140-30#
	140-32	140-32	140-32	140-32#	140-34	140-34	140-34#	140-36	140-36	140-36	140-36#	140-38	140-38	140-38#
	140-40	140-40	140-40	140-40#	140-42	140-42	140-42#	140-44	140-44	140-44	140-44#	140-46	140-46	140-46#
	140-48	140-48	140-48	140-48#	140-50	140-50	140-50#	140-57	140-57	140-57	140-57#	140-59	140-59	140-59#

CROSS REFERENCE TABLE (CREF V04.00)

	140-63	140-63	140-63	140-63#	140-65	140-65	140-65#	140-77	140-77	140-77	140-77#	140-79	140-79	140-79#
	140-81	140-81	140-81	140-81#	140-83	140-83	140-83#	140-85	140-85	140-85	140-85#	140-87	140-87	140-87#
	140-89	140-89	140-89	140-89#	140-91	140-91	140-91#	140-93	140-93	140-93	140-93#	140-95	140-95	140-95#
	140-97	140-97	140-97	140-97#	140-99	140-99	140-99#	140-101	140-101	140-101	140-101#	140-103	140-103	140-103#
	140-105	140-105	140-105	140-105#	140-107	140-107	140-107#	140-109	140-109	140-109	140-109#	140-111	140-111	140-111#
	140-114	140-114	140-114	140-114#	140-116	140-116	140-116#	140-118	140-118	140-118	140-118#	140-120	140-120	140-120#
	140-122	140-122	140-122	140-122#	140-124	140-124	140-124#	140-127	140-127	140-127	140-127#	140-129	140-129	140-129#
	140-131	140-131	140-131	140-131#	140-133	140-133	140-133#	140-135	140-135	140-135	140-135#	140-137	140-137	140-137#
	140-139	140-139	140-139	140-139#	141-1	141-1	141-1#	141-22	141-22	141-22	141-22#	219-10	219-10	219-10#
	219-14	219-14	219-14	219-14#	220-18	220-18	220-18#	220-21	220-21	220-21	220-21#	238-5	238-5	238-5#
	238-9	238-9	238-9	238-9#	238-11	238-11	238-11#	238-13	238-13	238-13	238-13#	240-38	240-38	240-38
	240-38#	241-3	241-3	241-3#	241-10	241-10	241-10#	244-43	244-43	244-43	244-43#	245-8	245-8	245-8#
	245-14	245-14	245-14	245-14#	246-8	246-8	246-8#	257-23	257-23	257-23	257-23#	258-10	258-10	258-10#
	258-12	258-12	258-12	258-12#	259-8	259-8	259-8#	259-21	259-21	259-21	259-21#	259-23	259-23	259-23
	259-23#	260-3	260-3	260-3#	260-6	260-6	260-6#	261-1	261-1	261-1#	261-14	261-14	261-14	261-14#
	262-1	262-1	262-1#	262-15	262-15	262-15	262-15#	263-1	263-1	263-1#	263-32	263-32	263-32	263-32#
	264-1	264-1	264-1#	266-11	266-11	266-11	266-11#	267-1	267-1	267-1#	267-4	267-4	267-4	267-4#
	268-1	268-1	268-1#	268-6	268-6	268-6	268-6#	269-1	269-1	269-1#	269-10	269-10	269-10	269-10#
	269-14	269-14	269-14	269-14#	271-3	271-3	271-3#	271-24	271-24	271-24	271-24#	272-3	272-3	272-3#
	272-14	272-14	272-14	272-14#	273-3	273-3	273-3#	286-7	286-7	286-7	286-7#	286-9	286-9	286-9
	286-9#	287-3	287-3	287-3#	287-14	287-14	287-14#	288-9	288-9	288-9	288-9#	289-12	289-12	289-12#
	290-15	290-15	290-15	290-15#	291-10	291-10	291-10	291-10#						
T$NS0	112-33#	115-21	116-3#	240-38	241-3#	259-23	260-3#	286-9	287-3#	291-10				
T$NS1	114-10#	114-18	115-10#	115-19	140-14#	140-16	140-18#	140-20	140-22#	140-24	140-26#	140-28	140-30#	140-32
	140-34#	140-36	140-38#	140-40	140-42#	140-44	140-46#	140-48	140-50#	140-57	140-59#	140-63	140-65#	140-77
	140-79#	140-81	140-83#	140-85	140-87#	140-89	140-91#	140-93	140-95#	140-97	140-99#	140-101	140-103#	140-105
	140-107#	140-109	140-111#	140-114	140-116#	140-118	140-120#	140-122	140-124#	140-127	140-129#	140-131	140-133#	140-135
	140-137#	140-139	141-1#	141-22	219-10#	219-14	220-18#	220-21	238-5#	238-9	238-11#	238-13	241-10#	244-43
	245-8#	245-14	246-8#	257-23	258-10#	258-12	259-8#	259-21	260-6#	269-14	271-3#	271-24	272-3#	272-14
	273-3#	286-7	287-14#	288-9	289-12#	290-15								
T$NS2	261-1#	261-14	262-1#	262-15	263-1#	263-32	264-1#	266-11	267-1#	267-4	268-1#	268-6	269-1#	269-10
T$PCNT	292-1#	292-3	292-3	292-3#										
T$PTAB	292-3	292-3#												
T$PTHV	112-42	292-14#												
T$PTNU	112-12#	292-3	292-3#	292-14	292-1#									
T$SAVL	112-12#													
T$SEGL	112-12#													
T$SIZE	291-8	292-14#												
T$SUBN	112-12#	260-6#	261-1	261-1	261-1#	262-1	262-1	262-1#	263-1	263-1	263-1#	264-1	264-1	264-1#
	267-1	267-1	267-1#	268-1	268-1	268-1#	269-1	269-1	269-1#	271-3#	272-3#	273-3#		
T$TAGL	112-12#													
T$TAGN	112-12#	114-10	114-10	114-10#	115-10	115-10	115-10#	140-14	140-14	140-14#	140-18	140-18	140-18#	140-22
	140-22	140-22#	140-26	140-26	140-26#	140-30	140-30	140-30#	140-34	140-34	140-34#	140-38	140-38	140-38#
	140-42	140-42	140-42#	140-46	140-46	140-46#	140-50	140-50	140-50#	140-59	140-59	140-59#	140-65	140-65
	140-65#	140-79	140-79	140-79#	140-83	140-83	140-83#	140-87	140-87	140-87#	140-91	140-91	140-91#	140-95
	140-95	140-95#	140-99	140-99	140-99#	140-103	140-103	140-103#	140-107	140-107	140-107#	140-111	140-111	140-111#
	140-116	140-116	140-116#	140-120	140-120	140-120#	140-124	140-124	140-124#	140-129	140-129	140-129#	140-133	140-133
	140-133#	140-137	140-137	140-137#	141-1	141-1	141-1#	219-10	219-10	219-10#	220-18	220-18	220-18#	238-5
	238-5	238-5#	238-11	238-11	238-11#	241-10	241-10	241-10#	245-8	245-8	245-8#	246-8	246-8	246-8#
	258-10	258-10	258-10#	259-8	259-8	259-8#	260-6	260-6	260-6#	261-1	261-1	261-1#	262-1	262-1
	262-1#	263-1	263-1	263-1#	264-1	264-1	264-1#	267-1	267-1	267-1#	268-1	268-1	268-1#	269-1
	269-1	269-1#	271-3	271-3	271-3#	272-3	272-3	272-3#	273-3	273-3	273-3#	287-14	287-14	287-14#
	289-12	289-12	289-12#	292-1	292-1	292-1#	292-3	292-3	292-3	292-3	292-3#	292-3#		
T$TEMP	113-9	113-9	113-9	113-9	113-9	113-9	113-9	113-9	113-9#	113-9#	113-9#	113-9#	113-9#	114-18
	114-18#	115-19	115-19#	115-21	115-21#	140-16	140-16#	140-20	140-20#	140-24	140-24#	140-28	140-28#	140-32
	140-32#	140-36	140-36#	140-40	140-40#	140-44	140-44#	140-48	140-48#	140-57	140-57#	140-63	140-63#	140-77

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        140-77#  140-81   140-81#  140-85   140-85#  140-89   140-89#  140-93   140-93#  140-97   140-97#  140-101  140-101# 140-105
        140-105# 140-109  140-109# 140-114  140-114# 140-118  140-118# 140-122  140-122# 140-127  140-127# 140-131  140-131# 140-135
        140-135# 140-139  140-139# 141-22   141-22#  163-3    163-3    163-3    163-3#   163-3#   163-3#   219-14   219-14#  220-21
        220-21#  238-9    238-9#   238-13   238-13#  240-38   240-38#  244-12   244-12#  244-43   244-43#  245-14   245-14#  256-6
        256-6    256-6    256-6#   256-6#   256-6#   256-31   256-31#  257-23   257-23#  258-12   258-12#  259-21   259-21#  259-23
        259-23#  260-18   260-18#  261-14   261-14#  262-15   262-15#  263-32   263-32#  266-11   266-11#  267-4    267-4#   268-6
        268-6#   269-10   269-10#  269-14   269-14#  271-24   271-24#  272-14   272-14#  275-3    275-3    275-3    275-3#   275-3#
        275-3#   275-7    275-7    275-7    275-7#   275-7#   275-7#   276-44   276-44#  277-14   277-14   277-14   277-14#  277-14#
        277-14#  278-2    278-2    278-2    278-2#   278-2#   278-2#   278-8    278-8    278-8    278-8#   278-8#   278-8#   278-14
        278-14   278-14   278-14#  278-14#  278-14#  278-20   278-20   278-20   278-20#  278-20#  278-20#  278-21   278-21   278-21
        278-21#  278-21#  278-21#  278-24   278-24   278-24   278-24#  278-24#  278-24#  279-4    279-4    279-4    279-4#   279-4#
        279-4#   279-13   279-13   279-13   279-13#  279-13#  279-13#  279-14   279-14   279-14   279-14#  279-14#  279-14#  279-17
        279-17   279-17   279-17#  279-17#  279-17#  280-2    280-2    280-2    280-2#   280-2#   280-2#   280-4    280-4    280-4
        280-4#   280-4#   280-4#   281-2    281-2    281-2    281-2#   281-2#   281-2#   283-4    283-4    283-4    283-4#   283-4#
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        284-20#  284-20#  284-20#  285-2    285-2    285-2    285-2#   285-2#   285-2#   285-8    285-8    285-8    285-8#   285-8#
        285-8#   285-22   285-22   285-22   285-22#  285-22#  285-22#  286-2    286-2    286-2    286-2#   286-2#   286-2#   286-7
        286-7#   286-9    286-9#   288-1    288-1    288-1    288-1#   288-1#   288-1#   288-2    288-2    288-2    288-2#   288-2#
        288-2#   288-3    288-3    288-3    288-3#   288-3#   288-3#   288-4    288-4    288-4    288-4#   288-4#   288-4#   288-5
        288-5    288-5    288-5#   288-5#   288-5#   288-7    288-7    288-7    288-7#   288-7#   288-7#   288-9    288-9#   290-1
        290-1    290-1    290-1#   290-1#   290-1#   290-6    290-6    290-6    290-6#   290-6#   290-6#   290-7    290-7    290-7
        290-7#   290-7#   290-7#   290-8    290-8    290-8    290-8#   290-8#   290-8#   290-9    290-9    290-9    290-9#   290-9#
        290-9#   290-10   290-10   290-10   290-10#  290-10#  290-10#  290-15   290-15#  291-10   291-10#
TSTEST  112-12#  260-6    260-6    260-6#   261-1    262-1    263-1    264-1    267-1    268-1    269-1    271-3    271-3    271-3#
        272-3    272-3    272-3#   273-3    273-3    273-3#   291-8
TSTSTM  112-12#  140-16   140-20   140-24   140-28   140-32   140-36   140-40   140-44   140-48   140-57   140-62   140-63   140-77
        140-81   140-85   140-89   140-93   140-97   140-101  140-105  140-109  140-114  140-118  140-122  140-127  140-131  140-135
        140-139  141-22   143-7    143-8    147-21   147-22   149-22   149-40   149-43   150-10   151-21   152-11   160-32   163-3
        173-49   175-38   177-44   195-24   205-12   205-14   205-16   205-18   207-41   208-32   212-3    216-26   216-34   217-5
        223-18   223-40   225-13   225-24   225-27   225-30   227-44   228-27   228-36   229-5    232-12   233-21   233-24   233-26
        233-31   234-7    235-23   235-30   236-1    236-11   236-14   237-6    237-7    239-10   239-11   243-22   243-24   244-43
        247-1    247-5    247-8    247-11   247-12   248-21   248-29   248-30   249-1    249-2    249-12   249-14   249-23   250-10
        253-5    255-36   256-4    256-6    256-9    256-17   256-20   256-22   256-31   257-3    257-4    257-8    257-9    257-14
        257-15   257-20   257-21   257-23   258-12   259-21   260-18   261-1    261-3    261-7    261-10   261-11   261-14   262-1
        262-15   263-1    263-26   263-32   264-1    264-19   264-20   264-35   265-10   265-21   265-27   266-1    266-5    266-10
        266-11   267-1    267-4    268-1    268-6    269-1    269-10   269-14   270-11   270-19   271-24   272-14   274-7    275-3
        275-7    276-40   276-43   276-44   277-14   278-2    278-8    278-14   278-20   278-21   278-24   279-4    279-13   279-14
        279-17   280-2    280-4    281-2    283-4    283-10   283-14   284-10   284-14   284-20   285-2    285-8    285-22   286-7
        286-7
TSTSTS  112-12#  260-6#   271-3#   272-3#   273-3#
T1      113-9    260-6#
T1.1    261-1#
T1.2    262-1#
T1.3    263-1#
T1.4    264-1#
T1.5    267-1#
T1.6    268-1#
T1.7    269-1#
T1GOOD  261-9    261-13#
T1MSIZ  153-3    156-26#
T1NEXT  260-10#  260-17
T1NOW   260-13   260-20#
T1SKIP  260-15#  261-12   269-12
T2      113-9    271-3#
T2CMD   153-5    160-29#
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T2CMD0 160-33   160-36#
T2CMD2 160-38   162-1#
T2CMD3 163-9    164-3#
T2CMD9 160-34#
T2CMDE 163-16   164-7    164-10   164-12   164-27   164-32#  204-47
T2CMDM 160-30   160-32#
T2CMDN 164-17   164-19#
T2CMDQ 162-2    163-3#   164-33
T2CMDR 164-5    164-14#
T2CMDV 163-7    163-15#
T2CMDW 164-20   164-24   164-26#
T2CMDX 160-31   160-35   163-17   164-30#
T2CMS1 137-27#  161-1
T2CMS5 137-36#  164-32
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T2DR   134-15#  161-4*   163-13*  163-14
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        127-35   127-35   127-35#  127-36   127-36   127-36#  127-37   127-37   127-37#  127-38   127-38   127-38#  127-39   127-39
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        129-2    129-2    129-2#   129-3    129-3    129-3#   129-4    129-4    129-4#   129-5    129-5    129-5#   129-6    129-6
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CROSS REFERENCE TABLE (CREF V04.00)

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264-19#	264-19#	264-19#	264-19#	264-19#	264-20	264-20	264-20#	264-20#	264-35	264-35#	265-10	265-10	265-10#
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285-8#	285-8#	285-8#	285-8#	285-22	285-22	285-22	285-22	285-22	285-22	285-22	285-22	285-22#	285-22#
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286-7	286-7#	287-14	287-14#	288-1	288-1	288-1	288-1	288-1#	288-2	288-2	288-2	288-2	288-2#
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279-17	279-17#	280-2	280-2#	280-4	280-4#	281-2	281-2#	283-4	283-4#	283-10	283-10#	283-14	283-14#
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	140-38	140-38	140-38#	140-38#	140-40#	140-42	140-42	140-42#	140-42#	140-44#	140-46	140-46	140-46#	140-46#
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	140-99	140-99	140-99#	140-99#	140-101#	140-103	140-103	140-103#	140-103#	140-105#	140-107	140-107	140-107#	140-107#
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	140-120#	140-122#	140-124	140-124	140-124#	140-124#	140-127#	140-129	140-129	140-129#	140-129#	140-131#	140-133	140-133
	140-133#	140-133#	140-135#	140-137	140-137	140-137#	140-137#	140-139#	141-1	141-1	141-1#	141-1#	141-22#	143-7#
	143-8#	147-21#	147-22#	149-22#	149-40#	149-43#	150-10#	151-21#	152-11#	160-32#	163-3	163-3#	163-3#	173-49#
	175-38#	177-44#	195-24#	205-12#	205-14#	205-16#	205-18#	207-41#	208-32#	212-3#	216-26#	216-34#	217-5#	219-10
	219-10	219-10#	219-10#	220-18	220-18	220-18#	220-18#	223-18#	223-40#	225-13#	225-24#	225-27#	225-30#	227-44#
	228-27#	228-36#	229-5#	232-12#	233-21#	233-24#	233-26#	233-31#	234-7#	235-23#	235-30#	236-1#	236-11#	236-14#
	237-6#	237-7#	238-5	238-5	238-5#	238-5#	238-11	238-11	238-11#	238-11#	239-10#	239-11#	241-3	241-3#
	241-10	241-10	241-10#	241-1.#	243-22#	243-24#	244-43#	245-8	245-8	245-8#	245-8#	246-8	246-8	246-8#
	246-8#	247-1#	247-5#	247-8#	247-11#	247-12#	248-21#	248-29#	248-30#	249-1#	249-2#	249-12#	249-14#	249-23#
	250-10#	253-5#	255-36#	256-4#	256-6	256-6#	256-6#	256-9#	256-17#	256-20#	256-22#	256-31#	257-3#	257-4#
	257-8#	257-9#	257-14#	257-15#	257-20#	257-21#	257-23#	258-10	258-10	258-10#	258-10#	258-12#	259-8	259-8
	259-8#	259-8#	259-21#	260-3	260-3#	260-6	260-6	260-6	260-6#	260-6#	260-6#	260-18#	261-1	261-1
	261-1	261-1#	261-1#	261-1#	261-3#	261-7#	261-10#	261-11#	261-14#	262-1	262-1	262-1	262-1#	262-1#
	262-1#	262-15#	263-1	263-1	263-1	263-1#	263-1#	263-1#	263-26#	263-32#	264-1	264-1	264-1	264-1#
	264-1#	264-1#	264-19#	264-20#	264-35#	265-10#	265-21#	265-27#	266-1#	266-5#	266-10#	266-11#	267-1	267-1
	267-1	267-1#	267-1#	267-1#	267-4#	268-1	268-1	268-1	268-1#	268-1#	268-1#	268-6#	269-1	269-1
	269-1	269-1#	269-1#	269-1#	269-10#	269-14#	270-11#	270-19#	271-3	271-3	271-3	271-3#	271-3#	271-3#
	271-24#	272-3	272-3	272-3	272-3#	272-3#	272-3#	272-14#	273-3	273-3	273-3	273-3#	273-3#	273-3#
	274-7#	275-3	275-3#	275-3#	275-7	275-7#	275-7#	276-40#	276-43#	276-44#	277-14	277-14#	277-14#	278-2
	278-2#	278-2#	278-8	278-8#	278-8#	278-14	278-14#	278-14#	278-20	278-20#	278-20#	278-21	278-21#	278-21#
	278-24	278-24#	278-24#	279-4	279-4#	279-4#	279-13	279-13#	279-13#	279-14	279-14#	279-14#	279-17	279-17#
	279-17#	280-2	280-2#	280-2#	280-4	280-4#	280-4#	281-2	281-2#	281-2#	283-4	283-4#	283-4#	283-10
	283-10#	283-10#	283-14	283-14#	283-14#	284-10	284-10#	284-10#	284-14	284-14#	284-14#	284-20	284-20#	284-20#
	285-2	285-2#	285-2#	285-8	285-8#	285-8#	285-22	285-22#	285-22#	286-2	286-2#	286-2#	286-7#	287-3
	287-3#	287-14	287-14	287-14#	287-14#	289-12	289-12	289-12#	289-12#	292-1	292-1#	292-3	292-3	292-3
	292-3#													
M$LDRO	225-27	225-27#	233-21	233-21#	247-1	247-1#	247-5	247-5#	247-8	247-8#	247-12	247-12#	248-21	248-21#
	249-12	249-12#	249-14	249-14#	250-10	250-10#	253-5	253-5#	256-17	256-17#	256-20	256-20#	256-22	256-22#
	261-7	261-7#	264-20	264-20#	265-10	265-10#	265-21	265-21#	266-1	266-1#	266-10	266-10#		
M$MCHI	112-12	112-12#												
M$MCLO	112-12	112-12#												
M$POP	114-18	114-18#	115-19	115-19#	115-21	115-21#	140-16	140-16#	140-20	140-20#	140-24	140-24#	140-28	140-28#
	140-32	140-32#	140-36	140-36#	140-40	140-40#	140-44	140-44#	140-48	140-48#	140-57	140-57#	140-63	140-63#
	140-77	140-77#	140-81	140-81#	140-85	140-85#	140-89	140-89#	140-93	140-93#	140-97	140-97#	140-101	140-101#
	140-105	140-105#	140-109	140-109#	140-114	140-114#	140-118	140-118#	140-122	140-122#	140-127	140-127#	140-131	140-131#
	140-135	140-135#	140-139	140-139#	141-22	141-22#	219-14	219-14#	220-21	220-21#	238-9	238-9#	238-13	238-13#
	240-38	240-38#	244-43	244-43#	245-14	245-14#	257-23	257-23#	258-12	258-12#	259-21	259-21#	259-23	259-23#
	261-14	261-14#	262-15	262-15#	263-32	263-32#	266-11	266-11#	267-4	267-4#	268-6	268-6#	269-10	269-10#
	269-14	269-14#	271-24	271-24#	272-14	272-14#	286-7	286-7#	286-9	286-9#	288-9	288-9#	290-15	290-15#
	291-10	291-10#												
M$PRIN	140-62	140-62#	205-12	205-12#	205-14	205-14#	205-16	205-16#	205-18	205-18#	243-22	243-22#	243-24	243-24#
	255-36	255-36#												
M$PUSH	112-33	112-33#	114-10	114-10#	115-10	115-10#	116-3	116-3#	140-14	140-14#	140-18	140-18#	140-22	140-22#

CROSS REFERENCE TABLE (CREF V04.00)

	140-26	140-26#	140-30	140-30#	140-34	140-34#	140-38	140-38#	140-42	140-42#	140-46	140-46#	140-50	140-50#
	140-59	140-59#	140-65	140-65#	140-79	140-79#	140-83	140-83#	140-87	140-87#	140-91	140-91#	140-95	140-95#
	140-99	140-99#	140-103	140-103#	140-107	140-107#	140-111	140-111#	140-116	140-116#	140-120	140-120#	140-124	140-124#
	140-129	140-129#	140-133	140-133#	140-137	140-137#	141-1	141-1#	219-10	219-10#	220-18	220-18#	238-5	238-5#
	238-11	238-11#	241-3	241-3#	241-10	241-10#	245-8	245-8#	246-8	246-8#	258-10	258-10#	259-8	259-8#
	260-3	260-3#	260-6	260-6#	261-1	261-1#	262-1	262-1#	263-1	263-1#	264-1	264-1#	267-1	267-1#
	268-1	268-1#	269-1	269-1#	271-3	271-3#	272-3	272-3#	273-3	273-3#	287-3	287-3#	287-14	287-14#
	289-12	289-12#												
M$PUT	140-62	140-62	140-62#	205-12	205-12	205-12	205-12#	205-14	205-14	205-14	205-14#	205-16	205-16	205-16
	205-16#	205-18	205-18	205-18	205-18#	208-32	208-32	208-32	208-32	208-32#	225-24	225-24	225-24	225-24
	225-24#	243-22	243-22	243-22	243-22	243-22	243-22	243-22	243-22	243-22#	243-24	243-24	243-24	243-24
	243-24	243-24#	249-23	249-23	249-23	249-23	249-23#	255-36	255-36	255-36	255-36	255-36	255-36#	261-3
	261-3	261-3	261-3	261-3#	264-19	264-19	264-19	264-19	264-19#					
M$PUT1	140-62	140-62	140-62#	140-62#	205-12	205-12	205-12	205-12#	205-12#	205-12#	205-14	205-14	205-14	205-14#
	205-14#	205-14#	205-16	205-16	205-16	205-16#	205-16#	205-16#	205-18	205-18	205-18	205-18#	205-18#	205-18#
	208-32	208-32	208-32	208-32	208-32#	208-32#	208-32#	208-32#	225-24	225-24	225-24	225-24	225-24#	225-24#
	225-24#	225-24#	243-22	243-22	243-22	243-22	243-22	243-22	243-22	243-22	243-22#	243-22#	243-22#	243-22#
	243-22#	243-22#	243-22#	243-22#	243-24	243-24	243-24	243-24	243-24	243-24#	243-24#	243-24#	243-24#	243-24#
	249-23	249-23	249-23	249-23	249-23#	249-23#	249-23#	249-23#	255-36	255-36	255-36	255-36	255-36	255-36#
	255-36#	255-36#	255-36#	255-36#	261-3	261-3	261-3	261-3	261-3#	261-3#	261-3#	261-3#	264-19	264-19
	264-19	264-19	264-19#	264-19#	264-19#	264-19#								
M$RADI	163-3	163-3#	256-6	256-6#	275-3	275-3#	275-7	275-7#	277-14	277-14#	278-2	278-2#	278-8	278-8#
	278-14	278-14#	278-20	278-20#	278-21	278-21#	278-24	278-24#	279-4	279-4#	279-13	279-13#	279-14	279-14#
	279-17	279-17#	280-2	280-2#	280-4	280-4#	281-2	281-2#	283-4	283-4#	283-10	283-10#	283-14	283-14#
	284-10	284-10#	284-14	284-14#	284-20	284-20#	285-2	285-2#	285-8	285-8#	285-22	285-22#	286-2	286-2#
	288-1	288-1#	288-2	288-2#	288-3	288-3#	288-4	288-4#	288-5	288-5#	288-7	288-7#	290-1	290-1#
	290-6	290-6#	290-7	290-7#	290-8	290-8#	290-9	290-9#	290-10	290-10#				
M$RBRO	233-26	233-26#	233-31	233-31#	234-7	234-7#	235-23	235-23#	235-30	235-30#	236-1	236-1#	236-11	236-11#
	236-14	236-14#												
M$RNRO	173-49	173-49#	175-38	175-38#	177-44	177-44#	248-21	248-21#	249-2	249-2#	249-12	249-12#	249-14	249-14#
	250-10	250-10#	253-5	253-5#										
M$SETS	112-33	112-33#	114-10	114-10#	115-10	115-10#	116-3	116-3#	140-14	140-14#	140-18	140-18#	140-22	140-22#
	140-26	140-26#	140-30	140-30#	140-34	140-34#	140-38	140-38#	140-42	140-42#	140-46	140-46#	140-50	140-50#
	140-59	140-59#	140-65	140-65#	140-79	140-79#	140-83	140-83#	140-87	140-87#	140-91	140-91#	140-95	140-95#
	140-99	140-99#	140-103	140-103#	140-107	140-107#	140-111	140-111#	140-116	140-116#	140-120	140-120#	140-124	140-124#
	140-129	140-129#	140-133	140-133#	140-137	140-137#	141-1	141-1#	219-10	219-10#	220-18	220-18#	238-5	238-5#
	238-11	238-11#	241-3	241-3#	241-10	241-10#	245-8	245-8#	246-8	246-8#	258-10	258-10#	259-8	259-8#
	260-3	260-3#	260-6	260-6#	261-1	261-1#	262-1	262-1#	263-1	263-1#	264-1	264-1#	267-1	267-1#
	268-1	268-1#	269-1	269-1#	271-3	271-3#	272-3	272-3#	273-3	273-3#	287-3	287-3#	287-14	287-14#
	289-12	289-12#												
M$SVC	140-16	140-16#	140-20	140-20#	140-24	140-24#	140-28	140-28#	140-32	140-32#	140-36	140-36#	140-40	140-40#
	140-44	140-44#	140-48	140-48#	140-57	140-57#	140-62	140-62#	140-63	140-63#	140-77	140-77#	140-81	140-81#
	140-85	140-85#	140-89	140-89#	140-93	140-93#	140-97	140-97#	140-101	140-101#	140-105	140-105#	140-109	140-109#
	140-114	140-114#	140-118	140-118#	140-122	140-122#	140-127	140-127#	140-131	140-131#	140-135	140-135#	140-139	140-139#
	141-22	141-22#	143-7	143-8	143-8#	147-21	147-22	147-22#	149-22	149-40	149-43	149-43#	150-10	150-10#
	151-21	152-11	160-32	160-32#	163-3	163-3#	173-49	173-49#	175-38	175-38#	177-44	177-44#	195-24	205-12
	205-12#	205-14	205-14#	205-16	205-16#	205-18	205-18#	207-41	207-41#	208-32	208-32#	212-3	216-26	216-26#
	216-34	217-5	223-18	223-40	225-13	225-13#	225-24	225-24#	225-27	225-27#	225-30	227-44	228-27	228-27#
	228-36	229-5	232-12	232-12#	233-21	233-21#	233-24	233-24#	233-26	233-26#	233-31	233-31#	234-7	234-7#
	235-23	235-23#	235-30	235-30#	236-1	236-1#	236-11	236-11#	236-14	236-14#	237-6	237-7	237-7#	239-10
	239-10#	239-11	239-11#	243-22	243-22#	243-24	243-24#	244-12#	244-43	244-43#	247-1	247-1#	247-5	247-5#
	247-8	247-8#	247-11	247-11#	247-12	247-12#	248-21	248-21#	248-29	248-30	248-30#	249-1	249-1#	249-2
	249-2#	249-12	249-12#	249-14	249-14#	249-23	249-23#	250-10	250-10#	253-5	253-5#	255-36	255-36#	256-4
	256-4#	256-6	256-6#	256-9	256-9#	256-17	256-17#	256-20	256-20#	256-22	256-22#	256-31	256-31#	257-3
	257-4	257-4#	257-8	257-9	257-9#	257-14	257-15	257-15#	257-20	257-21	257-21#	257-23	257-23#	258-12
	258-12#	259-21	259-21#	260-18	260-18#	261-1	261-1#	261-3	261-3#	261-7	261-7#	261-10	261-11	261-11#

	261-14	261-14#	262-1	262-1#	262-15	262-15#	263-1	263-1#	263-26	263-32	263-32#	264-1	264-1#	264-19
	264-19#	264-20	264-20#	264-35	264-35#	265-10	265-10#	265-21	265-21#	265-27	266-1	266-1#	266-5	266-10
	266-10#	266-11	266-11#	267-1	267-1#	267-4	267-4#	268-1	268-1#	268-6	268-6#	269-1	269-1#	269-10
	269-10#	269-14	269-14#	270-11	270-11#	270-19	271-24	271-24#	272-14	272-14#	274-7	274-7#	275-3	275-3#
	275-7	275-7#	276-40	276-40#	276-43	276-43#	276-44	276-44#	277-14	277-14#	278-2	278-2#	278-8	278-8#
	278-14	278-14#	278-20	278-20#	278-21	278-21#	278-24	278-24#	279-4	279-4#	279-13	279-13#	279-14	279-14#
	279-17	279-17#	280-2	280-2#	280-4	280-4#	281-2	281-2#	283-4	283-4#	283-10	283-10#	283-14	283-14#
	284-10	284-10#	284-14	284-14#	284-20	284-20#	285-2	285-2#	285-8	285-8#	285-22	285-22#	286-2	286-2#
	286-7	286-7#												
MSTLAB	140-16#	140-20#	140-24#	140-28#	140-32#	140-36#	140-40#	140-44#	140-48#	140-57#	140-62#	140-63#	140-77#	140-81#
	140-85#	140-89#	140-93#	140-97#	140-101#	140-105#	140-109#	140-114#	140-118#	140-122#	140-127#	140-131#	140-135#	140-139#
	141-22#	143-7#	143-8#	147-21#	147-22#	149-22#	149-40#	149-43#	150-10#	151-21#	152-11#	160-32#	163-3#	173-49#
	175-38#	177-44#	195-24#	205-12#	205-14#	205-16#	205-18#	207-41#	208-32#	212-3#	216-26#	216-34#	217-5#	223-18#
	223-40#	225-13#	225-24#	225-27#	225-30#	227-44#	228-27#	228-36#	229-5#	232-12#	233-21#	233-24#	233-26#	233-31#
	234-7#	235-23#	235-30#	236-1#	236-11#	236-14#	237-6#	237-7#	239-10#	239-11#	243-22#	243-24#	244-43#	247-1#
	247-5#	247-8#	247-11#	247-12#	248-21#	248-29#	248-30#	249-1#	249-2#	249-12#	249-14#	249-23#	250-10#	253-5#
	255-36#	256-4#	256-6#	256-9#	256-17#	256-20#	256-22#	256-31#	257-3#	257-4#	257-8#	257-9#	257-14#	257-15#
	257-20#	257-21#	257-23#	258-12#	259-21#	260-18#	261-1#	261-3#	261-7#	261-10#	261-11#	261-14#	262-1#	262-15#
	263-1#	263-26#	263-32#	264-1#	264-19#	264-20#	264-35#	265-10#	265-21#	265-27#	266-1#	266-5#	266-10#	266-11#
	267-1#	267-4#	268-1#	268-6#	269-1#	269-10#	269-14#	270-11#	270-19#	271-24#	272-14#	274-7#	275-3#	275-7#
	276-40#	276-43#	276-44#	277-14#	278-2#	278-8#	278-14#	278-20#	278-21#	278-24#	279-4#	279-13#	279-14#	279-17#
	280-2#	280-4#	281-2#	283-4#	283-10#	283-14#	284-10#	284-14#	284-20#	285-2#	285-8#	285-22#	286-2#	286-7#
MSTSTL	140-16	140-16#	140-20	140-20#	140-24	140-24#	140-28	140-28#	140-32	140-32#	140-36	140-36#	140-40	140-40#
	140-44	140-44#	140-48	140-48#	140-57	140-57#	140-62	140-62#	140-63	140-63#	140-77	140-77#	140-81	140-81#
	140-85	140-85#	140-89	140-89#	140-93	140-93#	140-97	140-97#	140-101	140-101#	140-105	140-105#	140-109	140-109#
	140-114	140-114#	140-118	140-118#	140-122	140-122#	140-127	140-127#	140-131	140-131#	140-135	140-135#	140-139	140-139#
	141-22	141-22#	143-7	143-7#	143-7#	143-8	143-8#	147-21	147-21#	147-21#	147-22	147-22#	149-22	149-22#
	149-22#	149-40	149-40#	149-40#	149-43	149-43#	150-10	150-10#	151-21	151-21#	151-21#	152-11	152-11#	152-11#
	160-32	160-32#	163-3	163-3#	173-49	173-49#	175-38	175-38#	177-44	177-44#	195-24	195-24#	195-24#	205-12
	205-12#	205-14	205-14#	205-16	205-16#	205-18	205-18#	207-41	207-41#	208-32	208-32#	212-3	212-3#	212-3#
	216-26	216-26#	216-34	216-34#	216-34#	217-5	217-5#	217-5#	223-18	223-18#	223-18#	223-40	223-40#	223-40#
	225-13	225-13#	225-24	225-24#	225-27	225-27#	225-30	225-30#	225-30#	227-44	227-44#	227-44#	228-27	228-27#
	228-36	228-36#	228-36#	229-5	229-5#	229-5#	232-12	232-12#	233-21	233-21#	233-24	233-24#	233-26	233-26#
	233-31	233-31#	234-7	234-7#	235-23	235-23#	235-30	235-30#	236-1	236-1#	236-11	236-11#	236-14	236-14#
	237-6	237-6#	237-6#	237-7	237-7#	239-10	239-10#	239-11	239-11#	243-22	243-22#	243-24	243-24#	244-43
	244-43#	247-1	247-1#	247-5	247-5#	247-8	247-8#	247-11	247-11#	247-12	247-12#	248-21	248-21#	248-29
	248-29#	248-29#	248-30	248-30#	249-1	249-1#	249-2	249-2#	249-12	249-12#	249-14	249-14#	249-23	249-23#
	250-10	250-10#	253-5	253-5#	255-36	255-36#	256-4	256-4#	256-6	256-6#	256-9	256-9#	256-17	256-17#
	256-20	256-20#	256-22	256-22#	256-31	256-31#	257-3	257-3#	257-3#	257-4	257-4#	257-8	257-8#	257-8#
	257-9	257-9#	257-14	257-14#	257-14#	257-15	257-15#	257-20	257-20#	257-20#	257-21	257-21#	257-23	257-23#
	258-12	258-12#	259-21	259-21#	260-18	260-18#	261-1	261-1#	261-3	261-3#	261-7	261-7#	261-10	261-10#
	261-10#	261-11	261-11#	261-14	261-14#	262-1	262-1#	262-15	262-15#	263-1	263-1#	263-26	263-26#	263-26#
	263-32	263-32#	264-1	264-1#	264-19	264-19#	264-20	264-20#	264-35	264-35#	265-10	265-10#	265-21	265-21#
	265-27	265-27#	265-27#	266-1	266-1#	266-5	266-5#	266-5#	266-10	266-10#	266-11	266-11#	267-1	267-1#
	267-4	267-4#	268-1	268-1#	268-6	268-6#	269-1	269-1#	269-10	269-10#	269-14	269-14#	270-11	270-11#
	270-19	270-19#	270-19#	271-24	271-24#	272-14	272-14#	274-7	274-7#	275-3	275-3#	275-7	275-7#	276-40
	276-40#	276-43	276-43#	276-44	276-44#	277-14	277-14#	278-2	278-2#	278-8	278-8#	278-14	278-14#	278-20
	278-20#	278-21	278-21#	278-24	278-24#	279-4	279-4#	279-13	279-13#	279-14	279-14#	279-17	279-17#	280-2
	280-2#	280-4	280-4#	281-2	281-2#	283-4	283-4#	283-10	283-10#	283-14	283-14#	284-10	284-10#	284-14
	284-14#	284-20	284-20#	285-2	285-2#	285-8	285-8#	285-22	285-22#	286-2	286-2#	286-7	286-7#	
MSWORD	112-42	112-42#	113-9	113-9	113-9	113-9	113-9	113-9#	143-7	143-7	143-7	143-7#	147-21	147-21
	147-21	147-21#	149-22	149-22	149-22	149-22#	149-40	149-40	149-40	149-40#	151-21	151-21	151-21	151-21#
	152-11	152-11	152-11	152-11#	163-3	163-3	163-3#	163-3#	195-24	195-24	195-24	195-24#	212-3	212-3
	212-3	212-3#	216-34	216-34	216-34	216-34#	217-5	217-5	217-5	217-5#	223-18	223-18	223-18	223-18#
	223-40	223-40	223-40	223-40#	225-30	225-30	225-30	225-30#	227-44	227-44	227-44	227-44#	228-36	228-36
	228-36	228-36#	229-5	229-5	229-5	229-5#	237-6	237-6	237-6	237-6#	244-12	244-12#	248-29	248-29

CROSS REFERENCE TABLE (CREF V04.00)