IDENTIFICATION

PRODUCT CODE: AC-FF56A-YC

PRODUCT NAME: CZUDLAO BAD BLOCK REPLACEMENT UTILITY

PRODUCT DATE: 19 APR-1985

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.REM @

This software is furnished for the purpose of maintaining Digital Equipment Corporation RA series drives. It should only be used by persons authorized to perform service on these products. This software or any other copies thereof should not be provided or otherwise made available to any unauthorized person.

Even though this program is distributed along with diagnostics it is NOT (repeat not) intended for use as an RA drive diagnostic. This program assumes that the RA drive subsystem is not defective and that the user only intends to use this program for its intended purpose of finding and replacing bad blocks. Using this program on defective hardware could produce indeterminate results detrimental to the customer and Digital.

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1.0 INTRODUCTION

This program is a highly specialized utility for use in those cases where an RA drive has been diagnosed to have bad blocks on the media. These bad blocks may be causing ECC errors that can be isolated to a specific Logical Block Number(s) (LBN). Using the Digital Storage Architecture (DSA) Bad Block Replacement (BBR) algorithm, this program will replace those blocks that it either defines as bad (Automatic Replacement Mode) or will take an LBN address that the user supplies and replace only that block (Manual Mode). In either case, bad block(s) will be replaced, with no apparent loss of storage capacity to the customer.

WARNING WARNING WARNING WARNING WARNING WARNING WARNING
+---------- ---------- ----------+

```
)        IN ORDER TO PROPERLY EXECUTE THIS PROGRAM IN AUTOMATIC OR MANUAL     )
)        MODE, THE FOLLOWING STEPS MUST BE FOLLOWED WITHOUT EXCEPTION.        )
)        UNPREDICTABLE RESULTS COULD RESULT IF NOT FOLLOWED.                  )
)                                                                             )
)                                                                             )
)1. CUSTOMER MUST BACKUP THE DATA FROM THE DRIVE(S) TO BE USED AND VERIFY     )
)   ITS CORRECTNESS.                                                          )
)                                                                             )
)2. EXECUTE THIS PROGRAM ON THE DRIVE(S). MULTIPLE PASSES ON EACH DRIVE, WHEN )
)   IN AUTOMATIC MODE, IS RECOMMENDED ---- DR>Start/pass:(Number of passes)   )
)                                                                             )
)3. CUSTOMER MUST RESTORE THE BACKED UP DATA TO THOSE DRIVES FROM WHICH IT     )
)   WAS BACKED UP AND AGAIN VERIFY ITS CORRECTNESS.                           )
)                                                                             )
+-----------------------------------------------------------------------------+
```

1.1 Hardware Requirements

This program requires the following minimum hardware configuration:

- PDP-11 Unibus or Q-bus processor
- 28K words of memory (minimum)
- Console terminal
- XXDP+ load media containing this program
- One or more UDA50-A or KDA50-Q subsystems.
- One or more DSA disk drives.

- A system clock - either type L or P - will be used to report runtime, and to detect controller MSCP response timeouts.

1.2 Software Requirements

This program is designed to run using XXDP+ V2.0 or greater. It has been assembled using the SVC35R MACRO library.

1.3 Memory Requirements

The utility occupies approximately 20k bytes of memory. Each drive configured for test will require about 1k bytes additional memory.

2.0 MODES OF OPERATION

This program will run in one of three modes.

2.1 Verify Mode

This allows the user to "scan" the media without the program taking any action on what it finds. In this way, you can get a "picture" of any problem found, without the program writing in any way on the media. This is extremely valuable, since the drive can be write protected and thus the lengthy Backup and Restore operations recommended need not be done. By getting a "look" at the condition of the media, you can then decide whether to commit to either

Automatic or Manual mode and do the backup and restore of the customer data. This mode can also be used to get the replacement descriptors displayed (By answering the question "Display Replacement Descriptors" with a yes) without the Backup and Restore operations. This way you can get a "look" at the total number of replacements quickly. Execution in this mode is entered by:

1) WRITE PROTECT THE SUBJECT DRIVE --- AFTER THE DRIVE HAS BECOME READY. SPINNING UP AN RA80 WITH IT WRITE PROTECTED WILL RESULT IN A FAULT, BECAUSE OF A WRITE FAIL DURING THE SPIN-UP WRITE TESTS.
2) BRING UP THE PROGRAM AND SPECIFY AUTOMATIC MODE
3) ANSWER THE QUESTION "ENABLE REPLACEMENTS" WITH A "N" (NO)

Verify Mode can also be entered by specifying Manual Mode with replacements disabled. In this way, you can "look" at the "status" of a particular LBN.

2.2 Automatic Mode

This is the mode used when you do not know what the bad block LBN(s) are, or do not have the bad block LBN address(es) available in decimal. Or, possibly you just want the program to run unattended, and take action on any blocks it finds bad. Normally you should use Manual Mode and enter the bad blocks, given that you know (from the error logger or other sources of information) what blocks are bad. Please make note of the Warning in Section 4.0, when running with large pass counts. Large pass counts in Automatic Mode are recommended, however please understand and follow that warning. Execution in this mode is entered by:

1) Insure the Customer has backed-up and verified the data from the subject drive
2) Specify Automatic replacements
3) Answer "Enable Replacements" with a Y (yes)
4) After the completion of the program, the customer can restore and verify the backed-up data.

2.3 Manual Mode

This is the preferred method for using the program and the most efficient. If you can obtain a decimal address of the bad block(s) you want replaced, this mode will take the information (LBN address) and without hesitation replace it. Operating System error loggers, should provide the LBN address of those blocks that generate ECC and Header errors. Sometimes you may have to "convert" the LBN address from Hexadecimal or Octal, as provided in the error log-report, to decimal so it can be used by this program. Providing the wrong decimal address of a bad block is not good. The program will replace any LBN you specify and if you specify the wrong one, you will have one additional replaced block on the media.

If you have no idea what the LBN addresses of the bad block(s) are, you can possibly run this program in Verify Mode and if Verify finds any bad blocks, it will report them to you in decimal. Taking these addresses and using them in Manual Mode, will result in the quickest method for replacing known bad blocks. However, the customers operating system has much more time to find bad blocks than does Verify Mode. Thus, you should use the error log for bad block determination whenever possible. Execution in this mode is entered by

1) Insure the Customer has backed-up and verified the data from the

subject drive
2) Specify Manual replacements
3) Answer "Enable Replacements" with a Y (yes)
4) Provide the LBN address of the bad block in decimal, when asked for. A Carriage Return at this question will exit Manual mode.
4) After the completion of the program, the customer can restore the backed-up data and verify it.

3.0 BACKGROUND

This program was primarily developed for use in those cases where a customer has an operating system that does not have the DSA Bad Block Replacement capability already in it. Several operating systems already have a method of doing DSA Bad Block Replacement (BBR) and would only rarely need the services of this program (VMS is one of many). However, their are cases where even with an operating system that has the BBR capability, the need to replace a specific LBN, or allow this program to search for bad blocks, may be appropriate.

In those cases where a customer is running an operating system that does not have the BBR capability, bad blocks may develop and show up as ECC errors in the system error log. When this occurs, this program can be used to replace those bad blocks and thus eliminate the logging of ECC errors related to specific bad block(s). It's a known fact that bad blocks can become worse with time. What may start out as a 6 symbol ECC error may eventually end up as an uncorrectable ECC error, if action is not taken to replace that block.

CAUTION

It is imperative that every effort be used to establish the fact that errors showing up in the error log are indeed related to a bad block, before attempting to use this program. If ECC errors showing up in an error log are the result of a hardware problem, this program (When used in Automatic Mode) could replace a considerable number of blocks that are indeed good. If this happens, and later you fix the problem causing the ECC errors, you should reformat the HDA/Pack. A description of this situation is given in RA81-TT-12. The information in this Tech Tip applies to all RA series drives and would be helpful in this situation.

4.0 DISCUSSION

Normally, disk blocks that are defective generate ECC errors when read. These ECC errors, as seen from the error log, should all be logged against a particular LBN (or if multiple bad blocks, a specific number of LBN's). Thus, if you observe that the ECC error(s) seem to all occur at the same LBN address(es), you can start to assume that a bad block is the cause. This being the case, you can either provide this program with the LBN address(es) in decimal, and have them replaced in Manual Mode, or allow this program the opportunity to find the bad block(s) (Automatic Mode).
IT IS RECOMMENDED that if you feel sure you have identified the bad blocks, and have the LBN addresses of them in decimal, you should use Manual Mode to have them replaced. Manual Mode is a quick efficient method of getting a block replaced and should be used to save time and effort, however, be sure you know what your doing and have the right information needed by this program.

In Automatic Mode, this program will run the specified number of passes on the drives you specify. It does not execute simultaneously on the drives you specify but works in a "serial" fashion, doing one drive at a time. One pass is one execution of the program on the drive(s) you specify. IT IS HIGHLY RECOMMENDED that when using this program in Automatic Mode that you allow multiple passes to be run. Running this program, in Automatic Mode, over a weekend or overnight would provide the most benefit.

4.1 Sample Run times in Automatic Mode
RA81 - About 9 Minutes
RA60 -- About 4.5 Minutes
RA80 -- About 3 Minutes

NOTE: This time is extended, when replacements occur. Thus, if you have many bad blocks, the program will take considerably longer.

4.2 In order to verify that an LBN indeed needs replacement, this program (And all other Operating Systems with BBR capability) tries to "verify" that the bad block report is not a transient error and in fact relates to a defect in the media. If all reports of Bad Blocks (Like ECC errors) caused replacement, without question, then a substantial possibility would exist that blocks with no defect would be replaced. As you know, many times errors are caused by the environment (Like static, electrical problems etc). Errors reported that are not related to a media defect should not be replaced. Thus, an attempt is made to verify that a bad block report can be duplicated and therefore related to a higher probability of a media defect being the cause. This is the way it happens in the most usual case:

1) This program uses the MSCP ACCESS command to do large Byte count transfers (Read) from the drive being tested. It starts with LBN 0 progresses to the highest user LBN on the drive. The ACCESS command moves data from the drive to the controller, where the data is checked for any errors. The data IS NOT actually moved host memory. This way we can read data at the fastest possible rate and thereby make it possible for more passes to be made across the media in the shortest possible amount of time.

2) If an error (Lets say an 8 symbol ECC error) is detected by the controller, a flag gets set called the Bad Block Reported flag. This flag is reported to this program by whats called an "end packet". This packet describes the success or failure of the ACCESS command that we gave the controller. The end packet also provides the LBN address that caused the error.

3) When this program sees this Bad Block Reported Flag, it takes the LBN address that caused the Bad Block reported flag to set and goes into a series of READ commands to the LBN that reported the bad block. A series of 32 reads are attempted. If a second Bad Block report occurs, the program terminates the testing and replaces the block.

4) If 32 re-READ's are accomplished without error or bad block report then the error is considered a transient and replacement is not attempted.

5) HOWEVER, if it is considered a transient error, the LBN address is logged in a memory table called the transient error table If on a subsequent passes across the media, this same LBN address reports an error or Bad Block, the LBN is replaced without argument and without any further testing. In other words, if we have a transient error and then later this same LBN reports another error, it is replaced.

That is why running this program for multiple passes is beneficial. The transient error table is kept in memory and is kept updated as long as the program is running. If the program is terminated, the table is lost and any entries in it. The benefit of this table is that any marginal bad blocks that just does not show an error each time it is read can be replaced.

4.2.1 Transient Error Table Overflow

The Transient Error Table, that is kept in memory as long as this program is running, has the ability to keep track of 400 Transient errors for each drive being tested. This table should be of sufficient size for all cases where bad blocks that are only marginally bad need to be tracked. If this table overflows, a message is typed and the testing terminates. If this happens, you have more trouble than what this program can help with. This message is reported in the following manner:

```
Transient error table overflow;
  ADDITIONAL MAINTENANCE REQUIRED.
```

This is true. If you log more than 400 transients, then the drive being tested may not have bad blocks causing the errors you see. Most likely you have a data path problem giving false indications of ECC errors or something like a worn-out spindle ground brush.

The recovery from this condition would be to first fix whatever is causing the high transient error rate then reformat the media. Most likely their are many replacements that were made on blocks that were in fact not bad. Reformatting will put the media back to a known state (Please read RA81-TT-12). You may want to run several passes of this program, after having reformatted, just to be sure that the formatter found all the bad spots.

4.3 System Crash while running this program -- WARNING

```
 WARNING     WARNING     WARNING     WARNING     WARNING     WARNING
+-------------------------------------------------------------------+
) If the system crashes (CPU failure, power fail etc) DURING        )
) THE EXECUTION OF THIS PROGRAM (Either Manual or Automatic         )
) Mode) IT IS REQUIRED that you run at least one pass of this       )
) program after recovering from the crash condition.  Abrupt        )
) termination of this program could leave an incomplete replacement. )
) One quick pass of this program would allow for the completion of  )
```

) any incomplete replacements. Using the control "C" to terminate)
) this program is not considered an abrupt termination and should)
) not leave any incomplete replacements, although use of control)
) "C" to terminate this program is not recommended.)

5.0 STARTING THE PROGRAM

This section describes the hardware questions which must be answered for each Unit configured for testing. Each question is displayed along with the default value for the parameter. A carriage return (CR) selects the default value. An explanation of each question follows.

1) Boot the Diagnostic Media
2) After you have called for the running of this program, you will arrive at the diagnostic supervisor prompt - DR>. Typing "start/pass:(the number of passes you want run)" at the prompt will begin the execution of this program and ask you the following questions:

CHANGE HW (L) ? Yes -Answer "yes" to enable the selection of which drives you want to use and other operating parameters.

UNITS (D) 1 - This asks you HOW MANY DRIVES YOU WANT TO TEST. In Automatic Mode this diagnostic will execute on the number of drives you specify in a "serial" fashion (One drive at a time).

UNIT 0 - Unit 0 is NOT drive 0. This only refers to the first drive you want used and asks for certain information about this first drive to test.

BUS ADDRESS OF XDA (O) 172150 ? - UNIBUS ADDRESS OF THE CONTROLLER that the first drive is connected to is the first UDA50 default in Octal) "XDA" refers to the controller -- Like UDA or KDA.

VECTOR (O) 154 - VECTOR YOU WANT PROGRAMMED INTO THIS CONTROLLER. (RA drive controllers have software provided vectors (Take the default or provide the vector you want assigned).

BR LEVEL (D) 5 - TAKE THE DEFAULT, unless you have a good reason not to.

BUS BURST RATE (D) 63 ? - This defines the NUMBER OF LONG WORDS THAT WILL BE TRANSFERRED each time the controller becomes bus master. The default (63) should be good. Operating System Burst Rates must always equal 0 (zero).

DRIVE # (D) 0 - This is the DRIVE NUMBER TO TEST, in decimal. Default is drive "0".

The above questions will be asked for each of the number of Units you specified to test. Once the above information has been defined, for each drive you wish to test, the following questions will be asked. The following questions are asked only once and apply to this run of the test.

6.0 QUESTIONS ASKED BY THE PROGRAM

6.1 DISPLAY OPERATOR HELP (L) N ?

IT IS HIGHLY RECOMMENDED THAT YOU READ THE OPERATOR HELP INFORMATION. Answering yes will cause this help file to be typed. For the Operator Help file to be printed, it must be resident on the diagnostic media that this program was obtained from. This information is not a part of the program but is a separate file that resides on the diagnostic media and will be typed when this question is answered with a "Y" (Yes)

6.2 AUTOMATIC OR MANUAL REPLACEMENT (A) A ?

The default response of "A" selects Automatic replacement mode; an "M" selects Manual replacement mode.

If AUTOMATIC REPLACEMENT MODE is selected, the entire user LBN area of each Unit will be processed, and this program will replace all blocks found to be bad. In this mode, up to eight Units can be processed in a "serial" fashion (One drive at a time).

If MANUAL REPLACEMENT MODE is selected, the operator must specify the desired block(s) to be replaced. In this mode, the LBN address supplied to the program must be in decimal (Not Octal, Hexadecimal etc). Only a single Unit can be processed during each program execution, in Manual Mode.

6.3 Questions Asked In Automatic Replacement Mode

Invoking Automatic Replacement Mode, the following Automatic replacement mode questions are asked.

6.3.1 AUTOMATIC CRASH RECOVERY (L) Y ?

This parameter determines whether crash recovery will be performed automatically, upon the detection of an incomplete replacement. Incomplete replacements can occur due to a "system crash" on an earlier run of this test or operating system replacement process. If automatic recovery is selected, the program will complete the replacement operation before processing the Unit. If automatic recovery is disabled, the Unit will be dropped upon the detection of an incomplete replacement. WE RECOMMEND TAKING THE DEFAULT YES ANSWER. In Manual mode this question is asked only upon detection of a need for crash recovery. When an incomplete replacement is detected, a message similar to the following will occur:

```
RCT ERROR DETECTED;
  Crash occurred during previous replacement Phase 1.

  Attempting Recovery...
```

LBN: 679864. Status: RBN: 13331. Operation: SEC

This example indicates that a crash occurred, sometime in the past, during a phase 1 replacement. Replacement at phase 1 will assign a replacement RBN, and attempt recovery. If this program shows a crash recovery, it would be wise to allow at least one pass of of this program, in Automatic Mode, to take place. No "Status" is listed. This would be normal for recovery, as the recovery process does not know the original reason replacement was requested.

6.3.2 DISP' AY REPLACEMENTS AS THEY OCCUR (L) Y ?
This parameter determines whether replacement operations are displayed as they occur. A response of "Y" will cause replacement operations to be displayed; a "N" will inhibit the display of replacement operations. In Manual replacement mode, display is permanently enabled, allowing the operator to verify desired LBN's have been replaced. If answered with a "Yes", as a replacement is made the following output will be provided on the console terminal.

6.3.2.1 Replacement Status Messages
Each time the program is started, it will type out the following information. This information is used during the report of a replacement operation (Shown Below). Understanding these "codes" will allow you to better understand the replacement operation that was performed and why replacement was requested.

LBN Status codes:

BBR - Bad Block reported (ECC Error)
ECH - Hard ECC Error encountered
HCE - Header Compare Error encountered
DST - Data Sync Timeout encountered
FER - Forced Error encountered.
WFE - Block written with FE (Forced Error) set

RBN Operation types:

PRI - Primary replacement for LBN.
SEC - Secondary replacement for LBN.
UNS - RBN marked unusable.

NOTE

) Periods after a number indicate that the number)
) is a decimal number.)

PRIMARY BAD BLOCK REPLACEMENT

The LBN was tested, and the BBR flag was set repeatedly. The LBN's Primary replacement RBN was used to store the LBN's data.

LBN: 23271. Status: BBR RBN: 456. Operation: PRI

SECONDARY BAD BLOCK REPLACEMENT

The LBN was tested, and the BBR flag was set repeatedly. The LBN's Primary replacement RBN is currently used by another LBN. A Secondary replacement RBN was used.

LBN: 23271. Status: BBR RBN: 455. Operation: SEC

RBN BECOMES UNUSABLE

Upon reading data from an RBN, an error resulted. This indicated that the RBN is bad and must be marked as unusable. Also, the customer data residing in the RBN must be moved to a new RBN. A Secondary replacement always results from this condition.

LBN: 23271. Status: RBN: 456. Operation: UNS
LBN: 23271. Status: BBR RBN: 455. Operation: SEC

LBN WITH AN UNCORRECTABLE ECC ERROR REPLACED

An LBN is read repeatedly with an uncorrectable ECC error (ECH). The indicated replacement operation is performed. If enabled, the LBN data is written with the Forced Error (FE) flag set, and the following information appears.

LBN: 23271. Status: WFE RBN: 456. Operation: SEC (or PRI)

If the question about writing uncorrectable ECC errors WITHOUT the Forced Error Flag is answered with a NO, the corrupted data is written to the RBN as is, and the following information appears:

LBN: 23271. Status: ECH RBN: 456. Operation: SEC (or PRI)

TRANSIENT ECC ERROR REPORTED

During the "scan" for bad blocks, the BBR flag was set for a particular LBN. Once this condition was noted, the program tries to verify the report of a bad block. If the bad block report can not be verified, the operator is notified of the LBN and NO replacement is attempted. If you do not feel good about an ECC error being reported and then the program not being able to verify the error, you can use Manual Mode to replace the reported LBN.

LBN: 23271. Status: BBR

NOTE

) Many times the occurrence of an ECC error that is not)
) repeatable can indicate a Data Path problem or other)
) conditions that are not related to bad spots.)
) If this condition occurs many times during a pass of)

```
) this program, I would start to look for a data path  )
) problem or some other problem causing transient      )
) errors.                                              )
+- --- ----  ----- ----- ------  -------- - -----------+
```

6.4 Questions Asked In Manual Replacement Mode

Invoking Manual Replacement Mode, The following Manual Replacement Mode questions are asked.

6.4.1 ENTER LBN TO BE REPLACED (DECIMAL) OR <CR> TO EXIT (A) ?

This is asking for you to specify which LBN you wish to have replaced. BE SURE YOU ARE PREPARED TO PROVIDE THE LBN ADDRESS IN DECIMAL. Different Operating Systems error loggers display the LBN address in various radix's (Like Hex, Octal, Decimal etc) Be sure you know what your dealing with and make the proper conversions, if necessary.

The LBN entered is checked against the maximum number of user LBN's available (See section 7.12). If the limit check fails, the following message appears:

```
Limits:  LO= 0;  HI= dddddd.
```

HI would be the maximum LBN address that can be replaced on that drive. If the LBN passes the limit check, the replacement is made and the operation is displayed, as specified in the paragraphs below.

Once you have provided the LBN address for the replacement, and the replacement has occurred, this same question will be asked. If you have no more LBN's for replacement, just hit Carriage Return to exit.

6.4.2 Attempt Crash Recovery (L) Y ?

This question is only asked upon the detection of a previously incomplete replacement. Incomplete replacements can occur due to a "system crash" on an earlier run of this test or operating system replacement process. If you answer yes, the program will complete the replacement operation before processing the requested Manual Mode LBN replacement. If you answer no, the Unit will be dropped and the incomplete replacement will not be completed. We recommend a yes answer. The following is an example of this condition.

```
SCRUB1 SFT ERR  00061 ON UNIT 00 TST 001 SUB 000 PC:02506
RCT error detected

Crash occurred during previous replacement
Phase 1


Attempt crash recovery (L) Y ?
```

```
     Attempting Recovery...

     LBN:    679864.  Status:        RBN:    13331.   Operation: SEC
```

This example indicates that a crash occurred, sometime in the past, during a phase 1 replacement. Replacement at phase 1 will assign a replacement RBN, and attempt recovery. If this program shows a crash recovery, it would be wise to allow at least one pass of of this program, in Automatic Mode, to take place. No 'Status" is listed. This would be normal for recovery, as the recovery process does not know the orig'nal reason replacement was requested.

6.5 Questions Asked During Either Replacement Mode

6.5.1 DISPLAY RCT REPLACEMENT DESCRIPTORS (L) N ?

This parameter affects program execution in both replacement modes. The Replacement Control Table (RCT) keeps a "log" of all LBN's that get replaced and the Replacement Block Number (RBN) that is used. In Automatic replacement mode, display selection will cause the updated Replacement Control Table (RCT) descriptors to be printed at the end of each pass, for each Unit processed. In Manual replacement mode, this question is asked twice: When the Unit is brought Online, the operator may display the existing RCT replacement descriptors. After all desired LBN's have been replaced, the operator may display the updated RCT replacement descriptors.

Remember that the period used after a number indicates that the number is displayed in decimal.

```
RBN:   455. is SECONDARY   replacement for LBN:    23271.
RBN:   456. is PRIMARY     replacement for LBN:    23272.
RBN:   457. is UNUSABLE
```

After having described the "status" of all replacements logged in the Replacement Control Table, The following summary is provided:

```
RCT DESCRIPTOR CONTENTS SUMMARY
  Primary   replacement blocks: ddd.
  Secondary replacement blocks: ddd.
  Unusable  replacement blocks: ddd.
  Total RBNs on media: dddddd.
```

Displaying this information will provide an indication of the TOTAL number of replacements that are "logged" in the RCT. These replacements may have been made by the Operating System (If the O/S has the capability of doing Bad Block Replacement), the formatter or possibly this program. Although their is no "specification" for how many replacements are too many, you should be aware of certain conditions that would indicate a problem. An RA81 can accommodate 17,472 total replacements. A good working HDA can have a thousand primary replacements, however, the number of secondary replacements

should be small (Like on a ratio of about 100 primary's to 1 secondary or so). If you displayed something more than a thousand primary's or more than a few hundred secondaries, it could indicate that you may have a data path problem or had one in the past that was repaired. ECC errors being generated by a Data Path problem can cause a significant number of good blocks to be replaced before the data path problem can be repaired. If you see what may appear to be this condition, you should read RA81-TT-12. The Tech Tip applies to all RA drives, even though it is written as an RA81 Tech Tip. If this is the condition you sense, the tech tip will recommend that you reformat the HDA. Now that this program exists, it would be wise to not only reformat, to recover from this condition, but to run as many passes of this program as possible, after having reformatted. Any bad blocks that the formatter may not have found, may be found by this program and replaced.

6.5.2 ENABLE REPLACEMENTS (L) Y ?

This is a unique feature of this program. Disabling replacements (Answering with a NO) makes this program run in a similar fashion to the HSC50 "Verify" program. In other words, this program will "Scan" the media and report anything it finds but not do any replacements. DO NOT (REPEAT DO NOT) EXPECT THE SAME RESULTS FROM THIS PROGRAM WHEN COMPARED TO THE HSC50 "VERIFY" PROGRAM. THE HSC50 CAN LOWER THE "DRIVE THRESHOLD" WHERE THIS PROGRAM CAN NOT. Using it in this mode could possibly help you determine the "condition" of the media, without having any replacements occur. AGAIN -- THIS PROGRAM IS NOT (REPEAT NOT) INTENDED FOR USE AS A DIAGNOSTIC AND SHOULD NOT BE RUN ON DRIVES/CONTROLLERS THAT MAY HAVE PROBLEMS (Other than normal bad blocks and the like).

Using this program in this mode (Answering with a "NO") will disable all writes and therefore you can run it without the normal requirement for a back-up and restore. However, we can not be held responsible for any errors or subsystem problems that may create situations that cause this program (or subsystem) to do unexpected things.

WE HIGHLY RECOMMEND THAT YOU RUN IN THIS MODE (ANSWER = NO), WITH THE DRIVE(S) WRITE PROTECTED !!

What you can do is run with replacements disabled just to see if its worth your time to do the extensive Backup and Restore operations that are required when replacements are enabled. Remember you can not run this program with replacements enabled and the drives write protected. One pass may not find all the "marginal" bad spots. Thus we highly recommend that when running in the "disable replacement" mode (Answer=NO) that you allow the program to run several passes.

This mode can also be used to get a quick "look" at the number and types of replaced blocks that are "logged" in the Replacement Control table (RCT). By going into this mode, and answering the question "Display Replacement Descriptors" with a yes, you can get these typed without the Backup and Restore. When analyzing the descriptors that are typed, be sure you read and understand the discussion for the question "Display Replacement Descriptors"

(above).

6.5.3 ENABLE WRITE WITH FORCED ERROR FLAG (L) Y ?

This is not going to be easy to explain in 10 words or less. First you have to understand what a "Forced Error Flag" is. Many people have the wrong impression of what a "Forced Error" or "Forced Error Flag" is and what it does. Let me try to briefly explain. YOU NEED TO KNOW THIS.

When an uncorrectable ECC error is encountered, several attempts are made to read the data correctly (Using every means available). If these attempts fail, the block generating the Uncorrectable ECC error is assumed to be bad and in need of replacement. Thus, if you have a system that does "Dynamic Bad Block Replacement" (Like VMS, RSTS, RSX, IAS), or your running this program, the replacement process will take the uncorrectable (Corrupt) data and move it to a good replacement block (RBN). Now, we have a condition where we have corrupt data in a good block and if left this way the corrupt data would be read with no "indication" that the data is "corrupt". Therefore, in order to tell a user that the data was at one time uncorrectable and thus exists now as "corrupted" data (In a good RBN), the "Forced Error Flag" is attached to the block of "corrupted" data. When this block is read by a user, this flag (Inverted EDC character) is also read and is intended to inform the user that the requested data is "not reliable". THE FORCED ERROR FLAG IS NOT (REPEAT NOT) AN ERROR!! WHEN READ, IT WILL NOT MAKE AN ENTRY IN THE SYSTEM ERROR LOG. IT IS REPORTED AS A "STATUS" CODE 10 (OCTAL) IN A TRANSFER REQUEST "END PACKET" (This program calls the end packet status field the "Endmsg status", in several message types that can be displayed)

So why do we have this question. It seems that one or more Operating Systems have trouble dealing with, or reporting, the "Forced Error Flag". Also, some others do not have an intelligent way of reporting the flag to the user (Makes it appear as a "hardware error". Currently (March 1985) UNIX type systems (ULTRIX, Berkeley UNIX, AT&T UNIX etc) can "give up" (I assume that means crash) in certain situations when a "Forced Error Flag" is read. This being what we are told, we added this question to allow the user to disable the function that writes the forced error flag to an RBN with the uncorrectable data.

NOW LISTEN CAREFULLY.

If you answer the question "Enable write with Forced Error Flag" with a NO, you will put uncorrectable data into a good RBN (Just normal replacement). The "corrupted" data will read good, with NO indication of an error or the "corrupted data flag" (Forced error Flag). Therefore, the possibility of reading corrupted data with NO indication that it is corrupted. IF YOU FOLLOW THE RECOMMENDED PROCEDURE FOR RUNNING THIS PROGRAM AND DO THE BACKUP, AND THEN RESTORE THE BACKED-UP DATA AFTER RUNNING THIS PROGRAM, YOU WILL NOT HAVE A PROBLEM. Restoring the backed-up data, to a drive that had this question answered with a NO, should eliminate any problem condition for these systems. For those systems that do not

know how to handle the "Forced Error Flag", following the procedure of answering the question with a no and then doing a backed-up data restore is a REQUIREMENT WITHOUT EXCEPTION (repeat WITHOUT EXCEPTION)!!

7.0 "HARD" ERROR REPORTING

This program can display information from Error Log Packets and other sources of error information, that the controller/drive may send. This may not be what you think, due to the fact that THIS PROGRAM IS NOT (Repeat NOT) INTENDED TO BE USED ON RA DRIVES, OR CONTROLLERS, THAT ARE DEFECTIVE. You must be sure that you are trying to eliminate bad blocks, before using this program. This program will not give you all the details of an error that occurred (Like a Fault) but will give you the most important information AFTER HAVING GIVEN YOU THE ERROR INFORMATION IT WILL DROP THE DRIVE AND TERMINATE. This is for your protection. Doing replacements on a defective drive (or controller) can cause BIG TROUBLE. Since we can not control the use of the program, we must always assume the worst and try to prevent one from creating bigger problems from the misuse of this program.

If you see the following kinds of errors reported, you should discontinue the use of this program and use the other diagnostics, or system error logger, to better isolate any problems. If this program reports Hard Errors, like the following examples, their is always a possibility of a drive/controller generating a hard error that will cause an incomplete replacement. If you attempted to use this program, and noticed an error like the following examples, you should take action to better analyze the problem, using the other diagnostics. Once you feel that the subsystem is working properly, you should run at least one pass of this program, in automatic mode, to take care of any incomplete replacements and any other bad blocks.

The following examples list the possible errors reported by error log packets that will cause the program to terminate.

NOTE

) The little "o" used for the Status/event, Host address and)
) Drive Error Code means the information is typed in Octal. The)
) little "d" means decimal and the little "x" means Hexadecimal.)

7.1 Errors Reported by Error Log Packets from the Controller

Their are several sources of error information in an RA subsystem. One of the most common, is error log packets that the controller assembles and sends to the host. Their are 5 types of error log packets. Three of these types can be reported by this program.

7.1.1 Controller Error reported

This error occurs when an Error log packet is received specifying that a Controller detected an error within itself. The

Unit being tested will be dropped. This type of error will be reported in the following manner:

```
Controller Error Reported:
  Status/event: oooooo
```

The Status/Event code will give you an indication of what the trouble may be. A list of the Status/Event codes and their meanings are given in section 7.2

7.1.2 Host Memory Access Error Reported

This error occurs when an Error log packet is received specifying that a Host Memory Access Error was detected. This type of error packet reports problems that the controller experienced "dealing" with host memory (Like while doing data transfers etc). This type of error will be reported in the following manner:

```
Host Memory Access Error reported;
  Status/event: oooooo
  Host address: oooooo
```

The host bus (Like UNIBUS) address is displayed and was the one being used at the time of the error. The Status/Event code will give you and indication of what the problem was. A list of the Status/Event codes and their meanings are given in section 7.2

7.1.3 SDI Error Reported

This error occurs when an Error log packet is received specifying that an SDI Error or Drive Detected Error was detected. If a Status/Event code of 353 (S/E Codes are in Octal) is reported, a valid Drive error code may be reported. The Drive Error Code is displayed along with the Drive dependent information in the packet, IN HEXADECIMAL. This type of error will be reported in the following manner.

```
SDI Error reported;  LBN:  dddddd.
  Status/event:      oooooo
  Drive error code:  xxxxxx
  Drive dependent information (hex):  xx xx xx xx xx xx xx xx
```

The LBN is the Logical Block Number that was being accessed at the time the error was detected. The LBN is always reported by this program in decimal. The "Drive Dependent Information", and Drive Error Code, are typed in HEX because that's the way this information is provided in most of the drive service manuals. YOU CAN LOOK-UP THE DRIVE ERROR CODE IN THE DRIVE SERVICE MANUAL FOR THE MEANING OF THE REPORTED PROBLEM. Most of the drive service manuals (Like RA80 and RA81) provide some information on the meanings of the bytes displayed for the Drive Dependent information. This information is sometimes known as the "drive specific status bytes" of the "extended status". Re-stating this information as the byte number of the drive extended status, it would appear as:

Drive dependent information : 9 8 11 10 13 12 15 14

Where the byte number is the byte number of the drive specific status. As mentioned, many of the service manuals provide information on the meaning of these bytes.

7.2 STATUS/EVENT CODES

The following list shows the various Status/Event codes used in many of the messages displayed by this program. Certain deviations may exist for specific controllers. This is the "generic" list. Remember, this program reports Status/Event codes in Octal.

	Octal	Hex	DESCRIPTION
	0	0	Successful completion
	1	1	Invalid command (high byte = byte offset of bad command field)
	2	2	Command aborted
	3	3	Drive off line (unknown unit or Online to another controller)
	4	4	Drive available
	5	5	Media Format Error
	6	6	Unit Write Protected
	7	7	Compare error (on compare command or compare modifier)
	10	8	Data Error (Or may have been written with "Forced Error Flag")
	11	9	Host Buffer Access Error
	12	A	Controller Error (Command Time Out/Retry Exceeded)
	13	B	Drive Error
	40	20	Spin down ignored (multi-unit drives only)
	43	23	No volume mounted or drive run/stop switch out
	45	25	Format Control Table unreadable - EDC Error
	51	29	Odd transfer start address in MSCP packet
	52	2A	SERDES overrun error (controller probably broken)
*	53	2B	SDI level two response timeout (Or maybe se > incomplete) ('53 also shows up with drive errors as a result NOT CAUSE)
	100	40	Still Connected (multi-unit drives only)
	103	43	Drive inoperative (UDA cannot communicate with drive)
	105	45	Format Control Table unreadable - Invalid Sector Header
	110	48	Header compare error (header not found and no revector)
	111	49	Odd byte count in MSCP packet
	112	4A	EDC error (SERDES broken or EDC written bad -- Controller)
*	113	4B	Invalid SDI level two response (unsuccessful or trash)
	145	65	Format Control Table unreadable - Data Sync Timeout
	150	68	Data Sync timeout (Data Sync field in sector)
	151	69	UNIBUS nonexistent memory error
	152	6A	Inconsistent controller state
	153	6B	Positioner Error (headers consistent but not on cyl)
	200	80	Duplicate Unit Numbers
	203	83	Drive offline and duplicate unit numbers
	211	89	UNIBUS parity error (UNIBUS read)(Host Memory Parity?)
*	213	8B	Lost read/write ready during or between transfers ('213 also shows up with drive errors as a result NOT CAUSE)
	245	A5	Drive not 512 Byte format (16 bit format)
	253	AB	Lost Drive clock during data/SDI transfer
	305	C5	Drive not formatted or Format Control Table Corrupted

* 313	CB	Lost drive receiver ready during transfer (see 213 comment)
345	E5	ECC error on FCT read (media format - FCT unreadable)
350	E8	Uncorrectable ECC error (This uncorrectable data may be re-written to an RBN with the Forced Error Flag)
353	EB	Drive detected error (DRIVE HAD ERROR! -- Find drive error code)
400	100	Already Online (in response to ONLINE)
403	103	Drive offline. By field service or internal Diagnostics
410	108	One symbol ECC error
413	10B	RTDS pulse/parity error (IS UDA M7486 UP TO REV ?)
450	128	Two symbol ECC error
510	148	Three symbol ECC error
550	168	Four symbol ECC error
610	188	Five symbol ECC error
650	1A8	Six symbol ECC error
710	1C8	Seven symbol ECC error
750	1E8	Eight symbol ECC error
10006	1006	Drive software write protected
20006	2006	Drive hardware write protected

* NOTE: Codes 53,113,213 and 313 occur most often as the RESULT of a "Drive Error" (S/E Code 353 Octal). You should look for a problem in the drive before believing that these codes really represent the description of your problem.

KEY: EDC = Error Detection Code (Written in each sector)
SDI = Standard Disk Interface (Drive Bus)
SERDES = SERializer/DESerializer (In Controller)
FCT = Format Control Table (Written on media surface)
ECC = Error Correction Code (Written in each sector)

7.3 CONTROLLER INITIALIZATION ERRORS

The following errors can be reported during controller initialization. These are basically "HARD" serious errors and usually indicate a very sick controller. This program, as with any operating system, must first initialize the controller, to prepare it for use. For example, in the UDA50 and KDA50 type controllers, this is a 4 step process. Errors that are detected during this initialization are reported via the following types of messages.

7.3.1 Controller Address Error Occurred While Accessing Controller Register

This error occurs when the program attempts to read a controller register and a memory access error occurred. This is most likely caused by the operator specifying an incorrect controller address. The specified Unit will be dropped from testing. This type of error will be reported in the following manner:

```
CONTROLLER ADDRESS ERROR OCCURRED WHILE ACCESSING CONTROLLER REGISTER
  SA address:   000000
  Check controller address.
```

The SA address displays the UNIBUS address of the controller register that was being accessed at the time of the error. This is most likely caused by the operator specifying an incorrect controller address. Unit is dropped from testing.

7.3.2 Controller Resident Diagnostics Detected Failure

This error indicates that the controller resident diagnostics reported an error during initialization. This type of error

will be reported in the following manner:

```
CONTROLLER RESIDENT DIAGNOSTICS DETECTED FAILURE;
  SA address:  oooooo
  SA contents: oooooo
```

The SA register contains the detected error code. The specified Unit will be dropped from testing. Decoding information for the SA register contents (error code) is in section 7.4

7.3.3 Step Bit Error In SA Register During Initialization;

This error indicates that during the 4 step (phase) initialization of the controller a error was detected. This type of error will be reported in the following manner:

```
STEP BIT ERROR IN SA REGISTER DURING INITIALIZATION;
  SA address:  oooooo
  SA contents: oooooo
  SA expected: oooooo
```

The SA address is the UNIBUS address of the controller register that was being accessed, during the 4 step initialization of the controller, when the error was detected. The SA contents is what the controller register contained the displayed the error condition. SA expected is what this program expected, for correct results during that step in the initialization. Decoding information for the SA register contents (error code) is in section 7.4. The specified Unit will be dropped from testing.

7.3.4 SA Register Did Not Zero After Step 3 Write;

This error occurs when the SA register does not zero during Step 3 of controller initialization. This type of error will be reported in the following manner:

```
SA REGISTER DID NOT ZERO AFTER STEP 3 WRITE;
  SA address:  oooooo
  SA contents: oooooo
  SA expected: oooooo
```

The meanings of the SA address, SA contents and SA expected are the same as those for the previous error (Section 7.3.3) Decoding information for the SA register contents (error code) is in section 7.4. The specified Unit will be dropped from testing.

7.3.5 SA Register Error During Initialization.

This is the more common of the Controller Initialization Errors that can be reported. The SA register Error bit (Bit 15 should be set) was set during controller initialization. This type of error will be reported in the following manner:

```
SA REGISTER ERROR DURING INITIALIZATION.
```

```
SA address:  oooooo
SA contents: oooooo
SA expected: oooooo
```

The meanings of the SA address, SA contents and SA expected are the same as those for the previous error (Section 7.3.3) Decoding information for the SA register contents (error code) is in section 7.4. The specified Unit will be dropped from testing.

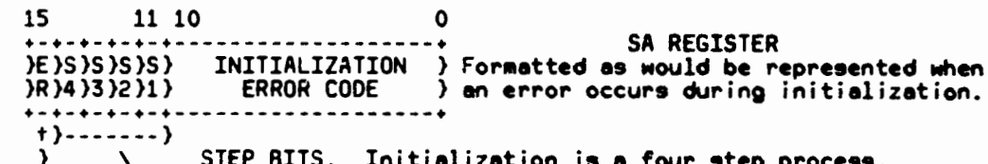
7.3.6 Controller Did Not Clear Ring Structure In Host Memory;

An error occurred during initialization of the Host communication area. At a certain point during host/controller initialization, the controller is responsible for clearing the host communication area (Rings) and this error results from a failure of the controller to perform this function (As detected by the host).

```
CONTROLLER DID NOT CLEAR RING STRUCTURE IN HOST MEMORY;
  Host address: oooooo
```

The Host address is a host memory location in the host communication area that the controller was to have cleared. The problem could be a problem in the controller or possibly the controller had problems accessing the hosts memory locations of the communications area.

7.4 CONTROLLER INITIALIZATION (BY SA REGISTER) ERROR CODES



UDA DURING INITIALIZATION
SA REGISTER ERROR CODES

Octal	Error Description	Possible FRU
104000	Fatal Sequence Error	7485
104040	D processor ALU	7485
104041	D processor control rom parity error	7485
105102	D proc with no board #2 or RAM Parity error	7486
105105	D proc RAM Buffer Error	7486
105152	D proc SDI Error	7486
105153	D proc Write Mode Wrap SERDES Error	7486

105154	D proc Read Mode SERDES,RSGEN & ECC Error	7486
106040	U proc ALU Error	7485
106041	U proc Control Register Error	7485
106042	U proc DFAIL/Control Rom Parity/BD #1 tst cnt	7485
106047	U proc Constant PROM error with D proc running SDI test	7485
106055	Unexpected trap found,Abort Diagnostic	7485
106071	U proc constant PROM Error	7485
106072	U proc Control ROM Parity Error	7485
106200	Step 1 Data Error (MSB not set)	7485
107103	U proc RAM Parity Error	7486
107107	U proc RAM Buffer Error	7486
107115	Test Count was wrong (BD#2)	7486
112300	Step 2 Error	7485
122240	NPR Error	7485
122300	Step 3 Error	7485
142300	Step 4 Error	7485

7.5 HOST/CONTROLLER COMMUNICATION ERRORS

The following errors can be reported during normal program execution. These are basically "HARD" serious errors and usually indicate a very serious problem. Errors that are reported via the "Status/Address" (SA) register are reported via the following types of messages.

7.5.1 NO INTERRUPT RECFIVED FOR 30 SECONDS

This error occurs when an interrupt timeout occurs during wait for an MSCP end message. An end message indicated to the host that the controller has completed the command that it was given.

```
NO INTERRUPT RECEIVED FOR 30 SECONDS;
   SA address:  oooooo
   SA contents: oooooo
```

The Host got tired of waiting for a response from the RA drive controller. If the end packet was not received by the host, the cause does not always necessarily mean that the controller was at fault. The SA address is the UNIBUS address of the controller Status/Address register that was being used at the time the problem was detected by the host. If the controller detected a problem, that accounted for the end packet not being delivered to the host, The Status/Address (SA) register contents should show an error code and the SA register error bit should be set (Bit 15). The specified Unit will be dropped from testing.

7.5.2 Fatal Error Reported In SA Register

This error can occur when the Error Bit is set in the SA register, during normal on-line use of the controller. The error bit (Bit 15) setting causes the controller to discontinue fetching commands from the host. The host will read the SA register, detecting that an error condition exists and display contents of the SA register in

this message.

FATAL ERROR REPORTED IN SA REGISTER;
SA address: oooooo
SA contents: oooooo

The SA register contents should have the error bit set (bit 15) and an error code. Section 7.6 has a list of the On-line error codes and a brief description of their meanings. Do not get these on-line error codes mixed-up with the initialization error codes that are described in section 7.4. The specified Unit will be dropped from testing.

7.6 CONTROLLER COMMUNICATION ERROR CODES

This section provides a list of the various controller error codes that can reside in the SA register, when the controller detects a hard error during on-line use of the controller. Do not get these confused with the SA register initialization error codes described in section 7.4. They are different

```
15          10              0
+-+-+-+-+-+-+----------------+
)E)        )     ONLINE     )   Formatted as would be represented when
)R)        )   Error Code   )   the UDA is "ONLINE" to the Host
+-+-+-+-+-+-+----------------+
 ↑
 )___ Error Bit (Error Code will be displayed in bits 0 - 10) IF bit 15
                 is NOT set, the contents of bits 0 - 10 are undefined.
```

SA REGISTER

UDA ONLINE
SA REGISTER ERROR CODES

octal	Error Description	FRU
100001	UNIBUS Packet Read Error	7485*
100002	UNIBUS Packet Write Error	7485*
100003	UDA ROM & RAM Parity Error	7485/7486
100004	UDA RAM Parity Error	7486
100005	UDA ROM Parity error	7485
100006	UNIBUS Ring Read Error	7485*
100007	UNIBUS Ring Write Error	7485*
100010	UNIBUS Interrupt Master Failure	7485
100011	Host Access Timeout Error	7485*
100012	Host Exceeded Command Limit	7485*
100013	UNIBUS Bus Master Failure	7486
100014	DM XFC Fatal Error	7486
100015	Hardware Timeout of Instruction Loop	7485*
100016	Invalid Virtual Ckt Identifier	7485*
100017	Interrupt Write Error on UNIBUS	7485*

* - denotes possible host CPU error.....

7.7 UNIT INITIALIZATION ERRORS

The following errors are reported when an error occurs during the initialization of a unit (Drive). These are basically "HARD" serious errors and usually indicate a problem either in a drive or communicating with a drive. Errors are reported via the "End Message" Status field (Endmsg status:) If the problem is severe, the specified unit (drive) will not continue being tested.

NOTE

) The meanings of the Endmsg status can be found by looking it up in the list of Status/Event codes provided in section 7.2

7.7.1 Failed Get Unit Status;

"Get Unit Status" is an MSCP command that is used by the host to get certain information about a drive connected to an RA drive controller. This error occurs when an attempt to "GET UNIT STATUS" fails during Unit initialization. This type of error will be reported in the following manner:

```
FAILED GET UNIT STATUS;
  Drive ddd is not accessible.
  Endmsg status:  oooooo
```

Drive ddd is the decimal drive logical unit address that the "Get Unit Status" was issued for. Possibly the drive port switches are not pushed in or the incorrect drive address was given to the program. Errors are reported via the "End Message" Status field (Endmsg status:) and the various Endmsg status codes can be found in the table of Status/Event codes in section 7.2

7.7 2 FAILED SET CONTROLLER CHARACTERISTICS;

"SET CONTROLLER CHARACTERISTICS" is an MSCP command that is used by the host to set certain controller characteristics (Like timeouts and to enable various kinds of messages). This error occurs when command completion status indicates a problem executing this command. This type of error will be reported in the following manner:

```
FAILED SET CONTROLLER CHARACTERISTICS;
  Host access timeout not disabled.
  Default timeout is 60 seconds.
  Error logging is not enabled.
  Endmsg status:  oooooo
```

The default host access timeout is retained, and error logging will not be enabled. Errors are reported via the "End Message" Status field (Endmsg status:) and the various Endmsg status codes can be found in the table of Status/Event codes in section 7.2. Processing of the specified unit (drive) will continue. However, if this

error message is seen, the user should terminate the test and try running it over. If the problem is again reported, the problem should be investigated using other diagnostics.

7.7.3 Failed ONLINE

"ONLINE" is an MSCP command that is used by the host to bring a unit (drive) Online to the controller. It also makes certain drive specific information available to the host and the drive to become usable. This error occurs when command completion status indicates a problem executing this command successfully. This type of error will be reported in the following manner:

```
Failed ONLINE;
  Endmsg status:  oooooo
```

Errors are reported via the "End Message" Status field (Endmsg status:) and the various Endmsg status codes can be found in the table of Status/Event codes in section 7.2. Processing of the specified unit (drive) will not continue for the pass in progress.

7.8 PROGRAM INITIALIZATION ERRORS

The following sections list the possible errors reported during initialization of program tables, etc. These errors could indicate a possible "system" problem or programming error.

7.8.1 Failed Dynamic Memory Allocation For Selected Unit

This error occurs when the memory table allocation fails. Possibly insufficient memory exists on the system to support the testing of the specified number of drives. The error is reported in the following manner:

```
FAILED DYNAMIC MEMORY ALLOCATION FOR SELECTED UNITS;
   RESTART PROGRAM AND SELECT FEWER UNITS.
```

7.9 MSCP COMMAND/RESPONSE ERRORS

The following sections list the possible errors reported that indicate the failure of an MSCP command issued by the host. Remember that a period after a number indicates that the number is provided in Decimal (Like the LBN below.

7.9.1 Failed READ

This error occurs when an MSCP 'READ" command fails with an end message status (Endmsg status:) other than Success or Data Error. The error is reported in the following manner:

```
Failed READ:  LBN:  dddddd.
  Endmsg flags:      ooo
  Endmsg status:  oooooo
```

This error can be the result of many different conditions. The host issued a "READ" command to the controller being used for testing and then received an End Packet indicating that an error was detected while trying to execute that command. The LBN is the one the "READ" was attempting to access, at the time the error occurred, as reported by the End Packet. The Endmsg status can be interpreted from the list of Status/Event codes in section 7.2. The Endmsg flags are provided in section 7.10. You should look these up in the charts to get a possible cause for the error. The Unit (drive) being tested will be dropped from further testing.

7.9.2 Failed WRITE

This error occurs when an MSCP "WRITE" command fails with an end message status (Endmsg status:) other than Success or Data Error. The error is reported in the following manner:

```
Failed WRITE;  LBN:  dddddd.
  Endmsg flags:      ooo
  Endmsg status:  oooooo
```

This error can be the result of many different conditions. The host issued a "WRITE" command to the controller being used for testing and then received an End Packet indicating that an error was detected while trying to execute that command. The LBN is the one the "WRITE" was attempting to write at the time the error occurred, as reported by the End Packet. The Endmsg status can be interpreted from the list of Status/Event codes in section 7.2. The Endmsg flags are provided in section 7.10. You should look these up in the charts to get a possible cause for the error. The Unit (drive) being tested will be dropped from further testing.

7.9.3 Failed ACCESS

This error occurs when an MSCP "ACCESS" command fails with an end message status (Endmsg status:) other than Success or Data Error. PLEASE READ THIS COMPLETE ERROR DESCRIPTION. The error is reported in the following manner:

```
Failed ACCESS;  LBN:  dddddd.
  Endmsg flags:      ooo
  Endmsg status:  oooooo
```

This error can be the result of many different conditions. The host issued an "ACCESS" command to the controller being used for testing and then received an End Packet indicating that an error was detected while trying to execute that command. The LBN is the one the "ACCESS" was attempting to read at the time the error occurred, as reported by the End Packet. An ACCESS command is the MSCP command used by this program to read all the LBN's on the media. The ACCESS command causes a read operation, checks for any

error conditions (Bad Block), but does not transfer any data to the host memory. This purpose for this command is to verify that data can be read without error. The Endmsg status can be interpreted from the list of Status/Event codes in section 7.2. The Endmsg flags are provided in section 7.10. You should look these up in the charts to get a possible cause for the error. The Unit (drive) being tested will be dropped from further testing.

7.9.4 Failed REPLACE

This error occurs when an MSCP "REPLACE" command fails with an end message status (Endmsg status:) other than Success or Data Error. PLEASE READ THIS COMPLETE ERROR DESCRIPTION. The error is reported in the following manner:

```
Failed REPLACE;  LBN:  dddddd.
  Endmsg flags:       ooo
  Endmsg status:  oooooo
```

This error can be the result of many different conditions. The host issued a "REPLACE" command to the controller being used for testing and then received an End Packet indicating that an error was detected while trying to execute that command. The LBN is the one the "REPLACE" was attempting to use at the time the error occurred, as reported by the End Packet. A REPLACE command is the MSCP command used by programs that do bad block replacement to actually cause the bad LBN to be logically replaced. The execution of the REPLACE command is very involved and leaves little room for error. The header of the bad LBN is written with special codes and the replacement RBN is allocated to the bad LBN. IF THIS ERROR IS SEEN, WE RECOMMEND THAT THE MEDIA RE REFORMATTED USING THE FIELD FORMATTER PROGRAM. HOWEVER, THE FAILURE OF THIS COMMAND COULD BE DUE TO A DEFECT IN THE DRIVE, OTHER THAN MEDIA BAD BLOCKS. BE SURE THAT ANY OTHER CAUSES FOR A FAILURE LIKE THIS IS INVESTIGATED AND ANY APPROPRIATE REPAIRS MADE, BEFORE ATTEMPTING TO REFORMAT THE MEDIA. A FAILURE LIKE THIS ONE IS ONE OF THE GOOD REASONS FOR USING THE FORMATTER, HOWEVER, BE SURE NOT TO USE "RECONSTRUCT" MODE OF THE FORMATTER (SEE RA81-TT-19). The Endmsg status can be interpreted from the list of Status/Event codes in section 7.2. The Endmsg flags are provided in section 7.10. You should look these up in the charts to get a possible cause for the error. The Unit (drive) being tested will be dropped from further testing.

7.9.5 Command/Response reference number mismatch

In Mass Storage Control Protocol (MSCP) commands that are issued to the controller are given a "unique" number. In this way, the host can distinguish this command, and any responses, from any other commands that may be issued. When a response to a command is received, the host attempts to associate the "unique" reference number to a command that has not yet received a response. If a response reference number can not be matched to a command with the same number (from commands that have not had responses yet) then this error occurs. This error is reported in the following manner:

```
Command/response reference number mismatch;
  Command ref:    oooooo
  Endmsg ref:     oooooo
  Endmsg flags:      ooo
  Endmsg status:  oooooo
```

The user should find that the Command Ref and Endmsg ref do not match. Why this would happen, is hard to say. The source for this kind of trouble, is not usually the drive being tested. Rather it is more likely that a controller or "system" problem exists. The Endmsg status can be interpreted from the list of Status/Event codes in section 7.2. The Endmsg flags are provided in section 7.10. You should look these up in the charts to get a possible cause for the error. For this kind of error, you may find that the Endmsg flags and Endmsg status will not indicate an error. In this case, possibly a "system" type error would be more likely. The Unit (drive) being tested will be dropped from further testing.

7.9.6 Fatal End Message status detected

An "end message" is the means by which the controller tells the host about how the command was processed and whether any errors occurred while executing a command. This error is indicating that a fatal status was reported by an end message. The error is reported in the following manner:

```
Fatal end message status detected;
  Endmsg flags:      ooo
  Endmsg status:  oooooo
```

Since the error is reporting Fatal end message status, you should find the an "Endmsg status" code typed. The Endmsg status can be interpreted from the list of Status/Event codes in section 7.2. The Endmsg flags are provided in section 7.10. You should look these up in the charts to get a possible cause for the error. The drive being tested will be dropped.

7.9.7 Failed Replacement Verification

After the "REPLACE" command has been issued and completed with good results, the customers data must be written to the replacement block (RBN). At this point in time, the original bad LBN has been written with a code that will cause all references to the LBN address to be "revectored" to the replacement block. Thus the host issues a "WRITE" command, with the compare modifier, and the customer data will end up in the replacement block. If this process reports a problem, this error message will result:

```
Failed Replacement verification;  LBN:  dddddd.
  Retry of replacement operation will be attempted.
  Endmsg flags:      ooo
  Endmsg status:  oooooo
```

The program assumes that the cause for the error is that the

replacement block is bad. This can happen. Thus, a retry of the replacement process takes place. This time another replacement block is used and the original one is marked unusable. The Endmsg status can be interpreted from the list of Status/Event codes in sectior 7.2. The Endmsg flags are provided in section 7.10. You should look these up in the charts to get a possible cause for the error. The drive being tested will not be dropped and the replacement retry will be attempted.

7.10 END MESSAGE FLAGS (Endmsg flags)

FLAGS

Bit flags, collectively called end flags, used to report various conditions detected due to this command but not directly related to success or failure. The following flags are defined:

Bad Block Reported: (200 OCTAL -- Bit 7)
Set if one or more bad blocks were detected and the host is expected to perform bad block replacement. Indicates that the host should replace the bad block identified by the LBN:

Bad Blocks Unreported: (100 OCTAL -- Bit 6)
Set if one or more bad blocks were detected and not reported in the "first bad block" field of an End Message Packet.

If the "Bad Block Reported" flag is also set, this indicates that two or more bad blocks were detected, and the host (This program) should perform bad block replacement. In this case the "first bad block" (LBN:) field only reports the first bad block in the transfer. If this happens, the program should be run for multiple passes.

Error Log Generated: (40 OCTAL -- Bit 5)
Set if one or more error log messages were generated that refer to this command -- i.e., that contain this command's command reference number. This flag allows the host to save any outstanding command context that it wishes to include in the error report. The MSCP server must send the error log messages either before or shortly after it sends the end message containing this flag. Depending upon the type of error log report referenced by this flag, this program will determine whether to display the error log report or not. In most cases, the Disk Transfer Error Log report is used to report blocks that need replacement, thus reporting this error log report is somewhat meaningless, since the program will make a replacement due to having received this error log type.

7.11 RCT READ/WRITE ERRORS

The following sections list the possible errors reported when a READ or WRITE to the Replacement Control Table occurs. The RCT does not require special MSCP commands, just normal READ and WRITE commands with the LBN address such that the commands are going to reference blocks in the RCT. The error is reported only once for a particular RCT block. Depending upon the severity of the error

program execution may or may not continue. Their must be at least one good copy of an RCT block for execution to continue. Their are four copies of the RCT and at least one good one must be found to do replacements. If no good copies can be found, then reformatting the media must be accomplished. Reformatting for this kind of error is a good use of the formatter. However, be sure that a good copy of the Format Control Table (FCT) exists (See RA81-TT-19).

Replacements can not be done on blocks within the RCT (That's why their are four copies). Thus, you may see RCT errors frequently and why they are not always fatal.

7.11.1 Failed RCT READ

Simply stated, a READ command was issued to a block in one of the copies of the RCT and an error was reported back for that command. This is not necessarily fatal, as their are four copies of the RCT and requirements are that at least one copy should have a good block for the one needed. The error is reported in the following manner:

```
Failed RCT READ;
  RCT copy: ddd
  Block no: ddd
  Endmsg status: oooooo
```

The RCT copy defines which of the four copies were being referenced when the error was detected. Block no is the Block number (LBN) that was being referenced within the copy, when the error was detected. The Endmsg status should provide an indication of what the error condition was and can be interpreted from the list of Status/Event codes in section 7.2. Program execution will continue.

7.11.2 Failed RCT WRITE

Simply stated, a WRITE command was issued to a block in one of the copies of the RCT and an error was reported back for that command. This is not necessarily fatal, as their are four copies of the RCT and requirements are that at least one copy should have a good block for the one needed. The error is reported in the following manner:

```
Failed RCT WRITE;
  RCT copy: ddd
  Block no: ddd
  Endmsg status: oooooo
```

The RCT copy defines which of the four copies were being referenced when the error was detected. Block no is the Block number (LBN) that was being referenced within the copy, when the error was detected. The Endmsg status should provide an indication of what the error condition was and can be interpreted from the list of Status/Event codes in section 7.2. Program execution will continue.

7.11.3 Failed READ of all copies of RCT

This is serious. This error occurs when the program detects a

failure during a READ of all copies of a particular RCT block. Replacements can not be done unless enough good RCT blocks exist to make-up a good RCT copy. Not only can this program not do replacements, but neither can any operating system that has the capability of doing replacements. The error is reported in the following manner:

```
Failed READ of all copies of RCT;
  Block no: ddd
  Endmsg status: oooooo
```

The Block no is the block (LBN) that was being referenced. This same block exists in each of the RCT copies. Thus, references to this block in each of the copies resulted in an error. The Endmsg status should provide an indication of what the error condition was and can be interpreted from the list of Status/Event codes in section 7.2. The Unit (drive) is dropped from testing.

The appropriate recovery for this kind of error, should be to first make sure that the drive does not have a hardware problem causing data errors that are not related to the media. If your certain that the basic drive is functioning properly, the recovery would be to try reformatting the media. The Format Control Table (FCT) must be able to be used during the format (Read RA81-TT-19). Once this has been accomplished, you can re-run this program, to assure yourself that the drive is now operating properly. If the problem persists, after having reformatted, the HDA/Pack may need replacement.

7.11.4 Failed WRITE of all copies of RCT

This is serious. This error occurs when the program detects a failure during a WRITE of all copies of a particular RCT block. Replacements can not be done unless enough good RCT blocks exist to make-up a good RCT copy. Not only can this program not do replacements, but neither can any operating system that has the capability of doing replacements. The error is reported in the following manner:

```
Failed WRITE of all copies of RCT;
  Block no: ddd
  Endmsg status: oooooo
```

The Block no is the block (LBN) that was being referenced. This same block exists in each of the RCT copies. Thus, references to this block in each of the copies resulted in an error. The Endmsg status should provide an indication of what the error condition was and can be interpreted from the list of Status/Event codes in section 7.2. The Unit (drive) is dropped from testing.

The appropriate recovery for this kind of error, should be to first make sure that the drive does not have a hardware problem causing data errors that are not related to the media. If your certain that the basic drive is functioning properly, the recovery would be to try reformatting the media. The Format Control Table (FCT) must be able to be used during the format (Read RA81-TT-19). Once this has been accomplished, you can re-run this program, to assure yourself

that the drive is now operating properly. If the problem persists, after having reformatted, the HDA/Pack may need replacement.

7.11.5 No Null descriptor entry found in RCT

This is serious. The Replacement Control Table (RCT) contains descriptors for 17,000 plus replacement blocks. If they are all used (No Null Descriptor) then something big is wrong. The descriptors could in fact all be used or possibly the RCT has been written with Garbage, which makes it appear that all replacement blocks have been used. Never-the-less, if this error occurs, you should read RA81-TT-12. The recovery will be to reformat the media. If the drive is operating normally, this should fix the RCT, as long as the Format Control Table (FCT) is good (See RA81-TT-19). You can re-run this program after having reformatted, just to be sure the problem has been corrected. The drive will be dropped form further testing. The error is reported in the following manner:

```
No Null descriptor entry found in RCT;
  RCT is probably corrupt.
  Reformat media.
```

8.0 INFORMATIONAL MESSAGES

The following sections describe the information which may be observed on the operator console during program execution.

8.1 Program Initialization

During program initialization, the following messages will appear on the console for the appropriate replacement mode:

1. MANUAL BAD BLOCK REPLACEMENT SELECTED.

2. AUTOMATIC BAD BLOCK REPLACEMENT SELECTED

8.2 Unit Initialization

Each Unit selected for test is brought Online, and the following information is displayed for that unit (Drive). Remember a unit is not necessarily the logical unit address of a drive.

```
INITIALIZATION INFORMATION FOR UNIT n
  Controller:  xDA
  Address:     172150 (Or what you provided when starting the program)
  Drive no:    d
  Drive type:  RAnn
  Volume SN:   dddd.
  Volume size: dddddd.

-- The controller will be a UDA50, KDA50 or whatever it finds
```

-- Drive no: Is the Drive being initialized logical address
-- Drive Type: Is the model of drive seen (Like RA80/81/60 etc)
-- Volume SN: This is the Serial Number of the HDA or Pack. This information comes from the Format Control Table (FCT), which is read during the execution of the MSCP "ONLINE" command.
-- Volume size: This is the number of user LBN's on the media. For example, the RA81 formatted for a VAX (16 bit) has 891072 (decimal) LBN's. Actually, starting with LBN zero, the last user LBN would be 891071.

8.2.1 Zero RCT size detected -- BBR not supported by this drive

This message is telling you that your running this program on a drive that does not support Bad Block replacement. The zero RCT size means that the drive has no "real" Replacement Control Table and replacements are not possible. If think that you have bad blocks on a drive like this, you should consult the appropriate service manual for action you need to take. The message is reported in the following manner:

```
Zero RCT size detected:
  BBR not supported by this drive.
  Endmsg status:  000004
```

The Endmsg status will most likely not tell you much (Unless something really out of the ordinary is happening). The Endmsg status can be interpreted from the list of Status/Event codes in section 7.2. The Unit (drive) is dropped from testing.

8.2.2 Scanning the RCT...

Just after typing the Initialization information for a drive that is going to be tested (Above), the statement "Scanning the RCT..." is typed. This portion of the program, attempts to find enough good RCT blocks to account for a good complete copy. Any error that it finds doing this is displayed. These messages (Shown Below) are only status messages and DO NOT necessarily mean that the drive is defective. The status is shown in the following manner:

```
RCT copy 1, block 184 (    891256.)   Status/event:  000110
RCT copy 1, block 185 (    891257.)   Status/Event:  000153
RCT copy 2, block 184 (    892021.)   Status/event:  000350
```

These messages do not become critical until the same block number shows an error for each copy. In the above example Block 184 is bad in two copies. This is not fatal, since their are more than 2 copies in our example. You will get a hard error report, if all copies of a block are bad. The Endmsg status can be interpreted from the list of Status/Event codes in section 7.2.

8.3 END OF PASS INFORMATION

The operator is notified of End of Pass, for the drive being tested, by the following:

1. EOM reached. Elapsed runtime hh:mm:ss
   The End of Media is reached in Automatic replacement mode when the highest LBN on the media has been tested.

2. EOF detected.
   The End of File is reached in Manual replacement mode when the operator enters a null LBN for replacement.

When EOP is reached in either Automatic or Manual mode, the following pass summary is displayed for the drive being tested. This summary will also be displayed by the operator "PRINT" command at the diagnostic supervisor prompt.

```
        REPLACEMENT INFORMATION FOR THIS PASS

          BAD BLOCKS reported:     ddd.
          ECC error detected:      ddd.
          FORCED ERRORs detected:  ddd.
          FORCED ERRORs written:   ddd.
          PRIMARY replacement:     ddd.
          SECONDARY replacements:  ddd.
          RBNs marked unusable:    ddd.
          Total replacements made: ddd.
```

The entries should be self-explanatory, after all the discussion above. The Bottom line indicates the total number of replacements that were made, which should not exceed a few hundred, unless something more is wrong with the drive. The total secondary replacements should be on a ratio of about less than 10 to every 100 primary replacements. The number of Forced Errors written, indicates the number of Uncorrectable ECC (ECH) errors that were encountered. If you have any forced errors written, or forced errors detected, you should not fail to restore the customer data from the back-up that was made, before you started execution of this program. If excessive replacements were made, read RA81-TT-12 for a possible explanation and recovery procedure.

8.4 ELAPSED RUNTIME

In Automatic mode, the following runtime message is periodically displayed to indicate that execution is in progress:

```
          LBN dddddd.   Elapsed runtime is hh:mm:ss
```

The LBN listed indicates where on the media the program is currently testing; the elapsed runtime is zeroed when each Unit is selected for test.

```
          @
1954                            ;*LAST REVISION 01-APR-1985
1955                            .IDENT  /01A/
2496                            .SBTTL  Program Header
2513
2514                                    .ENABL  AMA,ABS
2515    002000                          .       =       2000
2516
2518                            ;++
2519                            ; THE PROGRAM HEADER IS THE INTERFACE BETWEEN
2520                            ; THE DIAGNOSTIC PROGRAM AND THE SUPERVISOR.
```

Program Header

```
                                ;--
                                
                                
002000                          L$NAME::                ;DIAGNOSTIC NAME
002000      132                         .ASCII /Z/
002001      125                         .ASCII /U/
002002      104                         .ASCII /D/
002003      114                         .ASCII /L/
002004      000                         .BYTE   0
002005      000                         .BYTE   0
002006      000                         .BYTE   0
002007      000                         .BYTE   0
002010                          L$REV::                 ;REVISION LEVEL
002010      101                         .ASCII  /A/
002011                          L$DEPO::                ;0
002011      060                         .ASCII  /0/
002012                          L$UNIT::                ;NUMBER OF UNITS
002012  000001                          .WORD   T$PTHV
002014                          L$TIML::                ;LONGEST TEST TIME
002014  000000                          .WORD   0
002016                          L$HPCP::                ;POINTER TO H.W. QUES.
002016  042146                          .WORD   L$HARD
002020                          L$SPCP.:                ;POINTER TO S.W. QUES.
002020  000000                          .WORD   0
002022                          L$HPTP::                ;PTR. TO DEF. H.W. PTABLE
002022  002132                          .WORD   L$HW
002024                          L$SPTP::                ;PTR. TO S.W. PTABLE
002024  002146                          .WORD   L$SW
002026                          L$LADP::                ;DIAG. END ADDRESS
002026  047476                          .WORD   L$LAST
002030                          L$STA::                 ;RESERVED FOR APT STATS
002030  000000                          .WORD   0
002032                          L$CO::
002032  000000                          .WORD   0
002034                          L$DTYP::                ;DIAGNOSTIC TYPE
002034  000000                          .WORD   0
002036                          L$APT::                 ;APT EXPANSION
002036  000000                          .WORD   0
002040                          L$DTP::                 ;PTR. TO DISPATCH TABLE
002040  002124                          .WORD   L$DISPATCH
002042                          L$PRIO::                ;DIAGNOSTIC RUN PRIORITY
002042  000340                          .WORD   PRIO7
002044                          L$ENVI::                ;FLAGS DESCRIBE HOW IT WAS SETUP
002044  000000                          .WORD   0
002046                          L$EXP1::                ;EXPANSION WORD
002046  000000                          .WORD   0
002050                          L$MREV::                ;SVC REV AND EDIT #
002050      003                         .BYTE   C$REVISION
002051      003                         .BYTE   C$EDIT
002052                          L$EF::                  ;DIAG. EVENT FLAGS
002052  000000                          .WORD   0
002054  000000                          .WORD   0
002056                          L$SPC::
002056  000000                          .WORD   0
002060                          L$DEVP::                ; POINTER TO DEVICE TYPE LIST
002060  004300                          .WORD   L$DVTYP
002062                          L$REPP::                ;PTR. TO REPORT CODE
```

Program Header

```
002062  035132                  .WORD   L$RPT
002064                  L$EXP4::
002064  000000                  .WORD   0
002066                  L$EXP5::
002066  000000                  .WORD   0
002070                  L$AUT::                 ;PTR. TO ADD UNIT CODE
002070  000000                  .WORD   0
002072                  L$DUT::                 ;PTR. TO DROP UNIT CODE
002072  040146                  .WORD   L$DU
002074                  L$LUN::                 .LUN FOR EXERCISERS TO FILL
002074  000000                  .WORD   0
002076                  L$DESP::                ;POINTER TO DIAG. DESCRIPTION
002076  004324                  .WORD   L$DESC
002100                  L$LGAD::                ;GENERATE SPECIAL AUTOLOAD EMT
002100  104035                  EMT     E$LOAD
002102                  L$ETP::                 ;POINTER TO ERRTBL
002102  002166                  .WORD   L$ERRTBL
002104                  L$ICP::                 ;PTR. TO INIT CODE
002104  035726                  .WORD   L$INIT
002106                  L$CCP::                 ;PTR. TO CLEAN-UP CODE
002106  040124                  .WORD   L$CLEAN
002110                  L$ACP::                 ;PTR. TO AUTO CODE
002110  040122                  .WORD   L$AUTO
002112                  L$PRT::                 ;PTR. TO PROTECT TABLE
002112  035720                  .WORD   L$PROT
002114                  L$TEST::                ;TEST NUMBER
002114  000000                  .WORD   0
002116                  L$DLY::                 ;DELAY COUNT
002116  000000                  .WORD   0
002120                  L$HIME::                ;PTR. TO HIGH MEM
002120  000000                  .WORD   0
  2526
```

```
      1                                 .SBTTL  Dispatch Table
      2
      3                                 ;++
      4                                 ; THE DISPATCH TABLE CONTAINS THE STARTING ADDRESS OF EACH TEST.
      5                                 ; IT IS USED BY THE SUPERVISOR TO DISPATCH TO EACH TEST.
      6                                 ;--
      7
      8 002122  000002                          .WORD   2
        002124                          L$DISPATCH::
        002124  040314                  .WORD   T1
        002126  040624                  .WORD   T2
      9
```

```
                                .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.
                                ;--

002130  000005                          .WORD   L10000-L$HW/2
002132                          L$HW::
002132                          DFPTBL::
002132  172150                          .WORD   172150                  ; UNIBUS ADDRESS
002134  000154                          .WORD   154                     ; VECTOR ADDRESS
002136  000005                          .WORD   5.                      ; BR LEVEL
002140  000077                          .WORD   63.                     ; UNIBUS BURST RATE
002142  000000                          .WORD   0.                      ; LOGICAL DRIVE NUMBER

002144                          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.
                                ;--

002144  000010                          .WORD   L10001-L$SW/2
002146                          L$SW::
002146                          SFPTBL::

002146  000000                  OPHELP::        .WORD   0               ; Set to print operator help
002150  000000                  MANRPL::        .WORD   0               ; Set if manual replacement
002152  000001                  AUTORC::        .WORD   1               ; Set for automatic crash recovery
002154  000001                  DSPRPL::        .WORD   1               ; Set to display replacements
002156  000000                  DSPRCT::        .WORD   0               ; If set print RCT descriptors
002160  000001                  ENBRPL::        .WORD   1               ; Set to disable replacement
002162  000001                  ENBERRL::       .WORD   1               ; Set to enable Errorlog packets
002164  000001                  ENBWFE::        .WORD   1               ; Enable write FE

002166                          L10001:
```

```
                                .SBTTL  Global equates section
                                ;++
                                ; THE GLOBAL EQUATES SECTION CONTAINS PROGRAM EQUATES THAT
                                ; ARE USED IN MORE THAN ONE TEST.
                                ;--
                                ;
                                ; 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
                                ;
                                ;                                       ;  BIT POSITION IN SECOND STATUS WORD
000040                          EF.START==      32.                     ; (100000) START COMMAND WAS ISSUED
000037                          EF.RESTART==    31.                     ; (040000) RESTART COMMAND WAS ISSUED
000036                          EF.CONTINUE==   30.                     ; (020000) CONTINUE COMMAND WAS ISSUED
000035                          EF.NEW==        29.                     ; (010000) A NEW PASS HAS BEEN STARTED
000034                          EF.PWR==        28.                     ; (004000) A POWER-FAIL/POWER UP OCCURRED
                                ;
                                ;
                                ; PRIORITY LEVEL DEFINITIONS
                                ;
000340                          PRI07== 340
000300                          PRI06== 300
000240                          PRI05== 240
000200                          PRI04== 200
000140                          PRI03== 140
000100                          PRI02== 100
```

Global equates section

```
000040                  PRIO1== 40
000000                  PRIO0== 0
                        ;
                        ;OPERATOR FLAG BITS
                        ;
000004                  EVL==        4
000010                  LOT==       10
000020                  ADR==       20
000040                  IDU==       40
000100                  ISP==      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
```

```
                        .SBTTL  XDA bit definitions


                        ;xDA SA REGISTER UNIVERSAL READ BITS

100000                  SA.ERR  = 100000                ;ERROR INDICATOR
040000                  SA S4   = 040000                ;STEP 4 STATUS BIT
020000                  SA.S3   = 020000                ;STEP 3 STATUS BIT
010000                  SA.S2   = 010000                ;STEP 2 STATUS BIT
004000                  SA.S1   = 004000                ;STEP 1 STATUS BIT


                        ;xDA SA REGISTER ERROR STATUS BITS

003777                  SA.ERC  = 003777                ;ERROR CODE


                        ;xDASA REGISTER STEP 1 SEND 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


                        ;xDASA REGISTER STEP 1 RESPONSE BITS

002000                  SA.NV   = 002000                ;NON SETTABLE INTERRUPT VECTOR
001000                  SA.QB   = 001000                ;22 BIT ADDRESS BUS
000400                  SA.DI   = 000400                ;ENHANCED DIAGNOSTICS
000100                  SA.MP   = 000100                ;MAPPING BIT
                        ;         000377                ;ALL BITS RESERVED


                        ;xDASA REGISTER STEP 2 SEND BITS

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


                        ;xDASA REGISTER STEP 2 RESPONSE 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


                        ;xDASA REGISTER STEP 3 SEND BITS

                        ;         077777                ;HIGH ORDER MESSAGE RING BYTE ADDRESS
```

```
                100000          SA.TST  = 100000                ;PURGE POLE TEST ENABLE

                                ;xDASA REGISTER STEP 3 RESPONSE BITS

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

                                ;xDASA REGISTER STEP 4 SEND BITS

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

                                ;xDASA REGISTER STEP 4 RESPONSE BITS

                000017          SA.MCV  = 000017                ;xDA MICROCODE VERSION
                000360          SA.CNT  = 000360                ;CONTROLLER TYPE
                                ;         003400                ;RESERVED
```

```
                        .SBTTL  Host Communication area definitions

                        ;COMMAND/MESSAGE RING BIT DEFINITIONS

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


                        ;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


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

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

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.SIZ  = HC.CPK+HC.PSZ         ;TOTAL SIZE OF HOST COMMUNICATION AREA
```

SEQ 0046

```
                        .SBTTL  Host Communication area layout

                        ;
                        ;       HC.INT  )       INTERRUPT INDICATORS                    )   4 BYTES
                        ;               )                                               )
                        ;
                        ;       HC.MSG  )       MESSAGE (RESPONSE) RING                 )   4 BYTES
                        ;       HC.MGT  )                                               )
                        ;
                        ;       HC.CMD  )       COMMAND RING                            )   4 BYTES
                        ;       HC.CCT  )                                               )
                        ;
                        ;       HC.MEV  )       MESSAGE (RESPONSE) ENVELOPE             )   4 BYTES
                        ;               )                                               )
                        ;       HC.MPK  )       MESSAGE (RESPONSE) PACKET               )  48 BYTES
                        ;               )                                               )
                        ;               )                                               )
                        ;               )                                               )
                        ;               )                                               )
                        ;
                        ;       HC.CEV  )       COMMAND ENVELOPE                        )   4 BYTES
                        ;               )                                               )
                        ;       HC.CPK  )       COMMAND PACKET                          )  48 BYTES
                        ;               )                                               )
                        ;               )                                               )
                        ;               )                                               )
                        ;               )                                               )
                        ;
                        ;               NOTE: BYTES ARE GIVEN IN DECIMAL
```

```
                        .SBTTL  Command packet opcodes definitions

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 ATTENTION MESSAGE
000103                  OP.RLC  = 103                   ;RESET COMMAND LIMIT ATTENTION MESSAGE

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

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


                                ;END PACKET FLAGS

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


                                ;CONTROLLER FLAGS

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


                                ;UNIT FLAGS

000001                          UF.CMR  = 000001        ;COMPARE READS
000002                          UF.CMW  = 000002        ;COMPARE WRITES
100000                          UF.RPL  = 100000        ;HOST INITIATED BAD BLOCK 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
```

```
                        .SBTTL  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
```

```
                        .SBTTL  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


                        ;       Error log packet offsets

000000                  L.CRF   ==      0.              ; Command reference number
000010                  L.FMT   ==      8.              ; Format specifier
000011                  L.FLGS  ==      9.              ; Error log flags
000012                  L.EVNT  ==      10.             ; Event code
000030                  L.BADR  ==      24.             ; Host address
000050                  L.HDCD  ==      40.             ; Header code (LBN)
000054                  L.SDI   ==      44.             ; SDI information
000060                  L.DS    ==      L.SDI+4         ; Drive status info

                        ;GET COMMAND STATUS END PACKET OFFSETS

000014                  P.OTRF  = 12.                   ;OUTSTANDING REFERENCE NUMBER
000020                  P.CMST  = 16.                   ;COMMAND STATUS


                        ;GET UNIT STATUS E D 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.TRKS  = 36.                   ;TRACK SIZE
000046                  P.GRPS  = 38.                   ;GROUP SIZE
000050                  P.CYLS  = 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
000032                  P.MODEL = P.UNTI+6              ; Model Identifier
000033                  P.CLASS = P.UNTI+7              ; Class Identifier
000034                  P.MEDI  = 28.                   ;MEDIA TYPE IDENTIFIER
```

```
                                P.SHUN  = 32.                   ;SHADOW UNIT
                                P.SHST  = 34.                   ;SHADOW STATUS
                                P.UNSZ  = 36.                   ;UNIT SIZE
                                P.VSER  = 40.                   ;VOLUME SERIAL NUMBER


                                ;SET CONTROLLER CHARACTERISTICS END PACKET OFFSETS

                                P.VRSN  = 12.                   ;MSCP VERSION
                                P.CNTF  = 14.                   ;CONTROLLER FLAGS
                                P.CTMO  = 16.                   ;CONTROLLER TIMEOUT
                                P.CNCL  = 18.                   ;CONTROLLER COMMAND LIMIT
                                P.CNTI  = 20.                   ;CONTROLLER ID


                                ;GET DUST STATUS END PACKET OFFSETS

                                P.DEXT  = 12.                   ;EXTENSION FOR DOWNLINE LOADABLE PROGRAM
                                P.DFLG  = 15.                   ;FLAGS
                                P.DPRG  = 16.                   ;PROGRESS INDICATOR FOR REMOTE PROGRAM
                                P.DTMO  = 20.                   ;TIMEOUT
```

```
                                .SBTTL  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
000400          ST.AOL  = 400                   ;ALREADY ON-LINE

                ;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

                ;       Data error subcodes

000110          SB.HCE  =       110             ; Header compare error
000150          SB.DST  =       150             ; Data sync timeout
000350          SB.ECC  =       350             ; Uncorrectable ECC
```

```
                        .SBTTL  Controller table definitions
                        ;ONE TABLE WILL BE SET UP BY INITIALIZE SECTION FOR EACH xDA 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 CTLRTBL.
                        ;THE NUMBER OF TABLES IS CONTAINED IN CTRLRS.

000077                  CT.UNT  = 000077                ;LOGICAL UNIT NUMBER MASK
000777                  CT.VEC  = 000777                ;VECTOR ADDRESS MASK
007000                  CT.BRL  = 007000                ;BR LEVEL MASK

100000                  CT.AVL  = BIT15                 ;SET WHEN NOT AVAILABLE FOR TESTING
000040                  CT.U50  = BIT5                  ;CONTROLLER IS xDA50 IF SET/xDA52 IF CLEARED
000020                  CT.REQ  = BIT4                  ;BUFFER HAS BEEN GIVEN TO xDA FOR REQUEST
                                                        ;SET WHENEVER READ STUD DATA COMMAND GIVEN TO xDA
000010                  CT.MSG  = BIT3                  ;MESSAGE RESPONSE RECEIVED
                                                        ;WHENEVER THIS BIT IS SET, CT.CMD IS CLEARED
000004                  CT.CMD  = BIT2                  ;COMMAND ISSUED, WAITING FOR RESPONSE

000000                  C.UADR  = 0                     ;UNIBUS ADDRESS OF xDAIP REGISTER
000002                  C.VEC   = 2                     ;VECTOR ADDRESS/BR LEVEL
000004                  C.BST   = 4                     ;BURST LEVEL
000006                  C.DRVN  = 6                     ;DRIVE NUMBER TO TEST
000010                  C.JSR   = 10                    ;INTERRUPT SERVICE ROUTINE FOR CONTROLLER
000012                  C.JAD   = 12                    ;THESE TWO WORDS LOADED WITH [JSR R0    xDASRV]
000014                  C.FLG   = 14                    ;FLAGS
000016                  C.HCOM  = 16                    ;BEGINNING ADRS OF HOST COMM AREA IN MEMORY
000020                  C.DRVT  = 20                    ;POINTER TO DRIVE TABLE
000022                  C.TO    = 22                    ;TIMEOUT COUNTER
000024                  C.TOH   = 24                    ;  (TWO WORDS)
000026                  C.REF   = 26                    ;COMMAND REFERENCE NUMBER

000030                  C.SIZE  = 30                    ;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.

000077                          DT.UNT  = 000077                ; LOGICAL UNIT NUMBER OF DRIVE

100000                          DT.AVL  = BIT15                 ; SET WHEN NOT AVAILABLE FOR TESTING
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

000000                          D.PAT   = 0                     ;DATA PATTERN NUMBER
000002                          D.BB    = 2                     ;BAD BLOCK COUNT
000004                          D.BB01  = 4                     ;BAD BLOCK 1
000010                          D.BB02  = 10                    ;          2
000014                          D.BB03  = 14                    ;          3
000020                          D.BB04  = 20                    ;          4
000024                          D.BB05  = 24                    ;          5
000030                          D.BB06  = 30                    ;          6
000034                          D.BB07  = 34                    ;          7
000040                          D.BB08  = 40                    ;          8
000044                          D.BB09  = 44                    ;          9
000050                          D.BB10  = 50                    ;          10
000054                          D.BB11  = 54                    ;          11
000060                          D.BB12  = 60                    ;          12
000064                          D.BB13  = 64                    ;          13
000070                          D.BB14  = 70                    ;          14
000074                          D.BB15  = 74                    ;          15
000100                          D.BB16  = 100                   ;          16
```

```

000104      D.BEC   = 104          ;BEGIN/END SET COUNT
000106      D.BGN1  = 106          ;BEGIN BLOCK 1
000112      D.END1  = 112          ;END
000116      D.BGN2  = 116          ;BEGIN BLOCK 2
000122      D.END2  = 122          ;END
000126      D.BGN3  = 126          ;BEGIN BLOCK 3
000132      D.END3  = 132          ;END
000136      D.BGN4  = 136          ;BEGIN BLOCK 4
000142      D.END4  = 142          ;END
000146      D.BCYL  = 146          .BEGIN CYLINDER
000152      D.ECYL  = 152          ;END CYLINDER
000156      D.SERN  = 156          ;DRIVE SERIAL NUMBER

000164      D.SIZE  = 164          ;SIZE OF DRIVE TABLE IN BYTES
```

```
                                .SBTTL  Miscellaneous definitions

000620                          CACHESIZE       ==      400.            ; Number entries in Caching table
001000                          BLKSIZ  == 512.                         ; Number of bytes per block
000200                          GRPSIZ  == 128.                         ; ACCESS group size
000200                          ENTRYS  == 128.                         ; Number entries per RCT descriptor
```

```
                                .SBTTL  RCT Logical block 0 definitions

000000                          VOLSN   == 0                 ;Volume serial number   (LO WORD)
000010                          RFLAGS  == 10                ;Replacement flags
000014                          LBNLO   == 14                ;LBN being replaced     (LO WORD)
000020                          RBNLO   == 20                ;RBN replacement        (LO WORD)
000024                          BADRBN  == 24                ;Bad RBN                (LO WORD)
000030                          CACHID  == 30                ;Cache ID               (LO WORD)
000040                          INCARN  == 40                ;Cache incarnation no.  (LO WORD)
000044                          TIMDAT  == 44                ;VAX time and date      (LO WORD)


                                ;REPLACEMENT FLAG DEFINITIONS

000001                          WBC     == BIT0              ;Write-Back caching
000002                          VWP     == BIT1              ;Volume write protect
000200                          FEF     == BIT7              ;Forced Error flag
020000                          BRF     == BIT13             ;Bad RBN flag
040000                          P2      == BIT14             ;Phase 2 flag
100000                          P1      == BIT15             ;Phase 1 flag

```

```
                                .SBTTL  Global data section
                                ;
                                ;       Program data areas

002166                          L$ERRTBL::
002166  000000                  ERRTYP::        .WORD   0
002170  000000                  ERRNBR::        .WORD   0
002172  000000                  ERRMSG::        .WORD   0
002174  000000                  ERRBLK::        .WORD   0

002176  000000                  FFREE::         .WORD   0               ;FIRST FREE WORD IN MEMORY
002200  000000                  FSIZE::         .WORD   0               ;SIZE OF FREE MEMORY IN WORDS
002202  000000                  LOADFLG::       .WORD   0               ; Cleared by program load
002204  000000                  RTFLAG::        .WORD   0               ; Runtime flag
002206  000000                  CLKFLG::        .WORD   0               ; Set if KW11 present

                                ;       KW11 clock parameters

002210  000000                  KW.CSR: .WORD   0                       ;CSR OF CLOCK
002212  000000                  KW.BRL: .WORD   0                       ;BR LEVEL
002214  000000                  KW.VEC: .WORD   0                       ;VECTOR
002216  000000                  KW.HZ:  .WORD   0                       ;HERTZ (50. OR 60.)
002220  000000  000000          KW.EL:  .WORD   0,0                     ;ELAPSED TIME

002224  000000                  NXMAD:  .WORD   0                       ;SET TO ALL ONES BY NON-EXISTANT ADDRESS
002226  177777                  KTMEM:  .WORD   -1                      ;SET TO ALL ONES IF NO KT EXISTS


                                ;       UUT tables and pointers

002230                          CTLRLST::       .BLKW   10.             ; Controller address table list
002254                          CACHLST::       .BLKW   10.             ; Bad block caching table list
002300  000000                  TBLNDX::        .WORD   0               ; Table index
002302  000000                  PTABLE::        .WORD   0               ; PTABLE address ptr
002304  000000                  CTLRTBL::       .WORD   0               ; Address of current controller table
002306  000000                  DRIVTBL::       .WORD   0               ; Address of current drive table
002310  000000                  CACHTBL::       .WORD   0               ; Current caching table
002312  000000                  RCTTBL::        .WORD   0               ; RCT bad block address table

                                ;       SA register parameter storage

002314  000000                  SADDR::         .WORD   0               ; SA register address
002316  000000                  SAVAL::         .WORD   0               ; Saved SA value
002320  000000                  SAEXP::         .WORD   0               ; Expected SA value

002322  000000                  IPVAL::         .WORD   0               ; Saved IP value
```

```
                                ;
                                ;       Communications tables and pointers
                                ;
002324  000000                  HCOM::          .WORD   0               ; Address of host communication area
002326  000000                  CMDPCK::        .WORD   0               ; Address of command packet
002330  000000                  MSGPCK::        .WORD   0               ; Address of message packet
002332  000000                  INTRCV::        .WORD   0               ; Interrupt received flag
                                ;
002334  001000  000000          BCNT::          .WORD   BLKSIZ,0        ; Number of bytes to transfer
002340  042472                  UADR::          .WORD   DBUFF           ; contains UNIBUS buffer address
                                ;
                                ;       Command packet parameter storage
                                ;
002342  000000                  CMDREF::        .WORD   0               ; Command reference
002344  000000                  OPCODE::        .WORD   0               ; MSCP command
002346  000000                  CMDMOD::        .WORD   0               ; Command modifiers
                                ;
                                ;       End packet parameter storage
                                ;
002350  000000                  ENDREF::        .WORD   0               ; End packet reference
002352  000000                  ECODE::         .WORD   0               ; MSCP endcode
002354  000000                  EMSTAT::        .WORD   0               ; End msg status
002356  000000                  FLAGS::         .WORD   0               ; End msg flags
                                ;
                                ;       Error packet parameter storage
                                ;
002360  000000                  ERRREF::        .WORD   0               ; Error reference
002362  000000                  EVENT::         .WORD   0               ; Event code
002364  000000                  ERFLAG::        .WORD   0               ; Error msg flags
002366  000000                  ERRFMT::        .WORD   0               ; Error format
002370  000000                  EXTMSK::        .WORD   0               ; Extended error maskflags
                                ;
002372  000000                  ERLFMT::        .WORD   0               ; Error log format spec
002374  000000  000000          ERLLBN::        .WORD   0,0             ; Error log LBN
002400  000000  000000          HADDR::         .WORD   0,0             ; Error log host address
002404  000000                  DCODE::         .WORD   0               ; Drive error code
002406                          ERLDS::         .BLKW   4               ; Error log drive/status error info
                                ;
```

```
                                ;       Drive parameter area
                                ;
002416  000000                  RCTSIZ::        .WORD   0               ; Number of blocks in the RCT (w/ pad)
002420  000000                  TRKSIZ::        .WORD   0               ; Number of LBN'S per track
002422     000                  RBNS::          .BYTE   0               ; Number of REPLACEMENT BLOCKS per track
002423     000                  COPIES::        .BYTE   0               ; Number of copies of the RCT
002424  000000                  RCTCOPY::       .WORD   0               ; Current RCT copy
002426  000000                  RCTMASK::       .WORD   0               ; RCT bad copy mask
002430  000000  000000          UNSIZ::         .WORD   0,0             ; Number of blocks in of LBN space
                                                                        ; RCT start
002434  000000                  PRIMRY::.WORD   0                       ;primary replacement counter
002436  000000                  SCNDRY::.WORD   0                       ;secondary replacement counter
002440  000000                  UNUSE:: .WORD   0                       ;unusable replacement counter

002442  000000                  STATUS::        .WORD   0               ; Subroutine return value
002444  000000                  TMPSTAT::       .WORD   0               ; Multi-READ/WRITE temp status
002446  000000  000000          LBN::           .WORD   0,0             ;LBN being replaced
002452  000000  000000          RBN::           .WORD   0,0             ;RBN replacement
002456  000000  000000          RCTLBN::        .WORD   0,0             ; RCT LBN
002462  000000  000000          MATRBN::        .WORD   0,0             ;RBN which matched LBN being replaced
002466  000000                  RECOVR::        .WORD   0               ;recovery flag, Phase 1 or 2 recovery
                                                                        ; no recovery=0, recovery=1
002470  000000                  RDVALD::.WORD   0                       ; Valid data flag for READLBN
002472     000                  VIBUFF::.BYTE   0                       ;Valid image flag,
002473     000                  VBUFF1::.BYTE   0                       ;Valid buffer one flag,
002474     000                  VBUFF2::.BYTE   0                       ;Valid buffer two flag,
002475     000                  ERRCNT::.BYTE   0                       ;error count
                                        .EVEN

002476  000000                  RCTBLK::.WORD   0                       ;RCT logical block
002500  000000                  MATBLK::.WORD   0                       ;RCT logical block for matched LBN
002502  000000                  RCTOFF::.WORD   0                       ;RBN offset within RCT logical block
002504  000000                  MATOFF::.WORD   0                       ;RBN offset within RCT logical block
                                                                        ;for matched LBN
002506  000000                  STROFF::.WORD   0                       ;starting offset within RCT block
002510  000000                  DELTA:: .WORD   0                       ;change in offset while for RBN search
002512     000                  EMPTY:: .BYTE   0                       ;empty flag
002513     000                  RESCAN::.BYTE   0                       ;re-scan flag
002514     000                  MATFLG::.BYTE   0                       ;match status,
                                                                        ; 0=No match for LBN being replaced
                                                                        ; 1=RBN in 'MATRBN' was match for LBN
                                                                        ;   being replaced
002515     000                  SFLAG:: .BYTE   0                       ;search status,
                                                                        ; 0=Primary empty
                                                                        ; 1=Secondary empty
                                                                        ; 2=Full table (no match)
                                        .EVEN


                                ;       LBNSTAT: LBN status word

        000001                  TF.FER  =:      BIT0                    ; FER
        000002                  TF.HCE  =:      BIT1                    ; HCE
        000004                  TF.DST  =:      BIT2                    ; DST
        000010                  TF.ECC  =:      BIT3                    ; ECC
        000020                  TF.SEX  =:      BIT4                    ; EF.SEX
```

Global data section

```
                        TF.LOG  ==      BIT5                    ; EF.LOG
                        TF.BBU  ==      BIT6                    ; EF.BBU
                        TF.BBR  =       BIT7                    ; EF.BBR
                        TF.WFE  ==      BIT8                    ; WFE
                        TF.BAD  ==      BIT15                   ; Set if image is inval'd

002516  000000          LBNSTAT::       .WORD   0               ; LBN status word
002520  000000          RPLSTAT::       .WORD   0               ; Replacement status
002522  000000          LBNDX::         .WORD   0               ; LBN descriptor index
002524  000000          RDSTAT::        .WORD   0               ; READLBN read status
002526  000000          WRSTAT::        .WORD   0               ; READLBN write status

002530  000000          FERCNT::        .WORD   0               ; FER count
002532  000000          HCECNT::        .WORD   0               ; HCE count
002534  000000          DSTCNT::        .WORD   0               ; DST error count
002536  000000          ECCCNT::        .WORD   0               ; Uncorrectable ECC count
002540  000000          BBRCNT::        .WORD   0               ; BBR count
002542  000000          WFECNT::        .WORD   0               ; WRITE Forced error count


002544  000000          STEP::          .WORD   0               ; Current STEP value
002546  000000          NXTSTEP::       .WORD   0               ; Next STEP value
002550  000000          ERRSTEP::       .WORD   0               ; Error STEP indicator
002552  000000          BASEMSG::       .WORD   0               ; Error message address
002554  000000          INCRLBN::       .WORD   0               ; LBN Increment
002556  000000          RDCNT::         .WORD   0               ; Reread counter
002560  000000          PHASE::         .WORD   0               ; Replacement phase

002562  000000  000000  GLBN::          .WORD   0,0             ; ACCESS group LBN
002566  000000  000001  GBCNT::         .WORD   0,1             ; ACCESS group byte count
002572  000200          BLKCNT::        .WORD   GRPSIZ          ; ACCESS block count
002574  000000  000000  ACCESS::        .WORD   0,0             ; ACESS number
002600  000000  000000  MINLBN::        .WORD   0,0             ; Lowest LBN
002604  000000  000000  MAXLBN::        .WORD   0,0             ; Highest LBN
002610  000000          REPEAT::        .WORD   0               ; Flag endless loop
002612  000000          ONLINE::        .WORD   0               ; Flags unit online
002614  000000          BUSFLAG::       .WORD   0               ; Bus type flag
                                                                ; 0=UNIBUS, 1=QBUS
002616  000000          VSNPTR::        .WORD   0               ; Ptr to VSN text
002620                  VSNBUF::        .BLKB   24.             ; VSN text


```

```
                                .SBTTL  Operator interface parameters
                        
002650  000000          DEBUG:: .WORD   0                       ; Debug flag
002652  000000          BACKUP::.WORD   0                       ; Backup flag
                        
002654                  REPLY:: .BLKB   12                      ; Reply
                        
002666                  TTYIN:: .BLKW   12                      ;TTY CHARACTER INPUT BUFFER
002712  000000          CMDIN:: .WORD   0                       ;COMMAND CHARACTER INPUT BUFFER
002714  000000          OPTIN:: .WORD   0                       ;OPTION CHARACTER INPUT BUFFER
                        
002716                  LINBUF:         .BLKB   128.            ; Print buffer
                        
                        
```

```
                                .SBTTL  SA register error parameters
                                ;
                                ;       SA register error equates
                                ;
000001                          B.SADDR =       BIT0                    ; Print SA address
000002                          B.SAVAL =       BIT1                    ; Print SA contents
000004                          B.SAEXP =       BIT2                    ; Print SA expected value
                                ;
                                ;       SA register msg table
                                ;
003116                          SARMSG::
003116  003165                          .WORD   XSADDR                  ; "SA address:   xxxxxx"
003120  003136                          .WORD   XSAVAL                  ; "SA contents:  xxxxxx"
003122  003214                          .WORD   XSAEXP                  ; "SA expected:  xxxxxx"
003124  000000                          .WORD   0                       ; terminator
                                ;
                                ;       SA register value table
                                ;
003126                          SARVAL::
003126  002314                          .WORD   SADDR                   ; SA address
003130  002316                          .WORD   SAVAL                   ; Actual value
003132  002320                          .WORD   SAEXP                   ; Expected value
003134  000000                          .WORD   0                       ; terminator
                                ;
                                ;       SA register error extended text
                                ;
                                        .NLIST  BEX
003136  116  042  040  XSAVAL: .ASCIZ  /N"  SA contents:  "016/
003165  116  042  040  XSADDR: .ASCIZ  /N"  SA address:   "016/
003214  116  042  040  XSAEXP: .ASCIZ  /N"  SA expected:  "016/
                                        .LIST   BEX
                                        .EVEN
```

```
                                .SBTTL  Drive model parameters

                        000000  M.UNKN          =       0
                        000001  M.RA80          =       1
                        000004  M.RA60          =       4
                        000005  M.RA81          =       5
                        000013  M.RA82          =       11.

003244  000000         MODEL:          .WORD   0       ; Unit model no.
003246  000000         MDLNDX:         .WORD   0       ; Index to model table

003250                 MDLTBL:
003250  000000                 .WORD   M.UNKN          ; "Unknown"
003252  000001                 .WORD   M.RA80          ; "RA80"
003254  000004                 .WORD   M.RA60          ; "RA60"
003256  000005                 .WORD   M.RA81          ; "RA81"
003260  000013                 .WORD   M.RA82          ; "RA82"

                        000012  MDLSIZ  =       .-MDLTBL

003262                 MDLTEXT:
003262  003274                 .WORD   UNKNOWN                 ; 0 "Unknown"
003264  003304                 .WORD   RA80                    ; 1 "RA80"
003266  003311                 .WORD   RA60                    ; 4 "RA60"
003270  003316                 .WORD   RA81                    ; 5 "RA81"
003272  003323                 .WORD   RA82                    ; 11 "RA82"

                               .NLIST  BEX
003274    125   116   113  UNKNOWN:        .ASCIZ          /UNKNOWN/
003304    122   101   070  RA80:          .ASCIZ          /RA80/
003311    122   101   066  RA60:          .ASCIZ          /RA60/
003316    122   101   070  RA81:          .ASCIZ          /RA81/
003323    122   101   070  RA82:          .ASCIZ          /RA82/
                               .LIST   BEX
                               .EVEN
```

```
                                .SBTTL  MSCP error message parameters

                                ;       MSCP error equates

000001                          B.CMDRF =       BIT0                    ; Print cmd ref number
000002                          B.CODE  =       BIT1                    ; Print opcode
000004                          B.MOD   =       BIT2                    ; Print cmd modifiers
000010                          B.EMREF =       BIT3                    ; Print end msg ref
000020                          B.ECODE =       BIT4                    ; Print endcode
000040                          B.FLAGS =       BIT5                    ; Print end flags
000100                          B.ESTAT =       BIT6                    ; Print end msg status

000140                          B.MSCP  =       B.FLAGS+B.ESTAT

                                ;       MSCP extended msg table

003330                          MSCPMSG::
003330  003370                          .WORD   XCMDRF                  ; "Command ref:     xxxxxx"
003332  003421                          .WORD   XCODE                   ; "MSCP command:       xxx"
003334  003454                          .WORD   XMOD                    ; "Cmd modifiers:   xxxxxx"
003336  003506                          .WORD   XENDRF                  ; "Endmsg ref:      xxxxxx"
003340  003537                          .WORD   XECODE                  ; "MSCP endcode:       xxx"
003342  003572                          .WORD   XFLAGS                  ; "Endmsg flags:       xxx"
003344  003625                          .WORD   XESTAT                  ; "Endmsg status:   xxxxxx"
003346  000000                          .WORD   0                       ; terminator

                                ;       MSCP extended value table

003350                          MSCPVAL::
003350  002342                          .WORD   CMDREF                  ; Command reference number
003352  002344                          .WORD   OPCODE                  ; MSCP command
003354  002346                          .WORD   CMDMOD                  ; Command modifiers
003356  002350                          .WORD   ENDREF                  ; End msg reference number
003360  002352                          .WORD   ECODE                   ; End code
003362  002356                          .WORD   FLAGS                   ; End msg flags
003364  002354                          .WORD   EMSTAT                  ; End msg status
003366  000000                          .WORD   0                       ; terminator

                                ;       MSCP extended error text

                                        .NLIST  BEX
003370  116     042     040     XCMDRF: .ASCIZ  /N"  Command ref:     "016/
003421  116     042     040     XCODE:  .ASCIZ  /N"  MSCP command:       "08/
003454  116     042     040     XMOD:   .ASCIZ  /N"  Cmd modifiers:   "016N/
003506  116     042     040     XENDRF: .ASCIZ  /N"  Endmsg ref:      "016/
003537  116     042     040     XECODE: .ASCIZ  /N"  MSCP endcode:       "08/
003572  116     042     040     XFLAGS: .ASCIZ  /N"  Endmsg flags:       "08/
003625  116             XESTAT: .ASCII  /N/
003626  042     040     040     XSTAT:  .ASCIZ  /"  Endmsg status:   "016N2/
                                .LIST   BEX
                                        .EVEN
```

```
                                .SBTTL  RCT error message parameters

                                ;       RCT error equates

          00000'                B.BLOCK =       BIT0                    ; Print Block number
          000002                B.COPY  =       BIT1                    ; Print copy number
          000004                B.PHASE =       BIT2                    ;

          000003                B.RCT   =       B.BLOCK!B.COPY          ; RCT error bits

                                ;       RCT extended msg table

003660                          RCTMSG::
003660  003700                          .WORD   XBLOCK                  ; "RCT Block no:   ddd"
003662  003732                          .WORD   XCOPY                   ; "RCT copy:       ddd"
003664  003764                          .WORD   XPHASE                  ; "Replacement phase:  ddd"
003666  000000                          .WORD   0                       ; terminator

                                ;       RCT extended value table

003670                          RCTVAL::
003670  002476                          .WORD   RCTBLK                  ; "Block no:  ddd"
003672  002424                          .WORD   RCTCOPY                 ; "RCT copy:  ddd"
003674  002466                          .WORD   RECOVR                  ; "Replacement phase:  ddd"
003676  000000                          .WORD   0                       ; terminator

                                        .NLIST  BEX
003700    116   042   040   XBLOCK:     .ASCIZ  /N"  RCT block no: "D16"."/
003732    116   042   040   XCOPY:      .ASCIZ  /N"  RCT copy:     "D16"."/
003764    116   042   040   XPHASE:     .ASCIZ  /N"  Replacement phase: "D16/
                                        .LIST   BEX
                                        .EVEN
```

```
                                .SBTTL  Errorlog error message parameters
                                ;       Errorlog messages and equates

000001                          B.EVNT  =       BIT0                    ; Print status/event
000002                          B.HADDR =       BIT1                    ; Print host address
000004                          B.DCODE =       BIT2                    ; Print drive error code
000010                          B.DERR  =       BIT3                    ; Print drive error info

                                ;       Errorlog extended msg table

004020                          ERLMSG::
004020  004034                          .WORD   XEVENT                  ; "Status/event: xxxxxx"
004022  004063                          .WORD   XHADDR                  ; "Host address: xxxxxx"
004024  000000                          .WORD   0                       ; terminator

                                ;       Errorlog extended value table

004026                          ERLVAL::
004026  002362                          .WORD   EVENT                   ; Event code
004030  002400                          .WORD   HADDR                   ; Host address
004032  000000                          .WORD   0                       ; terminator

                                ;       Errorlog extended error text

                                        .NLIST  BEX
004034      116                 XEVENT: .ASCII  /N/
004035      042     040     040 XEVNT:  .ASCIZ  \"  Status/event: "016\
004063      116     042     040 XHADDR: .ASCIZ  /N"  Host address: "032/
004112      116     042     040 XDCODE: .ASCIZ  /N"  Drive error code (hex): "H8/
004152      116     042     040 XDINFO: .ASCIZ  \N"  Drive status/error info (hex): "\
004217      042     040     042 XDHEX:  .ASCIZ  /" "H8/
                                        .LIST   BEX
                                        .EVEN
```

Errorlog error message parameters

```
                                
                        000000          NDX.RD  =       0                       ; Index to READ
                        000001          NDX.WR  =       1                       ; Index to WRITE
                        000002          NDX.ACC =       2                       ; Index to ACCESS
                        000003          NDX.RPL =       3                       ; Index to REPLACE
                                
004226                                  MSCPNDX:
004226  000000                                  .WORD   0                       ; Index to msg ptr
                                
004230                                  MSCPTBL:
004230  004242                                  .WORD   XREAD                   ; "READ"
004232  004250                                  .WORD   XWRITE                  ; "WRITE"
004234  004257                                  .WORD   XACCESS                 ; "ACCESS"
004236  004267                                  .WORD   XREPLACE                ; "REPLACE"
004240  000000                                  .WORD   0                       ; Terminator
                                
                                                .NLIST  BEX
004242      122     105     101 XREAD:          .ASCIZ  /READ /
004250      127     122     111 XWRITE:         .ASCIZ  /WRITE /
004257      101     103     103 XACCESS:        .ASCIZ  /ACCESS /
004267      122     105     120 XREPLACE:       .ASCIZ  /REPLACE /
                                                .LIST   BEX
                                                .EVEN
```

```
                                .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
                                ;
004300                          L$DVTYP::
004300  114     157     147             .ASCIZ  %Logical disk drive%
                                        .EVEN

                                ; TEST DESCRIPTION
                                ;
004324                          L$DESC::
004324  102     141     144             .ASCIZ  /Bad Block Replacement Utility/
                                        .EVEN
                                ; FORMAT STATEMENTS USED IN PRINT CALLS
                                ;
```

```
                                        .SBTTL  Informational message text
                                        ;       Configuration information messages
 004362     116     062     042  INF100: .ASCII  /N2"BAD BLOCK REPLACEMENT UTILITY."/
 004424     116     062     042          .ASCII  /N2"WARNING:  All drives configured for test"/
 004500     116     042     115          .ASCIZ  /N"MUST have customer data backed-up."/

 004546     116     042     114  INF101: .ASCIZ  /N"Line clock not available."/

 004603     116     042     111  INF102: .ASCII  /N"It is recommended that you read the operator help"/
 004667     116     042     151          .ASCIZ  /N"information before proceeding."/

 004731     116     062     042  INF103: .ASCIZ  /N2"Restore customer data to drive after last pass."N/

                                        ;       Initialization information messages

 005016     116     064     042  INF110: .ASCII  /N4"INITIALIZATION INFORMATION FOR UNIT "D8/
 005070     116     042     040          .ASCII  /N"  Controller:   "A/
 005113     116     042     040          .ASCII  /N"  Address:      "O16/
 005140     116     042     040          .ASCIZ  /N"  Drive:        "D8/

 005165     116     042     040  INF111: .ASCII  /N"  Drive type:  "A/
 005210     116     042     040          .ASCII  /N"  Volume SN:   "A"."/
 005236     116     042     040          .ASCIZ  /N"  Volume size: "D32"."N2/

                                        ;       End of pass information messages

 005271     116     062     042  INF200: .ASCIZ  /N2"REPLACEMENT INFORMATION FOR THIS PASS"/
 005343     116     062     042  INF201: .ASCII  /N2"  BAD BLOCKs reported:          "D16"."/
 005414     116     042     040          .ASCII  /N"  Header compare errors:        "D16"."/
 005464     116     042     040          .ASCII  /N"  Data sync timeout errors:     "D16"."/
 005534     116     042     040          .ASCII  /N"  Uncorrectable ECC errors:    "D16"."/
 005604     116     042     040          .ASCII  /N"  FORCED ERROR flags detected: "D16"."/
 005654     116     042     040          .ASCIZ  /N"  FORCED ERROR flags written:  "D16"."/
 005725     116     062     042  INF202: .ASCII  /N2"  PRIMARY   replacements:      "D15"."/
 005776     116     042     040          .ASCII  /N"  SECONDARY replacements:      "D16"."/
 006046     116     042     040          .ASCII  /N"  RBN's marked UNUSABLE:       "D16"."/
 006116     116     042     040          .ASCIZ  /N"  Total blocks replaced:       "D16"."N/

                                        ;       RCT descriptor information messages

 006170     116     062     042  INF210: .ASCIZ  /N2"RCT DESCRIPTOR INFORMATION FOR UNIT "D8N/
 006244     116     042     122  INF211: .ASCIZ  /N"RBN:"D28". is PRIMARY   replacement for LBN:"D28"."/
 006332     116     042     122  INF212: .ASCIZ  /N"RBN:"D28". is SECONDARY replacement for LBN:"D28"."/
 006420     116     042     122  INF213: .ASCIZ  /N"RBN "D28". is UNUSABLE"/

 006452     116     062     042  INF220: .ASCIZ  /N2"RCT DESCRIPTOR SUMMARY FOR THIS UNIT"/
 006523     116     042     040  INF221: .ASCII  /N"  PRIMARY   replacement blocks: "D16"."/
 006574     116     042     040          .ASCII  /N"  SECONDARY replacement blocks: "D16"."/
 006645     116     042     040          .ASCII  /N"  UNUSABLE  replacement blocks: "D16"."/
 006716     116     042     040          .ASCIZ  /N"  "D16". RBNs used out of "D16". RBNs on media."N/
```

Informational message text

```
                                        ;       Automatic BBR information
                                        ;
 007002     116     062     042  INF301: .ASCIZ  /N2"SCANNING RCT..."N/
 007027     116     062     042  INF302: .ASCIZ  /N2"SCANNING LBN AREA..."N/
 007061     116     062     042  INF310: .ASCIZ  /N2"MANUAL BAD BLOCK REPLACEMENT SELECTED."N/
 007135     116     062     042  INF311: .ASCIZ  /N2"  EOF detected.    "/
 007164     116     062     042  INF320: .ASCIZ  /N2"AUTOMATIC BAD BLOCK REPLACEMENT SELECTED."/
 007242     116     062     042  INF321: .ASCII  /N2"  LBN Status codes:"/
 007271     116     042     040          .ASCII  /N"  BBR - Bad Block reported."/
 007327     116     042     040          .ASCII  /N"  ECH - Hard ECC Error encountered."/
 007375     116     042     040          .ASCII  /N"  HCE - Header Compare Error encountered."/
 007451     116     042     040          .ASCII  /N"  DST - Data Sync Timeout encountered."/
 007522     116     042     040          .ASCII  /N"  FER - Forced Error encountered."/
 007566     116     042     040          .ASCIZ  /N"  WFE - Block written with FE."/
 007630     116     062     042  INF322: .ASCII  /N2"  RBN Operation types:"/
 007662     116     042     040          .ASCII  /N"  PRI - Primary replacement for LBN."/
 007731     116     042     040          .ASCII  /N"  SEC - Secondary replacement for LBN."/
 010002     116     042     040          .ASCIZ  /N"  UNS - RBN marked Unusable."N/
 010043     116     042     040  INF323: .ASCIZ  /N"  LBN:"D28".  "/
 010065     116     062     042  INF324: .ASCIZ  /N2"  EOM reached.    "/

                                        ;       Replacement information messages

 010114     116     042     040  INF401: .ASCIZ  /N"  RCT copy "D16", block "D16" ("D28".)"/

 010166     116     042     040  INF405: .ASCIZ  /N"  LBN:"D28"."/
 010206     042     040     040  INF406: .ASCIZ  /"  Status: "A/
 010224     042     040     040  INF407: .ASCIZ  /"  RBN:"D28"."/
 010243     042     040     040  INF408: .ASCIZ  /"  Operation: "A/

                                        ;       RCT information messages
                                        ;
 010264     116     062     042  INF601: .ASCIZ  /N2"Attempting Recovery..."N/
 010320     116     062     042  INF602: .ASCIZ  /N2"RCT Recovery failed; MEDIA INTEGRITY UNCERTAIN."N/
 010405     116     062     042  INF603: .ASCIZ  /N2"Attempting to find another replacement block..."N/

```

```
                                        .SBTTL  Error messege text


                                        ;       Program initialization messages

 010472     120     122     117  HDR001: .ASCIZ  /PROGRAM INITIALIZATION ERROR/
 010527     116     042     106  ERM001: .ASCII  /N"Failed dynamic storage allocation for Unit "D3";"/
 010612     116     042     040          .ASCIZ  /N"  Restart program and select fewer Units."/

                                        ;       Controller initialization messages

 010667     103     117     116  HDR101: .ASCIZ  /CONTROLLER INITIALIZATION ERROR/
 010727     116     042     101  ERM101: .ASCII  /N"Address error occured while accessing contoller register;"/
 011023     116     042     040          .ASCIZ  /N"  Check contoller address."/
 011061     116     042     105  ERM102: .ASCIZ  /N"Error detected during controller initialization;"/
 011145     116     042     103  ERM103: .ASCIZ  /N"Controller did not clear ring structure in host memory;"/
 011240     116     042     123  ERM104: .ASCIZ  /N"SA register not zero after step 3 write;"/

                                        ;       Unit initialization errors

 011314     125     116     111  HDR201: .ASCIZ  /UNIT INITIALIZATION ERROR/
 011346     116     042     106  ERM201: .ASCII  /N"Failed GET UNIT STATUS command;"/
 011410     116     042     040          .ASCIZ  /N"  Drive "D8" is not accessable."/
 011453     116     042     106  ERM202: .ASCII  /N"Failed SET CONTROLLER CHARACTERISTICS command;"/
 011534     116     042     040          .ASCII  /N"  Host access timeout not disabled."/
 011602     116     042     040          .ASCII  /N"  Default timeout is 60 seconds."/
 011645     116     042     040          .ASCIZ  /N"  Error log packets not enabled."/
 011711     116     042     106  ERM203: .ASCIZ  /N"Failed ONLINE command;"/
 011743     116     042     132  ERM204: .ASCII  /N"Zero RCT size detected;"/
 011775     116     042     040          .ASCIZ  /N"  BBR not supported by this drive."/

                                        ;       MSCP cmd/msg error messages

 012043     115     123     103  HDR301: .ASCIZ  /MSCP STATUS ERROR DETECTED/
 012076     116     042     106  ERM300: .ASCIZ  /N"Failed "A"command; LBN:"D28"."/
 012137     116     042     106  ERM301: .ASCIZ  /N"Failed READ command; LBN:"D28"."/
 012202     116     042     106  ERM302: .ASCIZ  /N"Failed WRITE command; LBN:"D28"."/
 012246     116     042     106  ERM303: .ASCIZ  /N"Failed ACCESS command; LBN:"D28"."/
 012313     116     042     106  ERM304: .ASCIZ  /N"Failed REPLACE command; LBN:"D28"."/
 012361     116     042     106  ERM305: .ASCII  /N"Failed replacement verification; LBN:"D28"."/
 012437     116     042     040          .ASCIZ  /N"  Retry of replacement operation will be attempted."/
 012526     116     042     103  ERM306: .ASCIZ  \N"Command/message reference number mismatch; LBN:"D28"."\
 012617     116     042     125  ERM307: .ASCIZ  /N"Unrecognized endcode; LBN:"D28"."/

```

```
 1
 2                                      ;       Controller communication errormessages
 3
 4 012663     110     117     123  HDR401: .ASCIZ  \HOST/CONTROLLER COMMUNICATION ERROR\
 5 012727     116     042     116  ERM401: .ASCIZ  /N"No interrupt received for 30 seconds;"/
 6 013000     116     042     106  ERM402: .ASCIZ  /N"Fatal error reported in SA register;"/
 7 013050     116     042     123  ERM403: .ASCIZ  /N"Serious exception reported;"/
 8
 9                                      ;       Program errors
10
11 013107     120     162     157  HDR501: .ASCIZ  /Program error/
12 013125     116     042     115  ERM501: .ASCIZ  /N"Media overrun detected; LBN:"D28"."/
13
14                                      ;       RCT read/write errors
15
16 013173     122     103     124  HDR601: .ASCIZ  /RCT ERROR DETECTED/
17 013216     116     042     106  ERM601: .ASCIZ  /N"Failed RCT READ;"/
18 013242     116     042     106  ERM602: .ASCIZ  /N"Failed RCT WRITE;"/
19 013267     116     042     106  ERM603: .ASCIZ  /N"Failed READ of all copies of RCT;"/
20 013334     116     042     106  ERM604: .ASCIZ  /N"Failed WRITE to all copies of RCT;"/
21 013402     116     042     103  ERM605: .ASCIZ  /N"Crash occured during previous replacement operation;"/
22 013472     116     042     116  ERM606: .ASCII  /N"No NULL descriptor entry found in RCT;"/
23 013543     116     042     040          .ASCIZ  /N"  RCT is probably corrupt; REFORMAT MEDIA."/
24 013621     116     042     124  ERM607: .ASCII  /N"Transient error table overflow;"/
25 013663     116     042     040          .ASCIZ  /N"  ADDITIONAL MAINTENANCE REQUIRED."/
26
27                                      ;       Error log messages
28
29 013731     105     122     122  HDR701: .ASCIZ  /ERROR LOG PACKET RECEIVED/
30 013763     116     042     125  ERM700: .ASCIZ  /N"Unrecognized Errorlog format;"/
31 014024     116     042     103  ERM701: .ASCIZ  /N"Controller Error reported;"/
32 014062     116     042     110  ERM702: .ASCIZ  /N"Host Memory Access Error reported;"/
33 014130     116     042     123  ERM703: .ASCIZ  /N"SDI Error reported;"/
34 014157     116     042     123  ERM704: .ASCIZ  /N"Small Disk Error reported;"/
35
```

```
                                .SBTTL  Formatted text
                                ;
                                ;       Information text
                                ;
014215  045     116     000     F.CRLF: .ASCIZ  /%N/                    ; FAO New line
014220  045     124     000     F.TEXT: .ASCIZ  /%T/                    ; FAO Text
                                ;
014223  101     000             FMT.ASC:.ASCIZ  /A/                     ; FAO .ASCIZ
                                ;
014225  125     104     101     DEVNAME:.ASCIZ  /UDA/                   ; Controller name
014231  116     000             CRLF:   .ASCIZ  /N/
014233  042     040     040     RNTIM:  .ASCIZ  /"  Elapsed runtime "D16":"/
014266  104     071     042     RNTIM1: .ASCIZ  /D9":"/
014274  104     071     000     RNTIM2: .ASCIZ  /D9/
014277  042     040     077     LMT28:  .ASCIZ  /" ?Exceeded 28 bit input limit"N/
014340  042     040     077     INVCHR: .ASCIZ  /" ?Invalid character"N/
014367  116     042     114     OLIMIT: .ASCIZ  /N"Limits:  LO= 0;  HI= "D32"."N/
014427  116     042     105     ERRME1: .ASCIZ  /N"Error processing message string"N/
014473  116     042     115     MANDIS: .ASCIZ  /N"Manual intervention is disabled"N/
014537  116     042     040     XRCT:   .ASCIZ  /N"  RCT block number: "D16"."/
014575  116     042     040     XLBN:   .ASCIZ  /N"  LBN:"D28"."/
014615  116     042     040     XRBN:   .ASCIZ  /N"  RBN:"D28"."/
014635  116     042     040     XSTEP:  .ASCIZ  /N"  Replacement STEP: "D8"."/
                                .EVEN
                                ;
                                ; Unformatted text
                                ;
014672  132     125     104     HLPFILE:.ASCIZ  /ZUDLA0.HLP/
                                ;
014705  105     156     164     TXT000: .ASCIZ  /Enter LBN to be replaced (D) or <CR> to exit/
014762  122     102     116     TXT001: .ASCIZ  /RBN /
014767  114     102     116     TXT002: .ASCIZ  /LBN /
014774  105     156     164     TXT005: .ASCIZ  /Enter starting group LBN (D)/
015031  101     164     164     TXT006: .ASCIZ  /Attempt crash recovery/
                                ;
015060  105     156     164     TX.LB1: .ASCIZ  /Enter first LBN/
015100  105     156     164     TX.LB2: .ASCIZ  /Enter last LBN/
                                ;
015117  120     122     111     TX.PRI:         .ASCIZ  /PRI /
015124  123     105     103     TX.SEC:         .ASCIZ  /SEC /
015131  125     116     123     TX.UNS:         .ASCIZ  /UNS /
015136  106     105     122     TX.FER:         .ASCIZ  /FER /
015143  105     103     110     TX.ECH:         .ASCIZ  /ECH /
015150  102     102     122     TX.BBR:         .ASCIZ  /BBR /
015155  102     102     125     TX.BBU:         .ASCIZ  /BBU /
015162  123     105     130     TX.SEX:         .ASCIZ  /SEX /
015167  114     117     107     TX.LOG:         .ASCIZ  /LOG /
015174  040     040     040     TX.BLK:         .ASCIZ  /   /
015201  127     106     105     TX.WFE:         .ASCIZ  /WFE /
015206  110     103     105     TX.HCE:         .ASCIZ  /HCE /
015213  104     123     124     TX.DST:         .ASCIZ  /DST /
                                .EVEN
```

SEQ 0075

```
                        .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.
                        ;--
```

```
                                .SBTTL  Error processing routines
                                ;
                                ;ERR001:  General case error routine
                                ;
                                ;         Prints basic error msg from BASEMSG with Drive number
                                ;
015220                          ERR001::
                                ;
015220  010146                          MOV     R1,-(SP)                ;;PUSH R1 ON STACK
                                ;
015222  013701  002304                  MOV     CTLRTBL,R1              ; Load controller table ptr
015226  016546  000006                  MOV     C.DRVN(R5),-(SP)                ;PUSH C.DRVN(R5) ON STACK
015232  013746  002552                  MOV     BASEMSG,-(SP)           ;PUSH BASEMSG ON STACK
015236  004137  033254                  JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
015242  000004                          .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
015244  013746  002354                  MOV     EMSTAT,-(SP)            ;PUSH EMSTAT ON STACK
015250  012746  003625                  MOV     #XESTAT,-(SP)           ;PUSH #XESTAT ON STACK
015254  004137  033254                  JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
015260  000004                          .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
                                ;
015262  012601                          MOV     (SP)+,R1                ;;POP STACK INTO R1
015264                          L10002:
015264  104423                          TRAP    C$MSG
                                ;
                                ;ERR101:  Controller initialization error routine
                                ;
                                ;         Prints Basic msg in BASEMSG
                                ;         Prints extended SA register info
                                ;
015266                          ERR101::
                                ;
015266  010146                          MOV     R1,-(SP)                ;;PUSH R1 ON STACK
015270  010246                          MOV     R2,-(SP)                ;;PUSH R2 ON STACK
015272  010346                          MOV     R3,-(SP)                ;;PUSH R3 ON STACK
                                ;
015274  013746  002552                  MOV     BASEMSG,-(SP)           ;PUSH BASEMSG ON STACK
015300  004137  033254                  JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
015304  000002                          .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
                                ;
015306  012702  003116                  MOV     #SARMSG,R2              ; Load text table ptr
015312  012703  003126                  MOV     #SARVAL,R3              ; Load value table ptr
015316  004737  016042                  JSR     PC,CALR1                ; Print extended info
                                ;
015322  012603                          MOV     (SP)+,R3                ;;POP STACK INTO R3
015324  012602                          MOV     (SP)+,R2                ;;POP STACK INTO R2
015326  012601                          MOV     (SP)+,R1                ;;POP STACK INTO R1
                                ;
015330  000167                          .WORD   J$JMP
015332  000000                          .WORD   L10003-2-.
                                ;
015334                          L10003:
015334  104423                          TRAP    C$MSG
                                ;
```

Error processing routines

```
                                ;ERR201:  Unit initialization error routine
                                ;
                                ;         Prints basic msg in BASEMSG
                                ;         Prints extended end message info
                                ;
015336                          ERR201::
                                ;
015336  010146                          MOV     R1,-(SP)                ;;PUSH R1 ON STACK
015340  010246                          MOV     R2,-(SP)                ;;PUSH R2 ON STACK
015342  010346                          MOV     R3,-(SP)                ;;PUSH R3 ON STACK
                                ;
015344  013746  002552                  MOV     BASEMSG,-(SP)           ;PUSH BASEMSG ON STACK
015350  004137  033254                  JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
015354  000002                          .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
                                ;
015356  012702  003330                  MOV     #MSCPMSG,R2             ; Load text table ptr
015362  012703  003350                  MOV     #MSCPVAL,R3             ; Load value table ptr
015366  004737  016042                  JSR     PC,CALR1                ; Print MSCP info
                                ;
015372  012603                          MOV     (SP)+,R3                ;;POP STACK INTO R3
015374  012602                          MOV     (SP)+,R2                ;;POP STACK INTO R2
015376  012601                          MOV     (SP)+,R1                ;;POP STACK INTO R1
                                ;
015400  000167                          .WORD   J$JMP
015402  000000                          .WORD   L10004-2-.
                                ;
015404                          L10004:
015404  104423                          TRAP    C$MSG
                                ;
                                ;ERR300:  General MSCP error routine
                                ;
                                ;         Prints ERM300 with MSCP operation text ptr in MSCPNDX and LBN
                                ;         Prints extended end message info
                                ;
015406                          ERR300::
                                ;
015406  010146                          MOV     R1,-(SP)                ;;PUSH R1 ON STACK
015410  010246                          MOV     R2,-(SP)                ;;PUSH R2 ON STACK
015412  010346                          MOV     R3,-(SP)                ;;PUSH R3 ON STACK
                                ;
015414  013701  004226                  MOV     MSCPNDX,R1              ; Load index
015420  042701  177774                  BIC     #^C3,R1                 ; Clear illegal values
015424  006301                          ASL     R1                      ; Shift left
                                ;
015426  013746  002450                  MOV     LBN+2,-(SP)             ;PUSH LBN+2 ON STACK
015432  013746  002446                  MOV     LBN,-(SP)               ;PUSH LBN ON STACK
015436  016146  004230                  MOV     MSCPTBL(R1),-(SP)               ;PUSH MSCPTBL(R1) ON STACK
015442  012746  012076                  MOV     #ERM300,-(SP)           ;PUSH #ERM300 ON STACK
015446  004137  033254                  JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
015452  000010                          .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
                                ;
015454  012702  003330                  MOV     #MSCPMSG,R2             ; Load text table ptr
015460  012703  003350                  MOV     #MSCPVAL,R3             ; Load value table ptr
015464  004737  016042                  JSR     PC,CALR1                ; Print MSCP info
                                ;
015470  012603                          MOV     (SP)+,R3                ;;POP STACK INTO R3
```

```
    015472  012602                          MOV     (SP)+,R2                ;;POP STACK INTO R2
    015474  012601                          MOV     (SP)+,R1                ;;POP STACK INTO R1
 43
 44 015476  000167                          .WORD   J$JMP
    015500  000000                          .WORD   L10005-2-.
 45
 46 015502                          L10005:
    015502  104423                          TRAP    C$MSG
 47
 48                                 ;ERR301:  MSCP error routine
 49                                 ;
 50                                 ;         Prints basic msg in BASEMSG with LBN in command packet
 51                                 ;         Prints extended end message info
 52
 53 015504                          ERR301::
 54
 55 015504  010146                          MOV     R1,-(SP)                ;;PUSH R' ON STACK
    015506  010246                          MOV     R2,-(SP)                ;;PUSH R2 ON STACK
    015510  010346                          MOV     R3,-(SP)                ;;PUSH R3 ON STACK
 56
 57 015512  016401  000140                MOV     HC.CPK+P.LBN(R4),R1     ; Unload LBN (low)
 58 015516  016402  000142                MOV     HC.CPK+P.LBN+2(R4),R2   ; Unload LBN (high)
 59 015522  010246                        MOV     R2,-(SP)                ;PUSH R2 ON STACK
    015524  010146                        MOV     R1,-(SP)                ;PUSH R1 ON STACK
    015526  013746  002552                MOV     BASEMSG,-(SP)           ;PUSH BASEMSG ON STACK
    015532  004137  033254                JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
    015536  000006                        .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
 60
 61 015540  012702  003330                MOV     #MSCPMSG,R2             ; Load text table ptr
 62 015544  012703  003350                MOV     #MSCPVAL,R3             ; Load value table ptr
 63 015550  004737  016042                JSR     PC,CALR1                ; Print MSCP info
 64
 65 015554  012603                        MOV     (SP)+,R3                ;;POP STACK INTO R3
    015556  012602                        MOV     (SP)+,R2                ;;POP STACK INTO R2
    015560  012601                        MOV     (SP)+,R1                ;;POP STACK INTO R1
 66
 67 015562  000167                        .WORD   J$JMP
    015564  000000                        .WORD   L10006-2-.
 68
 69 015566                          L10006:
    015566  104423                          TRAP    C$MSG
 70
 71                                 ;ERR302:  MSCP error routine
 72                                 ;
 73                                 ;         Prints basic msg in BASEMSG with LBN for ACCESS error
 74                                 ;         Prints extended end message info
 75
 76 015570                          ERR302::
 77
 78 015570  010146                          MOV     R1,-(SP)                ;;PUSH R1 ON STACK
    015572  010246                          MOV     R2,-(SP)                ;;PUSH R2 ON STACK
    015574  010346                          MOV     R3,-(SP)                ;;PUSH R3 ON STACK
 79
 80 015576  013746  002450                MOV     LBN+2,-(SP)             ;PUSH LBN+2 ON STACK
    015602  013746  002446                MOV     LBN,-(SP)               ;PUSH LBN ON STACK
    015606  013746  002552                MOV     BASEMSG,-(SP)           ;PUSH BASEMSG ON STACK
    015612  004137  033254                JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
```

```
    015616  000006                          .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
 81
 82 015620  012702  003330                  MOV     #MSCPMSG,R2             ; Load text table ptr
 83 015624  012703  003350                  MOV     #MSCPVAL,R3             ; Load value table ptr
 84 015630  004737  016042                  JSR     PC,CALR1                ; Print MSCP info
 85
 86 015634  012603                          MOV     (SP)+,R3                ;;POP STACK INTO R3
    015636  012602                          MOV     (SP)+,R2                ;;POP STACK INTO R2
    015640  012601                          MOV     (SP)+,R1                ;;POP STACK INTO R1
 87
 88 015642  000167                          .WORD   J$JMP
    015644  000000                          .WORD   L10007-2-.
 89
 90 015646                          L10007:
    015646  104423                          TRAP    C$MSG
 91
```

```
      1
      2                                 ;ERR401:  Host/controller communication error routine
      3                                 ;
      4                                 ;         Prints basic msg in BASEMSG
      5                                 ;         Prints extended end message info
      6
      7 015650                          ERR401::
      8
      9 015650  010146                          MOV     R1,-(SP)                ;;PUSH R1 ON STACK
        015652  010246                          MOV     R2,-(SP)                ;;PUSH R2 ON STACK
        015654  010346                          MOV     R3,-(SP)                ;;PUSH R3 ON STACK
     10
     11 015656  013746  002552                MOV     BASEMSG,-(SP)           ;PUSH BASEMSG ON STACK
        015662  004137  033254                JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
        015666  000002                        .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
     12
     13 015670  012702  003116                MOV     #SARMSG,R2              ; Load text table ptr
     14 015674  012703  003126                MOV     #SARVAL,R3              ; Load value table ptr
     15 015700  004737  016042                JSR     PC,CALR1                ; Print MSCP info
     16
     17 015704  012603                        MOV     (SP)+,R3                ;;POP STACK INTO R3
        015706  012602                        MOV     (SP)+,R2                ;;POP STACK INTO R2
        015710  012601                        MOV     (SP)+,R1                ;;POP STACK INTO R1
     18
     19 015712  000167                        .WORD   J$JMP
        015714  000000                        .WORD   L10010-2-.
     20
     21 015716                          L10010:
        015716  104423                        TRAP    C$MSG
     22
     23                                 ;ERR601:  RCT error routine
     24                                 ;
     25                                 ;         Prints basic msg in BASEMSG
     26                                 ;         Prints extended RCT info
     27
     28 015720                          ERR601::
     29
     30 015720  010146                          MOV     R1,-(SP)                ;;PUSH R1 ON STACK
        015722  010246                          MOV     R2,-(SP)                ;;PUSH R2 ON STACK
        015724  010346                          MOV     R3,-(SP)                ;;PUSH R3 ON STACK
     31
     32 015726  013746  002552                MOV     BASEMSG,-(SP)           ;PUSH BASEMSG ON STACK
        015732  004137  033254                JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
        015736  000002                        .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
     33
     34 015740  012702  003660                MOV     #RCTMSG,R2              ; Load text table ptr
     35 015744  012703  003670                MOV     #RCTVAL,R3              ; Load value table ptr
     36 015750  004737  016042                JSR     PC,CALR1                ; Print RCT info
     37
     38 015754  012603                        MOV     (SP)+,R3                ;;POP STACK INTO R3
        015756  012602                        MOV     (SP)+,R2                ;;POP STACK INTO R2
        015760  012601                        MOV     (SP)+,R1                ;;POP STACK INTO R1
     39
     40 015762  000167                        .WORD   J$JMP
        015764  000000                        .WORD   L10011-2-.
     41
     42 015766                          L10011:
```

Error processing routines

```
        015766  104423                          TRAP    C$MSG
     43
```

```
                                ;ERR701:  Error Log packet error routine
                                ;
                                ;         Prints basic msg in BASEMSG
                                ;         Prints extended error log packet info

015770                          ERR701::

015770  010146                          MOV     R1,-(SP)                ;;PUSH R1 ON STACK
015772  010246                          MOV     R2,-(SP)                ;;PUSH R2 ON STACK
015774  010346                          MOV     R3,-(SP)                ;;PUSH R3 ON STACK

015776  013746  002552                  MOV     BASEMSG,-(SP)           ;PUSH BASEMSG ON STACK
016002  004137  033254                  JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
016006  000002                          .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
016010  013746  002362                  MOV     EVENT,-(SP)             ;PUSH EVENT ON STACK
016014  012746  004034                  MOV     #XEVENT,-(SP)           ;PUSH #XEVENT ON STACK
016020  004137  033254                  JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
016024  000004                          .WORD   ARG.CT                  ;ARGUMENT COUNT * 2

016026  012603                          MOV     (SP)+,R3                ;;POP STACK INTO R3
016030  012602                          MOV     (SP)+,R2                ;;POP STACK INTO R2
016032  012601                          MOV     (SP)+,R1                ;;POP STACK INTO R1

016034  000167                          .WORD   J$JMP
016036  000000                          .WORD   L10012-2-.

016040                          L10012:
016040  104423                          TRAP    C$MSG
```

```
      1                                 .SBTTL  Pre-programmed subroutines
      2
      3                                 ;CALR1: Pre-programmed routine 1
      4                                 ;       Prints extended error info
      5                                 ;
      6                                 ;Inputs:
      7                                 ;       EXTMSK  Extended message mask
      8                                 ;       R2      Pointer to ASCIZ msg address table
      9                                 ;       R3      Pointer to value address table
     10
     11 016042                          CALR1:
     12
     13 016042                          20$:
     14 016042  032737  000001  002370          BIT     #1,EXTMSK               ; Test if bit set
     15 016050  001406                          BEQ     30$                     ; Branch if NO
     16
     17 016052  017346  000000                  MOV     @(R3),-(SP)             ;PUSH @(R3) ON STACK
        016056  011246                          MOV     (R2),-(SP)              ;PUSH (R2) ON STACK
        016060  004137  033264                  JSR     R1,LPNTX                        ;CALL LPNTX PRINT ROUTINE
        016064  000004                          .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
     18 016066                          30$:
     19 016066  006237  002370                  ASR     EXTMSK                  ; Shift to next position
     20 016072  062703  000002                  ADD     #2,R3                   ; Bump to next value
     21 016076  062702  000002                  ADD     #2,R2                   ; Bump to next msg
     22 016102  005712                          TST     (R2)                    ; Test for null msg
     23 016104  001336                          BNE     20$                     ; Branch if NO
     24 016106                          40$:
     25 016106  012746  014231                  MOV     #CRLF,-(SP)             ;PUSH #CRLF ON STACK
        016112  004137  033254                  JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
        016116  000002                          .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
     26 016120  000207                          RTS     PC                      ; Return
     27
     28                                 ;Pre-programmed routine 2
     29                                 ;
     30                                 ;Not used
     31
     32 016122                          CALR2:
     33 016122  000207                          RTS     PC                      ; Return
     34
     35                                 ;Pre-programmed routine 3
     36                                 ;
     37                                 ;Not used
     38
     39 016124                          CALR3:
     40 016124  000207                          RTS     PC                      ; Return
     41
```

```
                                ;Pre-programmed routine 4
                                ;
                                ;Not used

016126                          CALR4:
016126  000207                          RTS     PC                      ; Return

                                ;Pre-programmed routine 5
                                ;
                                ;Not used

016130                          CALR5:
016130  000207                          RTS     PC                      ; Return

                                ;Pre-programmed routine 6
                                ;
                                ;Not used

016132                          CALR6:
016132  000207                          RTS     PC                      ; Return


                                .SBTTL  Error vector table

                                ;       Pre-programmed error routine dispatch table

016134  016042                  ERR.TB: .WORD   CALR1                    ; Print SA address
016136  016122                          .WORD   CALR2                    ; Print SA value
016140  016124                          .WORD   CALR3                    ; Print SA expected value
016142  016126                          .WORD   CALR4                    ; Print MSCP parms
016144  016130                          .WORD   CALR5                    ; Print LBN, RBN
016146  016132                          .WORD   CALR6                    ; Not used
016150  016132                          .WORD   CALR6                    ; Not used
016152  016132                          .WORD   CALR6                    ; Not used

        000010                          ERR.SZ  = <.-ERR.TB>/2

                                .SBTTL  Interrupt service routines
                                ;
                                ;
                                ;
                                ;
                                ;
                                ;
```

```
                                .SBTTL  NXMI    Nonexistant memory routine
                                ;NXMI
                                ;
                                ;Nonexistant memory service routine
                                ;
                                ;Inputs:
                                ;       NXMAD set to zero
                                ;Outputs:
                                ;       NXMAD set to ones if nonexistant trap occured.
                                
016154                          NXMI::
016154  012737  177777  002224        MOV     #-1,NXMAD
016162                          L10013:
016162  000002                        RTI
```

```
                                .SBTTL  xDASRV  Interrupt service routine
                                ;xDASRV
                                ;
                                ;xDA interrupt service routine.  Marks xDA controller table that an
                                ;interrupt has been received.
                                ;
                                ;This routine is called by a [JSR R0,xDASRV] 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

016164                          xDASRV::
016164  052710  000010                  BIS     #CT.MSG,(R0)            ;SET CT.MSG
016170  012600                          MOV     (SP)+,R0                ;;POP STACK INTO R0
016172                          L10014:
016172  000002                          RTI
```

```
                                .SBTTL  KW11I   Clock interrupt service routine
                                ;KW11T
                                ;
                                ;Clock interrupt service routine

016174                          KW11I::
016174  062737  000001  002220          ADD     #1,KW.EL                ;COUNT THE INTERRUPT
016202  005537  002222                  ADC     KW.EL+2
016206  012777  00C105  163774          MOV     #KW.OUT,@KW.CSR         ;RESTART THE CLOCK
016214                          L10015:
016214  000002                          RTI
016216                          INTSRV::
016216  005237  002332                  INC     INTRCV                  ; FLAG INTERRUPT AS RECEIVED
016222                          L10016:
016222  000002                          RTI

```

```
                                .SBTTL  RESET   Reset xDA
                                ;RESET
                                ;
                                ;Reset all xDA-30S in the controller tables
                                ;
                                ;Inputs:
                                ;       CTLRLST Contains the address of the 1st controller table
                                ;
                                ;Outputs:
                                ;       NONE
                                ;

016224                          RESET:
016224  010246                          MOV     R2,-(SP)                ;;PUSH R2 ON STACK
016226  010446                          MOV     R4,-(SP)                ;;PUSH R4 ON STACK
016230  005037  002224                   CLR     NXMAD                   ; CLEAR NON-EXISTANT MEMORY ADDRESS
016234  012737  177776  002300           MOV     #-2,TBLNDX              ; Reset controller table index

016242  012746  000340                   MOV     #PRI07,-(SP)
016246  012746  016154                   MOV     #NXMI,-(SP)
016252  012746  000004                   MOV     #4,-(SP)
016256  012746  000003                   MOV     #3,-(SP)
016262  104437                          TRAP    C$SVEC
016264  062706  000010                   ADD     #10,SP
                                                                        ;>>>>>>>>>BREAK BACK TO MONITOR<<<<<<<<<
016270  104422                          TRAP    C$BRK
016272                          10$:
016272  062737  000002  002300           ADD     #2,TBLNDX               ; Bump table index
016300  013702  002300                   MOV     TBLNDX,R2               ; Load index value
016304  016204  002230                   MOV     CTLRLST(R2),R4          ; Load address
016310  001421                          BEQ     50$                     ; Branch if done
016312                          20$:
016312  010437  002304                   MOV     R4,CTLRTBL              ; and save
016316  005034                          CLR     @(R4)+                  ; INITIALIZE xDA
016320  005737  002224                   TST     NXMAD                   ; Test for address error
016324  001762                          BEQ     10$                     ; Branch if NO
016326                          30$:
016326  012737  011061  002552           MOV     #ERM102,BASEMSG         ; "Memory error..."
016334  012737  000001  002370           MOV     #B.SADDR,EXTMSK         ; Flags address only
016342  104455                          TRAP    C$ERDF
016344  000146                          .WORD   102
016346  010667                          .WORD   HDR101
016350  015266                          .WORD   ERR101
016352  000747                          BR      10$                     ; and continue
016354                          50$:
016354  012700  000004                   MOV     #4,R0
016360  104436                          TRAP    C$CVEC
016362  012604                          MOV     (SP)+,R4                ;;POP STACK INTO R4
016364  012602                          MOV     (SP)+,R2                ;;POP STACK INTO R2
016366  000207                          RTS     PC
```

```
                                .SBTTL  RCTERR  Process RCT block error
                                ;RCTERR
                                ;
                                ;This routine updates the RCT error table.  The table contains one entry
                                ;for each RCT block.  The entry is a bit field for up to 16 copies of each
                                ;RCT block.  A new RCT error will set the corresponding copy bit in its entry.
                                ;
                                ;Inputs:
                                ;       RCTCOPY RCT copy count
                                ;       RCTTBL  Address of RCT error table
                                ;
                                ;Outputs:
                                ;       STATUS  Exit status
                                ;                1:  New bad RCT block
                                ;                0:  Bad RCT block not new
                                ;               -1:  All copies of RCT block bad
                                ;
                                ;Calling Seq:
                                ;
                                ;       JSR     PC,RCTERR
                                ;       .WORD   <error exit>
                                ;

016370                          RCTERR:

016370  010146                          MOV     R1,-(SP)                ;;PUSH R1 ON STACK
016372  010246                          MOV     R2,-(SP)                ;;PUSH R2 ON STACK

016374  113700  002424                  MOVB    RCTCOPY,R0              ; Load number of RCT copies
016400  012737  000001  002426          MOV     #1,RCTMASK              ; Initialize copy mask
016406                          10$:
016406  005300                          DEC     R0                      ; Decrement copy number
016410  001403                          BEQ     20$                     ; Branch if zero
016412  006337  002426                  ASL     RCTMASK                 ; Else, shift mask
016416  000773                          BR      10$                     ; And continue
016420                          20$:
016420  013702  002312                  MOV     RCTTBL,R2               ; Load table address
016424  013700  002476                  MOV     RCTBLK,R0               ; Load RCT block no.
016430  006300                          ASL     R0                      ; Times two for index
016432  060002                          ADD     R0,R2                   ; Add to table start
016434  033712  002426                  BIT     RCTMASK,(R2)            ; Test if this block already bad
016440  001057                          BNE     60$                     ; Branch if YES
016442                          30$:
016442  013704  002324                  MOV     HCOM,R4                 ; Load comm area ptr
016446  016446  000142                  MOV     HC.CPK+P.LBN+2(R4),-(SP)                ;PUSH HC.CPK+P.LBN-2(R4) ON STACK
016452  016446  000140                  MOV     HC.CPK+P.LBN(R4),-(SP)          ;PUSH HC.CPK+P.LBN(R4) ON STACK
016456  013746  002476                  MOV     RCTBLK,-(SP)            ;PUSH RCTBLK ON STACK
016462  013746  002424                  MOV     RCTCOPY,-(SP)           ;PUSH RCTCOPY ON STACK
016466  012746  010114                  MOV     #INF401,-(SP)           ;PUSH #INF401 ON STACK
016472  004137  033254                  JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
016476  000012                          .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
016500  013746  002354                  MOV     EMSTAT,-(SP)            ;PUSH EMSTAT ON STACK
016504  012746  004035                  MOV     #XEVNT,-(SP)            ;PUSH #XEVNT ON STACK
016510  004137  033254                  JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
016514  000004                          .WORD   ARG.CT                  ;ARGUMENT COUNT * 2

016516  053712  002426                  BIS     RCTMASK,(R2)            ; Else, mark this block bad
```

```
     48 016522  005000                        CLR     R0                      ; Clear register
     49 016524  113700  002423                MOVB    COPIES,R0               ; Load number of copies
     50 016530  011202                        MOV     (R2),R2                 ; Load entry
     51 016532  000241                        CLC                             ; Clear carry
     52 016534                          35$:
     53 016534  006202                        ASR     R2                      ; Shift LSB into Carry
     54 016536  103011                        BCC     50$                     ; Branch if bit clear
     55 016540  005300                        DEC     R0                      ; Decrement copy count
     56 016542  001374                        BNE     35$                     ; Continue until zero
     57
     58                                 ;     Fatal error exit
     59 016544                          40$:                                  ; All copies bad
     60 016544  012602                        MOV     (SP)+,R2                ;;POP STACK INTO R2
        016546  012601                        MOV     (SP)+,R1                ;;POP STACK INTO R1
     61 016550  017616  000000                MOV     @(SP),(SP)              ; Load fatal error return
     62 016554  012700  177777                MOV     #-1,R0                  ; Load fatal status
     63 016560  000207                        RTS     PC                      ; Return
     64
     65                                 ;     Report new bad RCT block
     66 016562                          50$:
     67 016562  012602                        MOV     (SP)+,R2                ;;POP STACK INTO R2
        016564  012601                        MOV     (SP)+,R1                ;;POP STACK INTO R1
     68 016566  062716  000002                ADD     #2,(SP)                 ; Bump past error return
     69 016572  012700  000001                MOV     #1,R0                   ; Report new bad RCT block
     70 016576  000207                        RTS     PC                      ; Return
     71
     72                                 ;     Bad RCT block was not new
     73 016600                          60$:
     74 016600  012602                        MOV     (SP)+,R2                ;;POP STACK INTO R2
        016602  012601                        MOV     (SP)+,R1                ;;POP STACK INTO R1
     75 016604  062716  000002                ADD     #2,(SP)                 ; Bump past error return
     76 016610  012700  000000                MOV     #0,R0                   ; Report bad RCT block not new
     77 016614  000207                        RTS     PC                      ; Return
     78
```

```
                                .SBTTL  ERRLOG  Process error log packet
                                ;ERRLOG
                                ;
                                ;This routine processes all ERRORLOG msg packets.  Errorlog types 0, 1, and 3
                                ;will cause a DEVICE FATAL error.  Disk transfer errors will print msg.
                                ;
                                ;Inputs:
                                ;       HCOM    Host comm. area
                                ;Outputs:
                                ;       STATUS  Exit status
                                ;                0:  Disk transfer errorlog packet (no msg)
                                ;               -1:  Fatal errorlog packet (err msg)
                                ;
                                ;Calling Seq:
                                ;
                                ;       JSR     PC,ERRLOG
                                ;       .WORD   <error exit>
                                ;

016616                          ERLPTBL:
016616  016734                          .WORD   ERRL0                   ; Controller error
016620  016772                          .WORD   ERRL1                   ; Memory access error
016622  017066                          .WORD   ERRL2                   ; Disk transfer error
016624  017224                          .WORD   ERRL3                   ; SDI error
016626  017462                          .WORD   ERRL4                   ; Small disk error

000005                          ERLPSIZ =       <.-ERLPTBL>/2           ; maximum index

016630  000000  000000          ERLAST: .WORD   0,0                     ; Last LBN

016634                          ERRLOG:
016634  010146                          MOV     R1,-(SP)                ;;PUSH R1 ON STACK

016636  013704  002324                  MOV     HCOM,R4                 ; Load comm area ptr
016642  116437  000030  002372          MOVB    HC.MPK+L.FMT(R4),ERLFMT ; Save format specifier
016650  016437  000032  002362          MOV     HC.MPK+L.EVNT(R4),EVENT ; Save event code
016656  113701  002372                  MOVB    ERLFMT,R1               ; Load format spec
016662  122701  000005                  CMPB    @ERLPSIZ,R1             ; Compare with max
016666  003017                          BGT     10$                     ; Branch if OK

                                ;       Unrecognized errorlog format
016670                          5$:
016670  012764  140000  000006          MOV     @RG.OWN+RG.FLG,HC.MCT(R4); Return msg descriptor to controller
016676  012737  000001  002370          MOV     #8.EVNT,EXTMSK          ; Load extended msg mask
016704  012737  013763  002552          MOV     @ERM700,BASEMSG         ; Load basic msg address
016712  104455                          TRAP    C$ERDF
016714  001274                          .WORD   700
016716  013731                          .WORD   HDR701
016720  015770                          .WORD   ERR701
016722  000137  017514                  JMP     ERLEXIT                 ; Exit

                                ;       Process errorlog
016726                          10$:
016726  006301                          ASL     R1                      ; Shift index
016730  000171  016616                  JMP     @ERLPTBL(R1)            ; Process errorlog
```

```
                                        ;       Controller error
016734                                  ERRL0:
016734  012764  140000  000006                MOV     #RG.OWN+RG.FLG,HC.MCT(R4); Return msg descriptor to controller
016742  012737  000001  002370                MOV     #B.EVNT,EXTMSK          ; Load extended msg mask
016750  012737  014024  002552                MOV     #ERM701,BASEMSG         ; Load basic msg address
016756  104455                                TRAP    C$ERDF
016760  001275                                .WORD   701
016762  013731                                .WORD   HDR701
016764  015770                                .WORD   ERR701
016766  000137  017514                        JMP     ERLEXIT                 ; Exit

                                        ;       Memory access error
016772                                  ERRL1:
016772  016437  000050  002400                MOV     HC.MPK+L.BADR(R4),HADDR; Save
017000  016437  000052  002402                MOV     HC.MPK+L.BADR+2(R4),HADDR+2; address

017006  012764  140000  000006                MOV     #RG.OWN+RG.FLG,HC.MCT(R4); Return msg descriptor to controller

017014  012737  000001  002370                MOV     #B.EVNT,EXTMSK          ; Load extended msg mask
017022  012737  014062  002552                MOV     #ERM702,BASEMSG         ; Load basic msg address
017030  104455                                TRAP    C$ERDF
017032  001276                                .WORD   702
017034  013731                                .WORD   HDR701
017036  015770                                .WORD   ERR701
017040  013746  002402                        MOV     HADDR+2,-(SP)           ;PUSH HADDR+2 ON STACK
017044  013746  002400                        MOV     HADDR,-(SP)             ;PUSH HADDR ON STACK
017050  012746  004063                        MOV     #XHADDR,-(SP)           ;PUSH #XHADDR ON STACK
017054  004137  033264                        JSR     R1,LPNTX                        ;CALL LPNTX PRINT ROUTINE
017060  000006                                .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
017062  000137  017514                        JMP     ERLEXIT                 ; Exit
```

```
 1
 2                                          ;       Disk transfer error
 3 017066                                   ERRL2:
 4 017066  016437  000070  002374                  MOV     HC.MPK+L.HDCD(R4),ERLLBN; Save
 5 017074  016437  000072  002376                  MOV     HC.MPK+L.HDCD+2(R4),ERLLBN+2; LBN
 6 017102  012764  140000  000006                  MOV     #RG.OWN+RG.FLG,HC.MCT(R4); Return msg descriptor to controller
 7
 8 017110  000436                                  BR      20$                     ; Branch if NO
 9 017112  023737  002374  016630                  CMP     ERLLBN,ERLAST           ; Else, test last LBN (low)
10 017120  001004                                  BNE     10$                     ; Branch if not same
11 017122  023737  002376  016632                  CMP     ERLLBN+2,ERLAST+2       ; Test LBN (high)
12 017130  001426                                  BEQ     20$                     ; Branch if same
13 017132                                  10$:
14 017132  013737  002374  016630                  MOV     ERLLBN,ERLAST           ; Save
15 017140  013737  002376  016632                  MOV     ERLLBN+2,ERLAST+2       ; Last LBN
16
17 017146  013746  002376                        MOV     ERLLBN+2,-(SP)          ;PUSH ERLLBN+2 ON STACK
   017152  013746  002374                        MOV     ERLLBN,-(SP)            ;PUSH ERLLBN ON STACK
   017156  012746  010166                        MOV     #INF405,-(SP)           ;PUSH #INF405 ON STACK
   017162  004137  033264                        JSR     R1,LPNTX                        ;CALL LPNTX PRINT ROUTINE
   017166  000006                                .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
18 017170  013746  002362                        MOV     EVENT,-(SP)             ;PUSH EVENT ON STACK
   017174  012746  004035                        MOV     #XEVNT,-(SP)            ;PUSH #XEVNT ON STACK
   017200  004137  033264                        JSR     R1,LPNTX                        ;CALL LPNTX PRINT ROUTINE
   017204  000004                                .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
19 017206                                  20$:
20 017206  012601                                  MOV     (SP)+,R1                ;;POP STACK INTO R1
21 017210  062716  000002                        ADD     #2,(SP)                 ; Bump past error return
22 017214  012737  000000  002442                  MOV     #0,STATUS               ; Load success
23 017222  000207                                  RTS     PC                      ; Return to caller
24
```

```
                                        ;       SDI error
017224                                  ERRL3:
017224  016437  000070  002374                MOV     HC.MPK+L.HDCD(R4),ERLLBN; Save
017232  016437  000072  002376                MOV     HC.MPK+L.HDCD+2(R4),ERLLBN+2; LBN
017240  062704  000100                        ADD     #HC.MPK+L.DS,R4         ; Add offset to status/error info
017244  012701  002406                        MOV     #ERLDS,R1               ; Load local address
017250  012702  000004                        MOV     #4,R2                   ; Load counter
017254                                  10$:
017254  012421                              MOV     (R4)+,(R1)+             ; Move data
017256  005302                              DEC     R2                      ; Decrement count
017260  001375                              BNE     10$                     ; continue until zero
017262                                  15$:
017262  013704  002324                      MOV     HCOM,R4                 ; Reload comm area ptr
017266  012764  140000  000006              MOV     #RG.OWN+RG.FLG,HC.MCT(R4); Return msg descriptor to controller

017274  012737  000001  002370              MOV     #B.EVNT,EXTMSK          ; Load extended msg mask
017302  012737  014130  002552              MOV     #ERM703,BASEMSG         ; Load basic msg address
017310  104455                              TRAP    C$ERDF
017312  001277                              .WORD   703
017314  013731                              .WORD   HDR701
017316  015770                              .WORD   ERR701

017320  013746  002376                      MOV     ERLLBN+2,-(SP)          ;PUSH ERLLBN+2 ON STACK
017324  013746  002374                      MOV     ERLLBN,-(SP)            ;PUSH ERLLBN ON STACK
017330  012746  014575                      MOV     #XLBN,-(SP)             ;PUSH #XLBN ON STACK
017334  004137  033264                      JSR     R1,LPNTX                        ;CALL LPNTX PRINT ROUTINE
017340  000006                              .WORD   ARG.CT                  ;ARGUMENT COUNT * 2

017342  005737  003246                      TST     MDLNDX                  ; Test for known model
017346  001421                              BEQ     30$                     ; Branch if zero

017350  012701  000006                      MOV     #6,R1                   ; Load drive code byte index
017354  122737  000004  003244              CMPB    #M.RA60,MODEL           ; Test for RA60
017362  001001                              BNE     20$                     ; Branch if NO
017364  005201                              INC     R1                      ; Else, change index for RA60
017366                                  20$:
017366  116137  002406  002404              MOVB    ERLDS(R1),DCODE         ; Save drive error code
017374  013746  002404                      MOV     DCODE,-(SP)             ;PUSH DCODE ON STACK
017400  012746  004112                      MOV     #XDCODE,-(SP)           ;PUSH #XDCODE ON STACK
017404  004137  033264                      JSR     R1,LPNTX                        ;CALL LPNTX PRINT ROUTINE
017410  000004                              .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
017412                                  30$:
017412  012746  004152                      MOV     #XDINFO,-(SP)           ;PUSH #XDINFO ON STACK
017416  004137  033264                      JSR     R1,LPNTX                        ;CALL LPNTX PRINT ROUTINE
017422  000002                              .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
017424  012702  000010                      MOV     #8.,R2                  ; Load byte count
017430  012701  002406                      MOV     #ERLDS,R1               ; Load ptr to status info
017434                                  35$:
017434  112104                              MOVB    (R1)+,R4                ; Load status
017436  010446                              MOV     R4,-(SP)                ;PUSH R4 ON STACK
017440  012746  004217                      MOV     #XDHEX,-(SP)            ;PUSH #XDHEX ON STACK
017444  004137  033264                      JSR     R1,LPNTX                        ;CALL LPNTX PRINT ROUTINE
017450  000004                              .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
017452  005302                              DEC     R2                      ; Decrement count
017454  001367                              BNE     35$                     ; continue until zero
017456  000137  017514                      JMP     ERLEXIT                 ; Exit
```

ERRLOG Process error log packet

```
     43
```

```
 1
 2                                          ;       Small disk error
 3 017462                                   ERRL4:
 4 017462  012764  140000  000006                   MOV     #RG.OWN+RG.FLG,HC.MCT(R4); Return msg descriptor to controller
 5 017470  012737  000001  002370                   MOV     #B.EVNT,EXTMSK          ; Load extended msg mask
 6 017476  012737  014157  002552                   MOV     #ERM704,BASEMSG         ; Load basic msg address
 7 017504  104455                                   TRAP    C$ERDF
   017506  001300                                   .WORD   704
   017510  013731                                   .WORD   HDR701
   017512  015770                                   .WORD   ERR701
 8
 9 017514                                   ERLEXIT:
10 017514  013704  002324                         MOV     HCOM,R4                 ; Reload comm area ptr
11 017520  005737  002650                         TST     DEBUG                   ; Test for DEBUG
12 017524  001007                                 BNE     20$                     ; Branch if yes
13 017526                                  10$:
14 017526  012601                                 MOV     (SP)+,R1                ;;POP STACK INTO R1
15 017530  017616  000000                         MOV     @(SP),(SP)              ; Load fatal return
16 017534  012737  177777  002442                 MOV     #-1,STATUS              ; Fatal status
17 017542  000207                                 RTS     PC                      ; and return
18 017544                                  20$:
19 017544  012601                                 MOV     (SP)+,R1                ;;POP STACK INTO R1
20 017546  062716  000002                         ADD     #2,(SP)                 ; Bump past error return
21 017552  012737  000000  002442                 MOV     #0,STATUS               ; Load success
22 017560  000207                                 RTS     PC                      ; Return to caller
23
```

```
                                .SBTTL  CACHTST Bad block cache test
                                ;CACHTST
                                ;
                                ;Inputs:
                                ;       LBN     Current LBN
                                ;       CACHTBL Address of caching table
                                ;
                                ;Outputs:
                                ;       STATUS  Exit status
                                ;                1:  LBN already in caching table
                                ;                0:  LBN entered in caching table
                                ;               -1:  Caching table full
                                ;
                                ;Calling Seq:
                                ;
                                ;       JSR     PC,CACHTST
                                ;       .WORD   <error exit>
                                ;

017562                          CACHTST:
017562  010146                          MOV     R1,-(SP)                ;;PUSH R1 ON STACK
017564  010246                          MOV     R2,-(SP)                ;;PUSH R2 ON STACK
017566  010346                          MOV     R3,-(SP)                ;;PUSH R3 ON STACK
017570  013702  002310                  MOV     CACHTBL,R2              ; Load table start
017574  005000                          CLR     R0                      ; Clear cache entry count
017576                          20$:
017576  005762  000002                  TST     2(R2)                   ; Test for null
017602  100461                          BMI     50$                     ; Branch if YES

017604  023712  002446                  CMP     LBN,(R2)                ; Compare low order LBN
017610  001007                          BNE     30$                     ; Branch if not same
017612  016201  000002                  MOV     2(R2),R1                ; Else, load high order LBN
017616  042701  170000                  BIC     #170000,R1              ; Clear flags
017622  020137  002450                  CMP     R1,LBN+2                ; Compare high order LBN
017626  001431                          BEQ     40$                     ; Branch if same
017630                          30$:
017630  062702  000004                  ADD     #4,R2                   ; Bump to next entry
017634  005200                          INC     R0                      ; Increment count
017636  022700  000620                  CMP     #CACHESIZE,R0           ; Compare with max
017642  003355                          BGT     20$                     ; Branch if less
017644                          35$:
017644  012737  013621  002552          MOV     #ERM607,BASEMSG         ; "transient error overflow..."
017652  012737  000000  002370          MOV     #0,EXTMSK               ; No extended msg
017660  104455                          TRAP    C$ERDF
017662  001137                          .WORD   607
017664  013173                          .WORD   HDR601
017666  015720                          .WORD   ERR601
017670  012603                          MOV     (SP)+,R3                ;;POP STACK INTO R3
017672  012602                          MOV     (SP)+,R2                ;;POP STACK INTO R2
017674  012601                          MOV     (SP)+,R1                ;;POP STACK INTO R1
017676  017616  000000                  MOV     @(SP),(SP)              ; Else, load error return
017702  012737  177777  002442          MOV     #-1,STATUS              ; Set fatal status
017710  000207                          RTS     PC                      ; and return
017712                          40$:
017712  012712  177777                  MOV     #-1,(R2)                ; Reset LBN (low)
017716  012762  177777  000002          MOV     #-1,2(R2)               ; Reset LBN (high)
```

```
     51 017724  012603                          MOV     (SP)+,R3                ;;POP STACK INTO R3
        017726  012602                          MOV     (SP)+,R2                ;;POP STACK INTO R2
        017730  012601                          MOV     (SP)+,R1                ;;POP STACK INTO R1
     52 017732  062716  000002                  ADD     #2,(SP)                 ; Bump past error return
     53 017736  012737  000001  002442          MOV     #1,STATUS               ; Set replace status
     54 017744  000207                          RTS     PC                      ; and return
     55 017746                          50$:
     56 017746  013712  002446                  MOV     LBN,(R2)                ; Save LBN
     57 017752  013762  002450  000002          MOV     LBN+2,2(R2)             ;
     58 017760  012603                          MOV     (SP)+,R3                ;;POP STACK INTO R3
        017762  012602                          MOV     (SP)+,R2                ;;POP STACK INTO R2
        017764  012601                          MOV     (SP)+,R1                ;;POP STACK INTO R1
     59 017766  062716  000002                  ADD     #2,(SP)                 ; Bump past error return
     60 017772  012737  000000  002442          MOV     #0,STATUS               ; Set replace status
     61 020000  000207                          RTS     PC                      ; and return
     62
```

```
                                .SBTTL  TYPSTAT Type replacement status
                                ;TYPSTAT
                                ;
                                ;THIS ROUTINE TYPES THE LBN, RBN REPLACEMENT INFORMATION TO THE TTY.
                                ;
                                ;INPUTS.
                                ;       SFLAG (Search status flag),
                                ;       MATFLG (Match status flag),
                                ;       LBN (Lo order word of LBN being replaced),
                                ;       LBN+2 (Hi order word of LBN being replaced),
                                ;       RBN (Lo order word of RBN replacement),
                                ;       RBN+2 (Hi order word of RBN replacement),
                                ;       MATRBN (Lo order word of RBN which matched the LBN being replaced),
                                ;       MATRBN+2 (Hi order word of RBN which matched the LBN being replaced)
                                ;
                                ;OUTPUTS:
                                ;       TYPE APPROPRIATE MESSAGE TO THE TTY
                                ;
                                ;       LBNSTAT: LBN status word
                                ;

020002                          TYPSTAT:
020002  010146                         MOV     R1,-(SP)                ;;PUSH R1 ON STACK
020004  010246                         MOV     R2,-(SP)                ;;PUSH R2 ON STACK

020006                          10$:
020006  105737  002514                  TSTB    MATFLG                  ; Test for LBN match
020012  001444                         BEQ     20$                     ; Branch if NO, else print msg

                                ;       Print UNUSABLE operation
020014                          15$:
020014  005237  002440                  INC     UNUSE                   ; Increment number of UNUSABLE RBNs
020020  013746  002450                  MOV     LBN+2,-(SP)             ;PUSH LBN+2 ON STACK
020024  013746  002446                  MOV     LBN,-(SP)               ;PUSH LBN ON STACK
020030  012746  010166                  MOV     #INF405,-(SP)           ;PUSH #INF405 ON STACK
020034  004137  033254                  JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
020040  000006                         .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
020042  012746  015174                  MOV     #TX.BLK,-(SP)           ;PUSH #TX.BLK ON STACK
020046  012746  010206                  MOV     #INF406,-(SP)           ;PUSH #INF406 ON STACK
020052  004137  033254                  JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
020056  000004                         .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
020060  013746  002464                  MOV     MATRBN+2,-(SP)          ;PUSH MATRBN+2 ON STACK
020064  013746  002462                  MOV     MATRBN,-(SP)            ;PUSH MATRBN ON STACK
020070  012746  010224                  MOV     #INF407,-(SP)           ;PUSH #INF407 ON STACK
020074  004137  033254                  JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
020100  000006                         .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
020102  012746  015131                  MOV     #TX.UNS,-(SP)           ;PUSH #TX.UNS ON STACK
020106  012746  010243                  MOV     #INF408,-(SP)           ;PUSH #INF408 ON STACK
020112  004137  033254                  JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
020116  000004                         .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
020120  105037  002514                  CLRB    MATFLG                  ; Clear flag
020124                          20$:
020124  012702  000000                  MOV     #0,R2                   ; Zero index
020130  013701  002516                  MOV     LBNSTAT,R1              ; Load status
020134  100422                         BMI     30$                     ; Branch if error status
020136  003111                         BGT     50$                     ; Else, branch if flag set
```

```
                                        ;       Print LBN with blank status
                                        25$:
020140  013746  002450                          MOV     LBN+2,-(SP)             ;PUSH LBN+2 ON STACK
020144  013746  002446                          MOV     LBN,-(SP)               ;PUSH LBN ON STACK
020150  012746  010166                          MOV     #INF405,-(SP)           ;PUSH #INF405 ON STACK
020154  004137  033254                          JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
020160  000006                                  .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
020162  012746  015174                          MOV     #TX.BLK,-(SP)           ;PUSH #TX.BLK ON STACK
020166  012746  010206                          MOV     #INF406,-(SP)           ;PUSH #INF406 ON STACK
020172  004137  033254                          JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
020176  000004                                  .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
020200  000400                                  BR      30$                     ; Exit

                                        ;       Print LBN status code
                                        30$:
020202  042701  177760                          BIC     #^C17,R1                ; CLear all but data codes
020206  001436                                  BEQ     40$                     ; Branch if None set
020210                                  32$:
020210  036201  020612                          BIT     BITTBL(R2),R1           ; Test for bit set
020214  001426                                  BEQ     35$                     ; Branch if bit clear

020216  013746  002450                          MOV     LBN+2,-(SP)             ;PUSH LBN+2 ON STACK
020222  013746  002446                          MOV     LBN,-(SP)               ;PUSH LBN ON STACK
020226  012746  010166                          MOV     #INF405,-(SP)           ;PUSH #INF405 ON STACK
020232  004137  033254                          JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
020236  000006                                  .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
020240  016246  020624                          MOV     STATBL(R2),-(SP)                ;PUSH STATBL(R2) ON STACK
020244  012746  010206                          MOV     #INF406,-(SP)           ;PUSH #INF406 ON STACK
020250  004137  033254                          JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
020254  000004                                  .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
020256  005272  020636                          INC     @CNTTBL(R2)             ; Increment counter
020262  046237  020612  002516                  BIC     BITTBL(R2),LBNSTAT      ; Clear so we won't print again
020270  000405                                  BR      40$                     ; Exit loop
020272                                  35$:
020272  062702  000002                          ADD     #2,R2                   ; Else, bump index
020276  005762  020624                          TST     STATBL(R2)              ; Test address
020302  100342                                  BPL     32$                     ; continue if not null

```

```
                                        ;       Test for Write w/FE
020304                                  40$:
020304  032737  000400  002516                BIT     @TF.WFE,LBNSTAT         ; Test for WFE
020312  001451                                BEQ     60$                     ; Branch if NO

020314  013746  002450                        MOV     LBN+2,-(SP)             ;PUSH LBN+2 ON STACK
020320  013746  002446                        MOV     LBN,-(SP)               ;PUSH LBN ON STACK
020324  012746  010166                        MOV     @INF405,-(SP)           ;PUSH @INF405 ON STACK
020330  004137  033254                        JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
020334  000006                                .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
020336  012746  015201                        MOV     @TX.WFE,-(SP)           ;PUSH @TX.WFE ON STACK
020342  012746  010206                        MOV     @INF406,-(SP)           ;PUSH @INF406 ON STACK
020346  004137  033254                        JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
020352  000004                                .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
020354  005237  002542                        INC     WFECNT                  ; Increment count
020360  000426                                BR      60$                     ; Type replacement info

                                        ;       Test for BBR
020362                                  50$:
020362  032737  000200  002516                BIT     @TF.BBR,LBNSTAT         ; Test for BBR
020370  001422                                BEQ     60$                     ; Branch if NO

020372  013746  002450                        MOV     LBN+2,-(SP)             ;PUSH LBN+2 ON STACK
020376  013746  002446                        MOV     LBN,-(SP)               ;PUSH LBN ON STACK
020402  012746  010166                        MOV     @INF405,-(SP)           ;PUSH @INF405 ON STACK
020406  004137  033254                        JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
020412  000006                                .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
020414  012746  015150                        MOV     @TX.BBR,-(SP)           ;PUSH @TX.BBR ON STACK
020420  012746  010206                        MOV     @INF406,-(SP)           ;PUSH @INF406 ON STACK
020424  004137  033254                        JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
020430  000004                                .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
020432  005237  002540                        INC     BBRCNT                  ; Increment count
```

```
                                ;       Print replacement operation
                        60$:
020436  005737  002520                TST     RPLSTAT                 ; Test replacement status
020442  001455                      BEQ     100$                    ; Exit if none

020444  122737  000000  002515      CMPB    #0,SFLAG                ; Test for PRIMARY search status
020452  001023                      BNE     80$                     ; Branch if NO

                                ;       Print PRIMARY operation

020454  005237  002434              INC     PRIMRY                  ; Increment PRIMARY RBN count
020460  013746  002454              MOV     RBN+2,-(SP)             ;PUSH RBN+2 ON STACK
020464  013746  002452              MOV     RBN,-(SP)               ;PUSH RBN ON STACK
020470  012746  010224              MOV     #INF407,-(SP)           ;PUSH #INF407 ON STACK
020474  004137  033254              JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
020500  000006                      .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
020502  012746  01511`              MOV     #TX.PRI,-(SP)           ;PUSH #TX.PRI ON STACK
020506  012746  010243              MOV     #INF408,-(SP)           ;PUSH #INF408 ON STACK
020512  004137  033254              JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
020516  000004                      .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
020520  000426                      BR      100$                    ; and exit
020522                          80$:
020522  122737  000001  002515      CMPB    #1,SFLAG                ; Test for SECONDARY search status
020530  001022                      BNE     100$                    ; Branch if NO

                                ;       Print SCEONDARY operation

020532  005237  002436              INC     SCNDRY                  ; Increment SECONDARY RBN count
020536  013746  002454              MOV     RBN+2,-(SP)             ;PUSH RBN+2 ON STACK
020542  013746  002452              MOV     RBN,-(SP)               ;PUSH RBN ON STACK
020546  012746  010224              MOV     #INF407,-(SP)           ;PUSH #INF407 ON STACK
020552  004137  033254              JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
020556  000006                      .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
020560  012746  015124              MOV     #TX.SEC,-(SP)           ;PUSH #TX.SEC ON STACK
020564  012746  010243              MOV     #INF408,-(SP)           ;PUSH #INF408 ON STACK
020570  004137  033254              JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
020574  000004                      .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
020576                          100$:
020576  012737  000000  002520      MOV     #0,RPLSTAT              ; Zero replacement status
020604  012601                      MOV     (SP)+,R1                ;;POP STACK INTO R1
020606  012602                      MOV     (SP)+,R2                ;;POP STACK INTO R2
020610  000207                      RTS     PC                      ;RETURN


020612                          BITTBL:
020612  000001                      .WORD   TF.FER
020614  000002                      .WORD   TF.HCE
020616  000004                      .WORD   TF.DST
020620  000010                      .WORD   TF.ECC
020622  177777                      .WORD   -1

020624                          STATBL:
020624  015136                      .WORD   TX.FER                  ; BIT0
020626  015206                      .WORD   TX.HCE                  ; BIT1
020630  015213                      .WORD   TX.DST                  ; BIT2
020632  015143                      .WORD   TX.ECH                  ; BIT3
020634  177777                      .WORD   -1                      ; Terminator
```

```
                                CNTTBL:
020636  002530                          .WORD   FERCNT                  ; FER count
020640  002532                          .WORD   HCECNT                  ; HCE count
020642  002534                          .WORD   DSTCNT                  ; DST count
020644  002536                          .WORD   ECCCNT                  ; ECC count
020646  177777                          .WORD   -1                      ; Terminator
```

```
                                .SBTTL  RNTIME  Print runtime
                                ;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
                                ;
020650  005737  002210        RNTIME: TST     KW.CSR                  ;CHECK IF A CLOCK PRESENT
020654  001470                        BEQ     RNTIMX                  ;BRANCH IF NOT
020656  010046                        MOV     R0,-(SP)                ;;PUSH R0 ON STACK
020660  010346                        MOV     R3,-(SP)                ;;PUSH R3 ON STACK
020662  010446                        MOV     R4,-(SP)                ;;PUSH R4 ON STACK
020664  010546                        MOV     R5,-(SP)                ;;PUSH R5 ON STACK
020666  013703  002220                MOV     KW.EL,R3                ;GET ELAPSED TIME
020672  013704  002222                MOV     KW.EL+2,R4
020676  013700  002216                MOV     KW.HZ,R0                ;GET SPEED OF CLOCK
020702  004737  034436                JSR     PC,DIVIDE               ;COMPUTE SECONDS OF ELAPSED TIME
020706  012700  000074                MOV     #60.,R0                 ;NOW DIVIDE BY 60
020712  004737  034436                JSR     PC,DIVIDE               ; TO COMPUTE MINUTES
020716  010546                        MOV     R5,-(SP)                ;;PUSH R5 ON STACK
020720  004737  034436                JSR     PC,DIVIDE               ;DIVIDE BY 60 AGAIN
020724  010346                        MOV     R3,-(SP)                ;PUSH R3 ON STACK
020726  012746  014233                MOV     #RNTIM,-(SP)            ;PUSH #RNTIM ON STACK
020732  004137  033302                JSR     R1,LPNT                 ;CALL LPNT PRINT ROUTINE
020736  000004                        .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
020740  020527  000011                CMP     R5,#9.                  ;IF MINUTES 9 OR LESS
020744  003004                        BGT     1$
020746  112700  000060                MOVB    #'0,R0                  ;STORE #'0 IN R0 AND
020752  004737  033066                JSR     PC,PRINTC               ;PRINT THE CHARACTER.
020756                          1$:
020756  010546                        MOV     R5,-(SP)                ;PUSH R5 ON STACK
020760  012746  014266                MOV     #RNTIM1,-(SP)           ;PUSH #RNTIM1 ON STACK
020764  004137  033302                JSR     R1,LPNT                 ;CALL LPNT PRINT ROUTINE
020770  000004                        .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
020772  012605                        MOV     (SP)+,R5                ;;POP STACK INTO R5
020774  020527  000011                CMP     R5,#9.                  ;IF 9 OR LESS
021000  003004                        BGT     2$
021002  112700  000060                MOVB    #'0,R0                  ;STORE #'0 IN R0 AND
021006  004737  033066                JSR     PC,PRINTC               ;PRINT THE CHARACTER.
021012                          2$:
021012  010546                        MOV     R5,-(SP)                ;PUSH R5 ON STACK
021014  012746  014274                MOV     #RNTIM2,-(SP)           ;PUSH #RNTIM2 ON STACK
021020  004137  033302                JSR     R1,LPNT                 ;CALL LPNT PRINT ROUTINE
021024  000004                        .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
021026  012605                        MOV     (SP)+,R5                ;;POP STACK INTO R5
021030  012604                        MOV     (SP)+,R4                ;;POP STACK INTO R4
021032  012603                        MOV     (SP)+,R3                ;;POP STACK INTO R3
021034  012600                        MOV     (SP)+,R0                ;;POP STACK INTO R0
021036                          RNTIMX:
021036  112700  000040                MOVB    #' ,R0                  ;STORE #'  IN R0 AND
021042  004737  033066                JSR     PC,PRINTC               ;PRINT THE CHARACTER.
```

```
CZUDLAC 'BR Replacement Utility MACRO Y05.03c Friday 19-Apr-85 10:42  Page 56-1
RNTIME  'rint runtime

     3" 021046  000207                          RTS      PC
```

```
                                .SBTTL  UNITINI Initialize Unit
                                ;
                                ;UNITINI:
                                ;       Perform the following initialization steps for the UUT:
                                ;
                                ;         Load controller table values
                                ;         Call XDAINT to initialize controller
                                ;         Issue GET UNIT STATUS command
                                ;         Issue SET CONTROLLER CHAR command
                                ;         Put drive ONLINE
                                ;         Allocate and clear RCT error table
                                ;         Read RCT block 0 and format Volume serial number
                                ;         Scan RCT using MULTI-READ
                                ;         Call STEP3 to test for crash during replacement
                                ;
                                ;Inputs:
                                ;       HCOM    Host communication area
                                ;       CTLRTBL Controller table
                                ;
                                ;Outputs:
                                ;       STATUS  Exit status
                                ;                0:  Disk transfer errorlog packet (no msg)
                                ;               -1:  Fatal errorlog packet (err msg)
                                ;
                                ;Calling Seq:
                                ;
                                ;       JSR     PC,UNITINI
                                ;       .WORD   <error exit>
                                ;

021050                          UNITINI:
021050  013705  002304                  MOV     CTLRTBL,R5              ; Load Table address
021054  011537  002314                  MOV     (R5),SADDR              ; Save controller address
021060  016546  000002                  MOV     C.VEC(R5),-(SP)         ;;PUSH C.VEC(R5) ON STACK
021064  011604                          MOV     (SP),R4                 ;GET BR LEVEL/VECTOR OF xDA AND
021066  042704  177000                  BIC     #^C<CT.VEC>,R4          ;SAVE THE VECTOR ADDRESS.
021072  012600                          MOV     (SP)+,R0                ;;POP STACK INTO R0
021074  042700  170777                  BIC     #^C<CT.BRL>,R0          ;SAVE THE BR LEVEL AND
021100  000300                          SWAB    R0                      ;PUT IT INTO LO BYTE.
021102  010501                          MOV     R5,R1                   ;GET ADDRESS OF CONTROLLER TABLE AND
021104  062701  000010                  ADD     #C.JSR,R1               ;USE THE TABLE ADDRESS OF THE 'JSR'
                                                                        ;INSTRUCTION IN THE CONTROLLER TABLE, AS
                                                                        ;THE INTERRUPT SERVICE ROUTINE.
021110  010046                          MOV     R0,-(SP)
021112  010146                          MOV     R1,-(SP)
021114  010446                          MOV     R4,-(SP)
021116  012746  000003                  MOV     #3,-(SP)
021122  104437                          TRAP    C$SVEC
021124  062706  000010                  ADD     #10,SP
021130  006204                          ASR     R4                      ;DIVIDE VECTOR ADDRESS BY 4 TO
021132  006204                          ASR     R4                      ;USE IN xDA INITIALIZE SUBROUTINE.
021134  004737  036670                  JSR     PC,XDAINT               ;RING LENGTH, INTERRUPTS AND VECTOR ADDR
021140  001002                          BNE     100$                    ;BRANCH IF NO ERROR, ELSE
021142  000137  022172                  JMP     900$                    ; Error exit
```

```
                                        ;       Get UNIT status
                                        100$:
021146  004737  030626                        JSR     PC,INTCPK               ;INITIALIZE THE COMMAND PACKET
                                                                                ; Setup to issue OP.GUS command
021152  012700  000003                        MOV     #OP.GUS,R0              ; Load MSCP opcode
021156  004737  030204                        JSR     PC,ISSUE                ; Issue command to the xDA
021162  022172                                900$                            ; Here if fatal error,
021164  001423                                BEQ     120$                    ; Branch if command successful,
021166  013700  002354                        MOV     EMSTAT,R0               ; Reload emdmsg status
021172  042700  177740                        BIC     #^CST.MSK,R0            ; Clear any subcodes
021176  022700  000004                        CMP     #ST.AVL,R0              ; See if unit is available
021202  001414                                BEQ     120$                    ; Branch if YES
021204                                  110$:                                 ; Else, report fatal error
021204  012737  011346  002552                MOV     #ERM201,BASEMSG         ; "Drive not accessable"
021212  012737  000100  002370                MOV     #B.ESTAT,EXTMSK         ; Print status
021220  104455                                TRAP    C$ERDF
021222  000311                                .WORD   201
021224  011314                                .WORD   HDR201
021226  015220                                .WORD   ERR001
021230  000137  022172                        JMP     900$                    ; Error exit
021234                                  120$:
021234  013704  002324                        MOV     HCOM,R4                 ; Load comm area address
021240  016437  000064  002420                MOV     HC.MPK+P.TRKS(R4),TRKSIZ; Get the track size
021246  016437  000074  002416                MOV     HC.MPK+P.RCTS(R4),RCTSIZ; Number of blocks in the RCT
021254  003014                                BGT     130$                    ; Continue if RCT size > 0
021256  012737  011743  002552                MOV     #ERM204,BASEMSG         ; "Zero RCT size..."
021264  012737  000000  002370                MOV     #0,EXTMSK               ; No extended info
021272  104455                                TRAP    C$ERDF
021274  000314                                .WORD   204
021276  011314                                .WORD   HDR201
021300  015220                                .WORD   ERR001
021302  000137  022172                        JMP     900$                    ; Error exit
021306                                  130$:
021306  116437  000076  002422                MOVB    HC.MPK+P.RBNS(R4),RBNS  ; Number of RBN'S
021314  116437  000077  002423                MOVB    HC.MPK+P.RCTC(R4),COPIES; Number of copies of RBN's.

                                        ;       Set controller characteristics
021322                                  200$:
021322  012764  000000  000124                MOV     #0,HC.CPK+P.HTMO(R4)    ; Disable host access timeout
021330  012700  000000                        MOV     #0,R0                   ; Assume no error log
021334  005737  002162                        TST     ENBERRL                 ; Test error log enabled
021340  001402                                BEQ     220$                    ; Branch if NO
021342  052700  000020                        BIS     #CF.THS,R0              ; Else, set error log enabled
021346                                  220$:
021346  010064  000122                        MOV     R0,HC.CPK+P.CNTF(R4)    ; Load characteristics
                                                                                ; Setup to issue OP.SCC command
021352  012700  000004                        MOV     #OP.SCC,R0              ; Load MSCP opcode
021356  004737  030204                        JSR     PC,ISSUE                ; Issue command to the xDA
021362  022172                                900$                            ; Here if fatal error,
021364  001412                                BEQ     300$                    ; Branch if command successful,
                                                                                ; REPORT ERROR
021366  012737  011453  002552                MOV     #ERM202,BASEMSG         ; Failed disable host timeout..."
021374  012737  000100  002370                MOV     #B.ESTAT,EXTMSK         ; Print status
021402  104456                                TRAP    C$ERHRD
021404  000312                                .WORD   202
```

```
021406  011314                          .WORD   HDR201
021410  015220                          .WORD   ERR001
     43
```

```
 1
 2                                          ;       Put the drive ONLINE
 3 021412                                   300$:
 4                                                                          ; Setup to issue OP.ONL command
   021412  012700  000011                           MOV     #OP.ONL,R0      ; Load MSCP opcode
   021416  004737  030204                           JSR     PC,ISSUE        ; Issue command to the xDA
   021422  022172                                   900$                    ; Here if fatal error,
   021424  001423                                   BEQ     320$            ; Branch if command successful,
 5
 6 021426  013700  002354                           MOV     EMSTAT,R0       ; Reload emdmsg status
 7 021432  042700  177740                           BIC     #^CST.MSK,R0    ; Clear any subcodes
 8 021436  022700  000400                           CMP     #ST.AOL,R0      ; See if unit is already online
 9 021442  001414                                   BEQ     320$            ; Branch if YES
10                                                                          ; Else, Report fatal error
11 021444  012737  011711  002552                   MOV     #ERM203,BASEMSG ; "Drive not ONLINE"
12 021452  012737  000100  002370                   MOV     #8.ESTAT,EXTMSK ; Print status
13 021460  104455                                   TRAP    C$ERDF
   021462  000313                                   .WORD   203
   021464  011314                                   .WORD   HDR201
   021466  015220                                   .WORD   ERR001
14 021470  000137  022172                           JMP     900$            ; Error exit
15 021474                                  320$:
16 021474  013704  002324                           MOV     HCOM,R4         ; Load comm area address
17 021500  016437  000064  002430                   MOV     HC.MPK+P.UNSZ(R4),UNSIZ ; Get LO order word and
18 021506  016437  000066  002432                   MOV     HC.MPK+P.UNSZ+2(R4),UNSIZ+2; HI order word of unit size
19 021514  116437  000052  003244                   MOVB    HC.MPK+P.MODEL(R4),MODEL; Save model type
20
21 021522  012700  000012                           MOV     #MDLSIZ,R0      ; Load max model table index
22 021526                                  325$:
23 021526  123760  003244  003250                   CMPB    MODEL,MDLTBL(R0) ; Compare with table contents
24 021534  001403                                   BEQ     330$            ; Branch if match
25 021536  162700  000002                           SUB     #2,R0           ; Decrement index
26 021542  003371                                   BGT     325$            ; Continue until zero
27 021544                                  330$:
28 021544  010037  003246                           MOV     R0,MDLNDX       ; Save model index
29
30                                          ;       Allocate new RCT error table
31 021550                                  340$:
32 021550  013746  002176                           MOV     FFREE,-(SP)     ;;PUSH FFREE ON STACK
   021554  013746  002200                           MOV     FSIZE,-(SP)     ;;PUSH FSIZE ON STACK
33 021560  013701  002416                           MOV     RCTSIZ,R1       ; Load RCT size
34 021564  004737  040054                           JSR     PC,ALOCM        ; Allocate error table
35 021570  010137  002312                           MOV     R1,RCTTBL       ; Save table address
36 021574  012637  002200                           MOV     (SP)+,FSIZE     ;;POP STACK INTO FSIZE
   021600  012637  002176                           MOV     (SP)+,FFREE     ;;POP STACK INTO FFREE
37
38                                          ;       Clear RCT error table
39
40 021604  013700  002416                           MOV     RCTSIZ,R0       ; Load count
41 021610                                  350$:
42 021610  005021                                   CLR     (R1)+           ; Clear location
43 021612  005300                                   DEC     R0              ; Decrement
44 021614  001375                                   BNE     350$            ; Continue until zero
45
46                                          ;       Read RCT block 0 to obtain volume info
47 021616                                  360$:
48 021616  004737  030626                           JSR     PC,INITCPK      ;INITIALIZE THE COMMAND PACKET
```

```
     49 021622  012737  042472  002340          MOV     #DBUFF,UADR             ;GET BEGINNING ADDRESS OF DATA BUFFER
     50 021630  012737  000000  002476          MOV     #0,RCTBLK               ;INIT THE RCT LOGICAL BLOCK TO 0 AND
     51 021636  004737  030074                  JSR     PC,INITRW               ;SOME READ/WRITE PARAMETERS.
     52                                                                         ; Setup to issue MULTRD command
        021642  004737  027224                  JSR     PC,MULTRD               ; Issue command to the xDA
        021646  022172                           900$                            ; Here if fatal error,
     53 021650                          370$:
     54 021650  013704  002324                  MOV     HCOM,R4                 ; Load host comm area ptr
     55 021654  013705  002304                  MOV     CTLRTBL,R5              ; Load controller table ptr
     56 021660  004737  032022                  JSR     PC,GETVSN               ; Format volume serial number
     57
     58 021664  016546  000006                  MOV     C.DRVN(R5),-(SP)                ;PUSH C.DRVN(R5) ON STACK
        021670  011546                          MOV     (R5),-(SP)              ;PUSH (R5) ON STACK
        021672  012746  014225                  MOV     #DEVNAM,-(SP)           ;PUSH #DEVNAM ON STACK
        021676  013746  002074                  MOV     L$LUN,-(SP)             ;PUSH L$LUN ON STACK
        021702  012746  005016                  MOV     #INF110,-(SP)           ;PUSH #INF110 ON STACK
        021706  004137  033254                  JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
        021712  000012                          .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
     59
     60 021714                          385$:
     61 021714  013700  003246                  MOV     MDLNDX,R0               ; Load model index
     62 021720  013746  002432                  MOV     UNSIZ+2,-(SP)           ;PUSH UNSIZ+2 ON STACK
        021724  013746  002430                  MOV     UNSIZ,-(SP)             ;PUSH UNSIZ ON STACK
        021730  013746  002616                  MOV     VSNPTR,-(SP)            ;PUSH VSNPTR ON STACK
        021734  016046  003262                  MOV     MDLTEXT(R0),-(SP)               ;PUSH MDLTEXT(R0) ON STACK
        021740  012746  005165                  MOV     #INF111,-(SP)           ;PUSH #INF111 ON STACK
        021744  004137  033254                  JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
        021750  000012                          .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
     63
```

```
                                        ;       Read all RCT blocks
                                        400$:
021752  013704  002324                          MOV     HCOM,R4                 ; Load host comm area address
021756  004737  030626                          JSR     PC,INITCPK              ; Initialize command packet
021762  012737  042472  002340                  MOV     #DBUFF,UADR             ; Load buffer address
021770  012737  000000  002476                  MOV     #0,RCTBLK               ; Reset RCT logical block number
021776  012746  007002                          MOV     #INF301,-(SP)           ;PUSH #INF301 ON STACK
022002  004137  033254                          JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
022006  000002                                  .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
022010                                  420$:
022010  004737  030074                          JSR     PC,INITRW               ; Initialize R/W parameters
022014  063764  002476  000140                  ADD     RCTBLK,HC.CPK+P.LBN(R4) ; Add RCT logical block
022022  005564  000142                          ADC     HC.CPK+P.LBN+2(R4)      ; To start of RCT area
                                                                                ; Setup to issue MULTRD command
022026  004737  027224                          JSR     PC,MULTRD               ; Issue command to the xDA
022032  022172                                  900$                            ; Here if fatal error,
022034                                  430$:
022034  005237  002476                          INC     RCTBLK                  ; Increment to next block
022040  023737  002476  002416                  CMP     RCTBLK,RCTSIZ           ; Test for all block sread
022046  002760                                  BLT     420$                    ; Branch if NO
```

```
                                ;       Call STEP3 to read RCT block 0 and process replacement
                                ;       recovery if necessasy.
                                500$:
022050  004737  024260          JSR     PC,STEP3                ; Call STEP3 tc test for crash
022054  100446                  BMI     900$                    ; Branch if fatal error

022056  005737  002546          TST     NXTSTEP                 ; Test for recovery
022062  001433                  BEQ     550$                    ; Branch if NO

022064  005737  002150          TST     MANRPL                  ; Test for MANUAL mode
022070  001004                  BNE     520$                    ; Branch if YES

022072  005737  002152          TST     AUTORC                  ; Test for automatic recovery
022076  001015                  BNE     540$                    ; Branch if yes
022100  000434                  BR      900$                    ; Else, error exit
022102                          520$:
022102  012737  000001  002654  MOV     #1,REPLY                ; Else, set default reply
022110  104443                  TRAP    C$GMAN
022112  000404                  BR      10000$
022114  002654                  .WORD   REPLY
022116  000130                  .WORD   T$CODE
022120  015031                  .WORD   TXT006
022122  177777                  .WORD   -1
022124                          10000$:
022124  005737  002654          TST     REPLY                   ; Test replay
022130  001420                  BEQ     900$                    ; Branch if NO
022132                          540$:
022132  012746  010264          MOV     #INF601,-(SP)           ;PUSH #INF601 ON STACK
022136  004137  033254          JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
022142  000002                  .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
022144  004737  024156          JSR     PC,REPLACE              ; Process possible recovery
022150  022172                  900$                            ; Error exit
022152                          550$:
022152  004737  023160          JSR     PC,INIPARM              ; Initialize program variables

                                ;       Normal exit
022156                          800$:
022156  062716  000002          ADD     #2,(SP)                 ; Bump past error return
022162  012737  000000  002442  MOV     #0,STATUS               ; Load success
022170  000207                  RTS     PC                      ; and return

                                ;       Error exit
022172                          900$:
022172  017616  000000          MOV     @(SP),(SP)              ; Load error return
022176  012737  177777  002442  MOV     #-1,STATUS              ; Load failure
022204  000207                  RTS     PC                      ; and return
```

```
                                .SBTTL  INISWP  Initialize software parms
                                ;
                                ;INISWP:
                                ;       Initialize the parameters below by prompting for
                                ;       Operator input:
                                ;
                                ;       OPHELP:         Display operator help?
                                ;       MANRPL:         Automatic or Manual replacement?
                                ;       AUTORC:         Automatic crash recovery?
                                ;       DSPRPL:         Display replacements as they occur?
                                ;       DSPRCT:         Display RCT replacement descriptors?
                                ;       ENBRPL:         Enable Replacements?
                                ;       ENBWFE:         Enhibit write with Forced Error flag?
                                ;

022206                          INISWP:
022206  012746  004603                  MOV     @INF102,-(SP)           ;PUSH @INF102 ON STACK
022212  004137  033254                  JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
022216  000002                          .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
022220  012701  022525                  MOV     @SWMSG0,R1              ; Load Question address
022224  012702  002146                  MOV     @OPHELP,R2              ; Load reply address
022230  012712  000000                  MOV     @0,(R2)                 ; Default is "NO"
022234  004737  023126                  JSR     PC,GETLOG               ; Ask operator
022240  005737  002146                  TST     OPHELP                  ; Test response
022244  001402                          BEQ     10$                     ; Branch if "NO"
022246                          5$:
022246  004737  032150                  JSR     PC,DSPHELP              ; Display operator help
022252                          10$:
022252  012737  000000  002150          MOV     @0,MANRPL               ; Default is Auto replacemet
022260  012701  022553                  MOV     @SWMSG1,R1              ; Load Question address
022264  012702  002654                  MOV     @REPLY,R2               ; Load reply address
022270  012712  000101                  MOV     @'A,(R2)                ; Default is "AUTOMATIC"
022274  004737  023070                  JSR     PC,GETCHR               ; Ask operator
022300  122737  000115  002654          CMPB    @'M,REPLY               ; Test for "M"
022306  001004                          BNE     20$                     ; Branch if NO
022310  012737  000001  002150          MOV     @1,MANRPL               ; Else, set Manual replacement
022316  000430                          BR      50$                     ; and continue
022320                          20$:
022320  012701  022613                  MOV     @SWMSG2,R1              ; Load Question address
022324  012702  002152                  MOV     @AUTORC,R2              ; Load reply address
022330  012712  000001                  MOV     @1,(R2)                 ; Default is "YES"
022334  004737  023126                  JSR     PC,GETLOG               ; Ask operator
022340                          30$:
022340  012701  022644                  MOV     @SWMSG3,R1              ; Load Question address
022344  012702  002154                  MOV     @DSPRPL,R2              ; Load reply address
022350  012712  000001                  MOV     @1,(R2)                 ; Default is "YES"
022354  004737  023126                  JSR     PC,GETLOG               ; Ask operator
022360                          40$:
022360  012701  022707                  MOV     @SWMSG4,R1              ; Load Question address
022364  012702  002156                  MOV     @DSPRCT,R2              ; Load reply address
022370  012712  000000                  MOV     @0,(R2)                 ; Default is "NO"
022374  004737  023126                  JSR     PC,GETLOG               ; Ask operator
022400                          50$:
022400  012701  022753                  MOV     @SWMSG5,R1              ; Load Question address
022404  012702  002160                  MOV     @ENBRPL,R2              ; Load reply address
022410  012712  000001                  MOV     @1,(R2)                 ; Default is "YES"
022414  004737  023126                  JSR     PC,GETLOG               ; Ask operator
```

```
     56 022420                          60$:
     57 022420  000410                           BR      70$                     ; Bypass this one
     58 022422  012701  022777                   MOV     @SWMSG6,R1              ; Load Question address
     59 022426  012702  002162                   MOV     @ENBERRL,R2             ; Load reply address
     60 022432  012712  000001                   MOV     #1,(R2)                 ; Default is "YES"
     61 022436  004737  023126                   JSR     PC,GETLOG               ; Ask operator
     62 022442                          70$:
     63 022442  012701  023024                   MOV     @SWMSG7,R1              ; Load Question address
     64 022446  012702  002164                   MOV     @ENBWFE,R2              ; Load reply address
     65 022452  012712  000001                   MOV     #1,(R2)                 ; Default is "YES"
     66 022456  004737  023126                   JSR     PC,GETLOG               ; Ask operator
     67 022462                          100$:
     68 022462  000207                           RTS     PC                      ; Return to caller
     69
     70                                         .NLIST  BEX
     71 022464     110     141     163  BACKMSG:.ASCIZ  \Have you backed-up customer data\
     72 022525     104     151     163  SWMSG0: .ASCIZ  \Display operator Help\
     73 022553     101     165     164  SWMSG1: .ASCIZ  \Automatic or Manual replacement\
     74 022613     101     165     164  SWMSG2: .ASCIZ  \Automatic crash recovery\
     75 022644     104     151     163  SWMSG3: .ASCIZ  \Display replacements as they occur\
     76 022707     104     151     163  SWMSG4: .ASCIZ  \Display RCT replacement descriptors\
     77 022753     105     156     141  SWMSG5: .ASCIZ  \Enable replacements\
     78 022777     105     156     141  SWMSG6: .ASCIZ  \Enable error logging\
     79 023024     105     156     141  SWMSG7: .ASCIZ  \Enable write with Forced Error flag\
     80                                         .LIST   BEX
     81                                         .EVEN
     82
```

```
                                .SBTTL  GETCHR  Get character from Operator
                                ;
                                ;GETCHR:
                                ;       Gets an alphanumeric character input from operator.
                                ;Inputs:
                                ;       R1      .ASCIZ Prompt msg address
                                ;       R2      Reply address
                                ;
                                ;Outputs:
                                ;       Prints prompt; response is placed in reply address.
                                ;
                                ;Calling Seq:
                                ;
                                ;       MOV     #PROMPT,R1
                                ;       MOV     #REPLY,R2
                                ;       JSR     PC,GETCHR
                                ;


023070                          GETCHR:
023070  010137  023110                  MOV     R1,CHRMSG               ; Save message address
023074  010237  023104                  MOV     R2,CHRRPLY              ; Save reply address
023100                          10$:
023100  104443                          TRAP    C$GMAN
023102  000406                          BR      10001$
023104  023104                          .WORD   CHRRPLY
023106  000152                          .WORD   T$CODE
023110  023110                          .WORD   CHRMSG
023112  177777                          .WORD   -1
023114  000001                          .WORD   T$LOLIM
023116  000001                          .WORD   T$HILIM
023120                          10001$:
023120                          20$:
023120  117700  177760                  MOVB    @CHRRPLY,R0             ; Set return code
023124  000207                          RTS     PC                      ; and return
```

```
                                .SBTTL  GETLOG  Get Logical from Operator
                                ;
                                ;GETLOG:
                                ;       Gets an logical (Y/N) reply from operator.
                                ;Inputs:
                                ;       R1      .ASCIZ Prompt msg address
                                ;       R2      Reply address
                                ;
                                ;Outputs:
                                ;       Prints prompt; response is placed in reply address.
                                ;
                                ;Calling Seq:
                                ;
                                ;       MOV     #PROMPT,R1
                                ;       MOV     #REPLY,R2
                                ;       JSR     PC,GETLOG
                                ;

023126                          GETLOG:
023126  010137  023146                  MOV     R1,LOGMSG               ; Save message address
023132  010237  023142                  MOV     R2,LOGRPLY              ; Save reply address
023136                          10$:
023136  104443                  TRAP    C$GMAN
023140  000404                  BR      10002$
023142  023142                  .WORD   LOGRPLY
023144  000130                  .WORD   T$CODE
023146  023146                  .WORD   LOGMSG
023150  177777                  .WORD   -1
023152                          10002$:
023152                          20$:
023152  117700  177764                  MOVB    @LOGRPLY,R0             ; Set return code
023156  000207                  RTS     PC                              ; and return
```

```
                                .SBTTL  INIPARM Initialize program parameters
                                ;
                                ;INIPARM:
                                ;       Initialize program variables.
                                ;Inputs:
                                ;       None.
                                ;Outputs:
                                ;       Initializes program variables.
                                ;
                                ;Calling Seq:
                                ;
                                ;       JSR     PC,INIPARM
                                ;

023160                          INIPARM:
023160  012737  000000  002574        MOV     #0,ACCESS               ; Initialize
023166  012737  000000  002576        MOV     #0,ACCESS+2             ; ACCESS count
023174  012737  000000  002562        MOV     #0,GLBN                 ; Initialize starting
023202  012737  000000  002564        MOV     #0,GLBN+2               ; group LBN
023210  012737  000000  002600        MOV     #0,MINLBN               ; Reset
023216  012737  000000  002602        MOV     #0,MINLBN+2             ; Minimum
023224  013737  002430  002604        MOV     UNSIZ,MAXLBN            ; Reset
023232  013737  002432  002606        MOV     UNSIZ+2,MAXLBN+2        ; Maximum

023240  012737  000000  002566        MOV     #0,GBCNT                ; Group byte count
023246  012737  000001  002570        MOV     #1,GBCNT+2              ; is 128. x 512.

023254  012737  000000  002220        MOV     #0,KW.EL                ; Clear
023262  012737  000000  002222        MOV     #0,KW.EL+2              ; Elapsed time
023270  012737  000000  002466        MOV     #0,RECOVR               ; Reset recovery flag
023276  012737  000000  002434        MOV     #0,PRIMRY               ; Zero PRIMARY RBN count
023304  012737  000000  002436        MOV     #0,SCNDRY               ; Zero SECONDARY RBN count
023312  012737  000000  002440        MOV     #0,UNUSE                ; Zero UNUSABLE RBN count

023320  012737  000000  002530        MOV     #0,FERCNT               ; Clear FORCED ERROR count
023326  012737  000000  002532        MOV     #0,HCECNT               ; Clear HEADER COMP ERROR count
023334  012737  000000  002534        MOV     #0,DSTCNT               ; Clear DATA SYNC TMO count
023342  012737  000000  002536        MOV     #0,ECCCNT               ; Clear ECC ERROR count
023350  012737  000000  002540        MOV     #0,BBRCNT               ; Clear BBR count
023356  012737  000000  002542        MOV     #0,WFECNT               ; Clear WRITE FE count

023364  012737  000000  002516        MOV     #0,LBNSTAT              ; Clear LBN status
023372  012737  000000  002520        MOV     #0,RPLSTAT              ; Clear Replacement status
023400  012737  000000  002342        MOV     #0,CMDREF               ; Zero cmd ref number

023406  000207                        RTS     PC                      ; Return to caller
```

```
                                .SBTTL  GETLBN  Get LBN from operator
                                ;GETLBN
                                ;
                                ;Inputs:
                                ;       R1 =    Address of operator prompt
                                ;       R2 =    Address of receiving long word
                                ;
                                ;Outputs:
                                ;       Operator is prompted for LBN.  Reply is checked
                                ;       against UNSIZ maximum.
                                ;       LBN is converted to a 28-bit value by CNV28.
                                ;
                                ;Calling seq:
                                ;
                                ;       MOV     #PROMPT,R1
                                ;       MOV     #LBN,R4
                                ;       JSR     PC,GETLBN
                                ;

023410                          GETLBN:
023410  010146                         MOV     R1,-(SP)                ;;PUSH R1 ON STACK
023412  010246                         MOV     R2,-(SP)                ;;PUSH R2 ON STACK
023414  010346                         MOV     R3,-(SP)                ;;PUSH R3 ON STACK
023416  010446                         MOV     R4,-(SP)                ;;PUSH R4 ON STACK
023420  010546                         MOV     R5,-(SP)                ;;PUSH R5 ON STACK
023422  010137  023456                 MOV     R1,MSGADR               ; Save message address
023426                          10$:
023426  012746  014231                 MOV     #CRLF,-(SP)             ;PUSH #CRLF ON STACK
023432  004137  033254                 JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
023436  000002                         .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
023440  012737  000000  002666         MOV     #0,TTYIN                ; Flag default response
                                                                        ;PRINT 'Enter LBN to be replaced(D) 0 ?'
023446                          20$:
023446  104443                         TRAP    C$GMAN
023450  000406                         BR      10003$
023452  002666                         .WORD   TTYIN
023454  000152                         .WORD   T$CODE
023456  023456                         .WORD   MSGADR
023460  177777                         .WORD   177777
023462  000000                         .WORD   T$LOLIM
023464  000011                         .WORD   T$HILIM
023466                          10003$:
023466  005737  002666                 TST     TTYIN                   ; Test response
023472  001433                         BEQ     40$                     ; Branch if null
023474  004737  034756                 JSR     PC,CNV28                ;CONVERT ASCIZ TO DECIMAL
023500  103752                         BCS     10$                     ;BRANCH IF ERROR
023502  013700  002430                 MOV     UNSIZ,R0                ;STUFF IN LO ORDER UNIT SIZE AND
023506  013701  002432                 MOV     UNSIZ+2,R1              ;HI ORDER UNIT SIZE TO GET
                                                                        ;RCT STARTING LBN.
023512  162700  000001                 SUB     #1,R0                   ;DECREMENT TO GET LAST HOST LBN AND
023516  005601                         SBC     R1                      ;SUBTRACT CARRY BIT.
023520  026401  000002                 CMP     2(R4),R1                ;SEE IF HI ORDER LBN WAS EXCEEDED,
023524  003003                         BGT     30$                     ;BRANCH IF SO, ELSE
023526  002412                         BLT     35$                     ;WITHIN LIMITS.
023530  021400                         CMP     (R4),R0                 ;SEE IF LO ORDER LBN WAS EXCEEDED,
023532  101410                         BLOS    35$                     ;BRANCH IF NOT, ELSE
023534                          30$:                                    ,PRINT 'LIMITS   LO= 0, HI= "D32".'
```

GETLBN Get LBN from operator

```
     49 023534  010146                          MOV     R1, (SP)              ;PUSH R1 ON STACK
        023536  010046                          MOV     R0,-(SP)              ;PUSH R0 ON STACK
        023540  012746  014367                  MOV     @OLIMIT,-(SP)         ;PUSH @OLIMIT ON STACK
        023544  004137  033244                  JSR     R1,LPNTF                      ;CALL LPNTF PRINT ROUTINE
        023550  000006                          .WORD   ARG.CT                ;ARGUMENT COUNT * 2
     50 023552  000725                          BR      10$                   ;TRY AGAIN
     51 023554                          35$:
     52 023554  012737  000001  002666          MOV     #1,TTYIN              ; Set SUCCESS
     53
     54 023562                          40$:
     55 023562  012605                          MOV     (SP)+,R5              ;;POP STACK INTO R5
        023564  012604                          MOV     (SP)+,R4              ;;POP STACK INTO R4
        023566  012603                          MOV     (SP)+,R3              ;;POP STACK INTO R3
        023570  012602                          MOV     (SP)+,R2              ;;POP STACK INTO R2
        023572  012601                          MOV     (SP)+,R1              ;;POP STACK INTO R1
     56 023574  013737  002666  002442          MOV     TTYIN,STATUS          ; Set condition codes for caller
     57 023602  000207                          RTS     PC                    ; Return to caller
     58
```

```
                                .SBTTL  READLBN Read suspect LBN
                                ;READLBN
                                ;
                                ;Reread suspect LBN 32 times to determine if really bad
                                ;and retrieve best data.
                                ;
                                ;Inputs:
                                ;       HCOM    Host communications area
                                ;
                                ;Outputs:
                                ;       LBNSTAT Status of read:
                                ;
                                ;         TF.FER = FORCED ERROR
                                ;         TF.HCE = HEADER COMP ERROR
                                ;         TF.DST = DATA SYNC TMO
                                ;         TF.ECC = ECC ERROR
                                ;         TF.SEX = SERIOUS EXCEPTION
                                ;         TF.LOG = ERRORLOG SENT
                                ;         TF.BBU = BAD BLOCK UNREPORTED
                                ;         TF.BBR = BAD BLOCK REPORTED
                                ;         TF.BAD = DATA IS BAD
                                ;
                                ;       STATUS  0 or 1: success
                                ;               -1: Fatal error
                                ;
                                ;Calling seq:
                                ;
                                ;       JSR     PC,READLBN
                                ;       .WORD   <error exit>
                                ;
023604                          READLBN:
023604  013704  002324                  MOV     HCOM,R4                 ; Load comm ptr
023610  012737  000040  002556          MOV     #32.,RDCNT              ; Initialize READ count
023616                          100$:
023616  012737  000000  002346          MOV     #0,CMDMOD               ; Zero cmd modifiers
023624  012737  000000  002516          MOV     #0,LBNSTAT              ; Zero LBN status
023632                          110$:
023632  004737  024772                  JSR     PC,STEP4                ; Read LBN data
023636  100517                          BMI     900$                    ; Branch if fatal error
023640  153737  002356  002516          BISB    FLAGS,LBNSTAT           ; Set end msg flags
023646  005737  002354                  TST     EMSTAT                  ; Test engmsg status
023652  001464                          BEQ     200$                    ; Branch if SUCCESS
023654                          120$:
023654  013700  002354                  MOV     EMSTAT,R0               ; Load endmsg status
023660  052737  100000  002516          BIS     #TF.BAD,LBNSTAT         ; Set LBN data bad
                                
023666  022700  000010                  CMP     #ST.DAT,R0              ; Test for Forced Error
023672  001004                          BNE     122$                    ; Branch if NO
023674  052737  000001  002516          BIS     #  .FER,LBNSTAT         ; Else, set FER status
023702  000450                          BR      200$                    ; And write to RCT
023704                          122$:
023704  022700  000110                  CMP     #SB.HCE,R0              ; Test for Header Compare Error
023710  001004                          BNE     124$                    ; Branch if NO
023712  052737  000002  002516          BIS     #TF.HCE,LBNSTAT         ; Else, set HCEstatus
023720  000415                          BR      130$                    ; And continue
023722                          124$:
```

```
                                                CMP     @SB.DST,R0              ; Test for Data Sync Timeout
                                                BNE     126$                    ; Branch if NO
                                                BIS     @TF.DST,LBNSTAT         ; Else, set DST status
                                                BR      130$                    ; And continue
                                        126$:
                                                CMP     @SB.ECC,R0              ; Test for Uncorrectable ECC
                                                BNE     130$                    ; Branch if NO
                                                BIS     @TF.ECC,LBNSTAT         ; Else, set ECC status
                                        130$:
                                                DEC     RDCNT                   ; Decrement count
                                                BNE     100$                    ; and continue until zero
                                        150$:
                                                BIT     TF.ECC,LBNSTAT          ; Test for uncorrectable ECC
                                                BEQ     180$                    ; Branch if NO
                                                MOV     @MD.SEC,CMDMOD          ; Else, suppress ECC
                                        180$:
                                                JSR     PC,STEP4                ; Read LBN
                                                BMI     900$                    ; Branch if fatal error
                                                TST     ENBRPL                  ; Test for replacement enabled
                                                BEQ     300$                    ; BRanch if NO
                                                JSR     PC,STEP5                ; Write LBN data
                                                BMI     900$                    ; Branch if fatal error
                                                BR      300$                    ; Exit
                                        200$:
                                                TST     ENBRPL                  ; Test for replacement enabled
                                                BEQ     210$                    ; BRanch if NO
                                                JSR     PC,STEP5                ; Else, record data in RCT
                                                BMI     900$                    ; Branch if fatal error
                                        210$:
                                                TST     LBNSTAT                 ; Test status
                                                BNE     300$                    ; Brnach if non-zero
                                        220$:
                                                DEC     RDCNT                   ; Decrement count
                                                BNE     100$                    ; continue if not zero
                                        300$:
                                                ADD     @2,(SP)                 ; Bump past error return
                                                MOV     LBNSTAT,STATUS          ; Set cond codes
                                                BIC     @TF.BAD,STATUS          ; Clear MSB
                                                RTS     PC                      ; Return to caller
                                        900$:
                                                MOV     @(SP),(SP)              ; Load error return
                                                MOV     @-1,STATUS              ; Load fatal error
                                                RTS     PC                      ; Return to caller

;
;
```

```
                                .SBTTL  REPLACE Replacement routine
                                ;REPLACE
                                ;
                                ;This is the global bad block replacement routine, used by all tests.
                                ;It performs all steps used in the modified replacement algorithm
                                ;designed for this diagnostic.  The routine will only execute one step
                                ;on each call, with the next step in the algorithm placed in NXTSTEP,
                                ;based upon program logic.
                                ;
                                ;Entries:
                                ;       REPLACE - Step to execute in NXTSTEP
                                ;       STEPx   - Step to execute in STEP
                                ;Exits:
                                ;       PC+2    -  Fatal error
                                ;
                                ;       NXTSTEP =  x:  Continue with STEPx
                                ;               =  0:  Replacement complete
                                ;               = -1:  Replacement step error
                                ;
                                ;Steps:
                                ;       REPLACE - General purpose entry.
                                ;
                                ;       STEP3   - Read RCT 0 and test for recovery in progress.
                                ;       STEP4   - Read LBN selected for replacement.
                                ;       STEP5   - Write LBN image to RCT block 1.
                                ;       STEP6   - Update RCT block 0 to indicate PHASE 1.
                                ;       STEP9   - Search for available RBN for replacement.
                                ;       STEP10  - Update RCT block 0 to indicate PHASE 2.
                                ;       STEP11  - Update RCT replacement descriptor.
                                ;       STEP12  - Issue REPLACE command and write LBN data.
                                ;       STEP13  - Update RCT block 0 to indicate replacement complete.
                                ;       STEP15  - Update RCT descriptor to indicate usage.
                                ;       STEP16  - Write LBN image to replaced LBN.
                                ;       STEP17  - Update RCT block 0 to indicate replacement complete.
                                ;
                                ;

024112                          STEPTBL:
024112  024250                         .WORD           STEPFTL         ; Step 0 entry
024114  024250                         .WORD           STEPFTL         ; Step 1 entry
024116  024250                         .WORD           STEPFTL         ; Step 2 entry
024120  024260                         .WORD           STEP3           ; Step 3 entry
024122  024772                         .WORD           STEP4           ; Step 4 entry
024124  025136                         .WORD           STEP5           ; Step 5 entry
024126  025204                         .WORD           STEP6           ; Step 6 entry
024130  024250                         .WORD           STEPFTL         ; Step 7 entry
024132  024250                         .WORD           STEPFTL         ; Step 8 entry
024134  025350                         .WORD           STEP9           ; Step 9 entry
024136  025460                         .WORD           STEP10          ; Step 10 entry
024140  025610                         .WORD           STEP11          ; Step 11 entry
024142  026132                         .WORD           STEP12          ; Step 12 entry
024144  026530                         .WORD           STEP13          ; Step 13 entry
024146  024250                         .WORD           STEPFTL         ; Step 14 entry
024150  026640                         .WORD           STEP15          ; Step 15 entry
024152  026760                         .WORD           STEP16          ; Step 16 entry
024154  027132                         .WORD           STEP17          ; Step 17 entry
```

```
                000044                  STEPSIZ =               .-STEPTBL       ; Number of table entries

024156                                  REPLACE:

024156                                  10$:
024156  013700  002546                          MOV     NXTSTEP,R0              ; Load next STEP
024162  010037  002544                          MOV     R0,STEP                 ; Save as current STEP
024166  006300                                  ASL     R0                      ; STEP * 2 is offset
024170  003416                                  BLE     STEPERR                 ; Error if STEP <= 0
024172  022700  000044                          CMP     #STEPSIZ,R0             ; Compare to table max
024176  003413                                  BLE     STEPERR                 ; Error if STEP >= STEPSIZ

024200  004770  024112                          JSR     PC,@STEPTBL(R0)         ; Else, JSR to STEP entry
024204  005737  002546                          TST     NXTSTEP                 ; Test return code
024210  003362                                  BGT     10$                     ; Branch if next STEP > zero
024212  100405                                  BMI     STEPERR                 ; Else, error if STEP < zero

                                        ;       Normal return
024214                                  20$:
024214  062716  000002                          ADD     #2,(SP)                 ; Bump past error return
024220  013700  002546                          MOV     NXTSTEP,R0              ; Set cond codes for caller
024224  000207                                  RTS     PC                      ; and return

                                        ;       Fatal error return for replacement STEPx.
024226                                  STEPERR:
024226  012737  177777  002546                  MOV     #-1,NXTSTEP             ; Load fatal status
024234  017616  000000                          MOV     @(SP),(SP)              ; Load error return
024240  013737  002546  002442                  MOV     NXTSTEP,STATUS          ; Set cond codes
024246  000207                                  RTS     PC                      ; Return to caller

                                        ;       Illegal STEP
024250                                  STEPFTL:
024250  012737  177777  002546                  MOV     #-1,NXTSTEP             ; Load fatal error
024256  000207                                  RTS     PC                      ; and return
```

```
                                .SBTTL  STEP3   Replacement step 3
                                ;STEP3
                                ;
                                ;Read RCT block 0.  Test for PHASE 1 or PHASE 2 replacement in progress.
                                ;If P1 set, control transferred to STEP9.  If P2 set, control transferred
                                ;to STEP11.
                                ;
                                ;Inputs:
                                ;       R4 - Address of host comm area
                                ;
                                ;Outputs:
                                ;       VIBUFF - Set if LBN data is valid
                                ;       TBUFF - Image of RCT block 0
                                ;
                                ;Externals:
                                ;       INTCPK, INITRW, MULTRD, COPY
                                ;
                                ;Exits:
                                ;       EXIT3   - DEFAULT next STEP is 4
                                ;                 PHASE 1 recover STEP is 9
                                ;                 PHASE 2 recover STEP is 11.
                                ;       STEPERR - Fatal error exit
                                ;

024260                          STEP3:
024260  013704  002324                  MOV     HCOM,R4                 ; Load host comm area address
024264  004737  030626                  JSR     PC,INTCPK               ;INITIALIZE THE COMMAND PACKET
024270  012737  042472  002340          MOV     #DBUFF,UADR             ;GET BEGINNING ADDRESS OF DATA BUFFER
024276  012737  000000  002476          MOV     #0,RCTBLK               ;INIT THE RCT LOGICAL BLOCK TO 0 AND
024304  004737  030074                  JSR     PC,INITRW               ;SOME READ/WRITE PARAMETERS.
                                                                        ; Setup to issue MULTRD command
024310  004737  027224                  JSR     PC,MULTRD               ; Issue command to the xDA
024314  024250                          STEPFTL                         ; Here if fatal error.
024316                          1$:
024316  004537  034276                  JSR     R5,COPY                 ;COPY RCT LOGICAL BLOCK 0 DATA FROM
024322  042472                          .WORD   DBUFF                   ;DATA BUFFER TO
024324  043472                          .WORD   TBUFF                   ;TEMPORARY BUFFER FOR LATER USE.
024326  013701  002340                  MOV     UADR,R1                 ;GET THE BEGINNING OF UNIBUS ADDRESS
```

```
                                        ;       Process possible crash recovery
                                        ;
024332  005037  002466                  CLR     RECOVR                  ; Assume no recovery needed
024336  032761  100000  000010          BIT     #P1,RFLAGS(R1)          ; Test for Phase 1 crash
024344  001404                          BEQ     25$                     ; Branch if NO
024346  012737  000001  002466          MOV     #1,RECOVR               ; Else, set for PHASE 1
024354  000415                          BR      3$                      ; and continue
024356                                  25$:
024356  032761  040000  000010          BIT     #P2,RFLAGS(R1)          ; Test for Phase 2 crash
024364  001404                          BEQ     30$                     ; Branch if NO
024366  012737  000002  002466          MOV     #2,RECOVR               ; Else, set for PHASE 2
024374  000405                          BR      3$                      ; and continue
024376                                  30$:
024376  012737  000000  002546          MOV     #0,NXTSTEP              ; Set done
024404  000137  024770                  JMP     EXIT3                   ; and exit
024410                                  3$:
024410  012737  000000  002516          MOV     #0,LBNSTAT              ; Zero LBN status
024416  112737  000001  002472          MOVB    #1,VIBUFF               ;ASSUME IMAGE DATA WAS VALID,
024424  016137  000014  002446          MOV     LBNLO(R1),LBN           ;RESTORE LO WORD OF LBN AND
024432  016137  000016  002450          MOV     LBNLO+2(R1),LBN+2       ;HI WORD OF LBN BEING REPLACED.
024440  032761  000200  000010          BIT     #FEF,RFLAGS(R1)         ;SEE IF FORCED ERROR FLAG IS SET,
024446  001405                          BEQ     5$                      ;BRANCH IF NOT, ELSE
024450  105037  002472                  CLRB    VIBUFF                  ;INDICATE IMAGE DATA IS NOT VALID
024454  052737  100001  002516          BIS     #TF.BAD!TF.FER,LBNSTAT  ; Set forced error indicator
024462                                  5$:
024462  016137  000020  002452          MOV     RBNLO(R1),RBN           ;RESTORE LO WORD OF RBN AND
024470  016137  000022  002454          MOV     RBNLO+2(R1),RBN+2       ;HI WORD OF THE RBN REPLACEMENT.
024476                                  50$:
024476  012737  000004  002370          MOV     #B.PHASE,EXTMSK         ; Print phase
024504  012737  013402  002552          MOV     #ERM605,BASEMSG         ; "CRASH occured during replacement..."
024512  104457                          TRAP    C$ERSOFT
024514  001135                          .WORD   605
024516  013173                          .WORD   HDR601
024520  015720                          .WORD   ERR601
```

```
                                        55$:
024522                                  MOV     #0,RPLSTAT              ; Zero replacement status
024522  012737  000000  002520          CLRB    MATFLG                  ;ASSUME NO MATCH FOR LBN
024530  105037  002514                  BIT     #BRF,RFLAGS(R1)         ;SEE IF BAD RBN FLAG IS SET,
024534  032761  020000  000010          BEQ     7$                      ;BRANCH IF NOT, ELSE
024542  001450                          MOVB    #1,MATFLG               ;SET THE MATCHED LBN FLAG.
024544  112737  000001  002514          MOV     BADRBN(R1),MATRBN       ;RESTORE MATCHED RBN LO ORDER WORD AND
024552  016137  000024  002462          MOV     BADRBN+2(R1),MATRBN+2   ;RBN HI ORDER WORD.
024560  0161..  000026  002464
                                        CLRB    SFLAG                   ;ASSUME PRIMARY EMPTY SEARCH STATUS
024566  105037  002515                  MOV     R4,-(SP)                ;;PUSH R4 ON STACK
024572  010446                          MOV     R5,-(SP)                ;;PUSH R5 ON STACK
024574  010546                          MOV     LBN,R3                  ;GET LO WORD AND
024576  013703  002446                  MOV     LBN+2,R4                ;HI WORD OF LBN BEING REPLACED.
024602  013704  002450                  MOV     TRKSIZ,R0               ;GET THE TRACK SIZE,
024606  013700  002420                  JSR     PC,DIVIDE               ;DIVIDE TO FIND THE TRACK
024612  004737  034436                                                  ;OF LBN BEING REPLACED
                                        MOV     (SP)+,R5                ;;POP STACK INTO R5
024616  012605                          MOV     (SP)+,R4                ;;POP STACK INTO R4
024620  012604                          MOVB    RBNS,R0                 ;GET NUMBER OF RBNS PER TRACK,
024622  113700  002422                  MOV     R0,-(SP)                ;PUT THE MULTIPLER ON THE STACK
024626  010046                          MOV     R3,-(SP)                ;PUT THE MULTIPLICAND ON THE STACK
024630  010346                          JSR     PC,MULT                 ;CALL THE MULTPLY ROUTINE
024632  004737  034542                  CMP     (SP)+,RBN               ;SEE IF LO ORDER RBN's ARE SAME,
024636  022637  002452                  BEQ     59$                     ; Branch if yes
024642  001402                          TST     (SP)+                   ; Else, adjust stack
024644  005726                          BR      6$                      ; And continue
024646  000403
                                        59$:
024650                                  CMP     (SP)+,RBN+2             ;SEE IF HI ORDER RBN's ARE SAME,
024650  022637  002454                  BEQ     7$                      ;BRANCH IF SO, ELSE
024654  001403                          6$:
                                        MOVB    #1,SFLAG                ;SET SECONDARY EMPTY SEARCH STATUS.
024656
024656  112737  000001  002515
```

```
                                        7$:
024664                                  MOV     #IBUFF,UADR             ;GET BEGINNING ADDRESS OF IMAGE BUFFER
024664  012737  044472  002340          MOV     #1,RCTBLK               ;INIT THE RCT LOGICAL BLOCK TO 1 AND
024672  012737  000001  002476          JSR     PC,INITRW               ;SOME READ/WRITE PARAMETERS.
024700  004737  030074                  ADD     RCTBLK,HC.CPK+P.LBN(R4) ;ADD RCT LOGICAL BLOCK TO STARTING
024704  063764  002476  000140          ADC     HC.CPK+P.LBN+2(R4)      ;HOST LBN OF THE RCT AREA.
024712  005564  000142                  ;
                                        ; Setup to issue MULTRD command
024716  004737  027224                  JSR     PC,MULTRD               ; Issue command to the xDA
024722  024250                          STEPFTL                         ; Here if fatal error,
024724  001405                          BEQ     9$                      ; Branch if command successful,
024726                                  8$:
024726  105037  002472                  CLRB    VIBUFF                  ;INDICATE IMAGE DATA IS NOT VALID
024732  052737  100000  002516          BIS     #TF.BAD,LBNSTAT         ; Set BAD LBN status
024740                                  9$:
024740  032761  100000  000010          BIT     #P1,RFLAGS(R1)          ;SEE IF CRASH OCCURED IN PHASE 1.
024746  001405                          BEQ     10$                     ; BRANCH IF NOT, ELSE
024750  012737  000011  002546          MOV     #9.,NXTSTEP             ; Next STEP for PHASE 1 recovery is 9
024756  000137  024770                  JMP     EXIT3                   ; and exit
024762                                  10$:
024762  012737  000013  002546          MOV     #11.,NXTSTEP            ; Next STEP is 11.
024770                                  EXIT3:
024770  000207                          RTS     PC                      ; Return to caller
```

```
                                .SBTTL  STEP4   Replacement step 4
                                ;STEP4
                                ;
                                ;Read LBN to be replaced.
                                ;
                                ;Inputs:
                                ;       R4 - Address of host comm area
                                ;       LBN - Address of LBN to read
                                ;
                                ;Outputs:
                                ;       IBUFF - Contains LBN image read
                                ;       VIBUFF - Set if LBN data is valid
                                ;
                                ;Externals:
                                ;       INITRW, CLRBUF, ISSUE
                                ;
                                ;Exits:
                                ;       LBNERR  - LBN error exit
                                ;       STEPERR - Fatal error exit
                                ;

024772                          STEP4:
024772  013704  002324                MOV     HCOM,R4                 ; Load host comm area address
024776  112737  000001  002472        MOVB    #1,VIBUFF               ; Assume image data is valid
025004  012737  044472  002340        MOV     #IBUFF,UADR             ;GET BEGINNING ADDRESS OF IMAGE BUFFER
025012  004737  030074                JSR     PC,INITRW               ;INIT SOME READ/WRITE PARAMETERS AND
025016  013764  002446  000140        MOV     LBN,HC.CPK+P.LBN(R4)    ;GET THE REPLACED LBN ADDRESS.
025024  013764  002450  000142        MOV     LBN+2,HC.CPK+P.LBN+2(R4)
025032  004737  034240                JSR     PC,CLRBUF               ;CLEAR THE BUFFER BEFORE READING
                                                                      ; Setup to issue OP.RD command
025036  012700  000041                MOV     #OP.RD,R0               ; Load MSCP opcode
025042  004737  030204                JSR     PC,ISSUE                ; Issue command to the xDA
025046  024250                        STEPFTL                         ; Here if fatal error,
025050  001426                        BEQ     EXIT4                   ; Branch if command successful,
025052                          20$:
025052  112737  000000  002472        MOVB    #0,VIBUFF               ; Set image data not valid
025060  013700  002354                MOV     EMSTAT,R0               ; Reload emdmsg status
025064  042700  177740                BIC     #^CST.MSK,R0            ; Clear any subcodes
025070  022700  000010                CMP     #ST.DAT,R0              ; Test for Data error
025074  001414                        BEQ     EXIT4                   ; Branch if YES

025076  012737  012137  002552        MOV     #ERM301,BASEMSG         ; "Failed READ..."
025104  012737  000140  002370        MOV     #8.MSCP,EXTMSK          ; Flag all MSCP fields
025112  104456                        TRAP    C$ERHRD
025114  000455                        .WORD   301
025116  012043                        .WORD   HDR301
025120  015504                        .WORD   ERR301
025122  000137  024250                JMP     STEPFTL                 ; Fatal error exit
025126                          EXIT4:
025126  012737  000005  002546        MOV     #5,NXTSTEP              ; Next STEP is 5.
025134  000207                        RTS     PC                      ; Return to caller
```

```
      1                                 .SBTTL  STEP5   Replacement step 5
      2                                 ;STEP5
      3                                 ;
      4                                 ;Write LBN image to RCT block 1.
      5                                 ;
      6                                 ;Inputs:
      7                                 ;       R4 - Address of host comm area
      8                                 ;       UADR - Contains address of LBN data to write
      9                                 ;
     10                                 ;Outputs:
     11                                 ;       LBN data written to RCT block 1
     12                                 ;
     13                                 ;Externals:
     14                                 ;       INITRW, MULTWR
     15                                 ;
     16                                 ;Exits:
     17                                 ;       EXIT4   - Successful exit; NXTSTEP is 5.
     18                                 ;       STEPERR - Fatal Error exit
     19                                 ;
     20
     21 025136                          STEP5:
     22 025136  013704  002324                  MOV     HCOM,R4                 ; Load host comm area address
     23 025142  012737  000001  002476          MOV     #1,RCTBLK               ;INIT THE RCT LOGICAL BLOCK TO 1 AND
     24 025150  004737  030074                  JSR     PC,INITRW               ;SOME READ/WRITE PARAMETERS.
     25 025154  063764  002476  000140          ADD     RCTBLK,HC.CPK+P.LBN(R4) ;ADD RCT LOGICAL BLOCK TO STARTING
     26 025162  005564  000142                  ADC     HC.CPK+P.LBN+2(R4)      ;HOST LBN OF THE RCT AREA.
     27                                                                         ; Setup to issue MULTWR command
        025166  004737  027514                  JSR     PC,MULTWR               ; Issue command to the xDA
        025172  024250                          STEPFTL                         ; Here if fatal error.
     28 025174                          EXIT5:
     29 025174  012737  000006  002546          MOV     #6,NXTSTEP              ; Next step is 6.
     30 025202  000207                          RTS     PC                      ; Return
     31
```

```
                                .SBTTL  STEP6   Replacement step 6
                                ;STEP6
                                ;
                                ;Read RCT block 0 into working buffer.  Update flags to indicate PHASE 1
                                ;replacement in progress.  Rewrite RCT block 0.  If MULTIWRITE fails,
                                ;control is transferred to STEP17.
                                ;
                                ;Inputs:
                                ;       R4 - Address of host comm area
                                ;       VIBUFF - Set if LBN data is valid
                                ;
                                ;Outputs:
                                ;       TBUFF - Contains RCT block 0 image
                                ;
                                ;Externals:
                                ;       INITRW, MULTRD, MULTWR, COPY
                                ;
                                ;Exits:
                                ;       RCT MULTIREAD error exit, next STEP is 17
                                ;       STEPERR - Fatal error exit
                                ;

025204                          STEP6:
025204  013704  002324          MOV     HCOM,R4                 ; Load host comm area address
025210  012737  042472  002340  MOV     #DBUFF,UADR             ;GET BEGINNING ADDRESS OF DATA BUFFER
025216  012737  000000  002476  MOV     #0,RCTBLK               ;INIT THE RCT LOGICAL BLOCK TO 0 AND
025224  004737  030074          JSR     PC,INITRW               ;SOME READ/WRITE PARAMETERS.
                                                                ; Setup to issue MULTRD command
025230  004737  027224          JSR     PC,MULTRD               ; Issue command to the xDA
025234  024250                  STEPFTL                         ; Here if fatal error.
025236                          1$:
025236  004537  034276          JSR     R5,COPY                 ;COPY RCT LOGICAL BLOCK 0 DATA FROM
025242  042472                  .WORD   DBUFF                   ;DATA BUFFER TO
025244  043472                  .WORD   TBUFF                   ;TEMPORARY BUFFER FOR LATER USE.

025246  013701  002340          MOV     UADR,R1                 ;GET THE BEGINNING OF UNIBUS ADDRESS
025252  013761  002446  000014  MOV     LBN,LBNLO(R1)           ;STORE LO WORD OF LBN AND
025260  013761  002450  000016  MOV     LBN+2,LBNLO+2(R1)       ;HI WORD OF LBN BEING REPLACED.
025266  012761  100000  000010  MOV     #P1,RFLAGS(R1)          ;SET P1 FLAG IN REPLACEMENT FLAG WORD
025274  005737  002516          TST     LBNSTAT                 ; Test for Valid LBN DATA
025300  100003                  BPL     3$                      ;BRANCH IF SO, ELSE
025302  052761  000200  000010  BIS     #FEF,RFLAGS(R1)         ;SET FORCED ERROR FLAG.
025310                          3$:
025310  012737  000000  002476  MOV     #0,RCTBLK               ;INIT THE RCT LOGICAL BLOCK TO 0 AND
025316  004737  030074          JSR     PC,INITRW               ;SOME READ/WRITE PARAMETERS.
                                                                ; Setup to issue MULTWR command
025322  004737  027514          JSR     PC,MULTWR               ; Issue command to the xDA
025326  024250                  STEPFTL                         ; Here if fatal error.
025330                          4$:
025330  004537  034276          JSR     R5,COPY                 ;COPY RCT LOGICAL BLOCK 0 DATA FROM
025334  042472                  .WORD   DBUFF                   ;DATA BUFFER TO
025336  043472                  .WORD   TBUFF                   ;TEMPORARY BUFFER FOR LATER USE.
025340                          EXIT6:
025340  012737  000011  002546  MOV     #9.,NXTSTEP             ; Load next STEP is 9.
025346  000207                  RTS     PC                      ; Return
```

```
                                .SBTTL  STEP9   Replacement step 9
                                ;STEP9
                                ;
                                ;Search for available RBN for replacement.
                                ;
                                ;Inputs:
                                ;       R4 - Address of host comm area
                                ;       DBUFF - Scratch buffer
                                ;
                                ;Outputs:
                                ;       RBN - Replacement RBN
                                ;       SFLAG - Search status
                                ;       MATRBN - Match RBN
                                ;       MATFLG - Set if LBNs matched
                                ;
                                ;Externals:
                                ;       SEARCH
                                ;
                                ;Exits:
                                ;       STEP16  - Search error exit
                                ;       STEPERR - Fatal error exit
                                ;

025350                          STEP9:
025350  013704  002324                  MOV     HCOM,R4                 ; Load host comm area address
025354  004737  030626                  JSR     PC,INITCPK              ;INITIALIZE THE COMMAND PACKET
025360  012737  042472  002340          MOV     #DBUFF,UADR             ;GET BEGINNING ADDRESS OF DATA BUFFER
025366  004737  031400                  JSR     PC,SEARCH               ;CALL SEARCH ROUTINE
025372  100004                          BPL     1$                      ; Branch if unsuccessful
025374  012737  177777  002546          MOV     #-1,NXTSTEP             ; Set fatal error
025402  000207                          RTS     PC                      ; and return
025404                          1$:
025404  123727  002515  000002          CMPB    SFLAG,#2                ;SEE IF RCT TABLE WAS FULL.
025412  001016                          BNE     EXIT9                   ;BRANCH IF NOT, ELSE
025414                          10$:
025414  012737  013472  002552          MOV     #ERM606,BASEMSG         ; "Full RCT table detected..."
025422  012737  000000  002370          MOV     #0,EXTMSK               ; Zero error mask
025430  104456                          TRAP    C$ERHRD
025432  001136                          .WORD   606
025434  013173                          .WORD   HDR601
025436  015720                          .WORD   ERR601
025440  012737  000020  002546          MOV     #16.,NXTSTEP            ; Next STEP is 16.
025446  000207                          RTS     PC                      ; Return
025450                          EXIT9:
025450  012737  000012  002546          MOV     #10.,NXTSTEP            ; Next STEP is 10.
025456  000207                          RTS     PC                      ; Return
```

```
                                .SBTTL  STEP10  Replacement step 10
                                ;STEP10
                                ;
                                ;Update RCT block 0 from working buffer to indicate PHASE 2 of
                                ;replacement.
                                ;
                                ;Inputs:
                                ;       R4 - Address of host comm area
                                ;       TBUFF - Working copy of RCT block 0
                                ;
                                ;       RBN - Replacement RBN
                                ;       SFLAG - Search status
                                ;       MATRBN - Match RBN
                                ;       MATFLG - Set if LBNs matched
                                ;
                                ;Outputs:
                                ;       RCT block 0 RBN - Replacement RBN
                                ;       RCT block 0 BADRBN - Bad RBN (if any)

                                ;Externals:
                                ;       INITRW, MULTWR, COPY
                                ;
                                ;Exits:
                                ;       STEP11  - Successful exit
                                ;       STEP16  - RCT MULTIWRITE error exit
                                ;       STEPERR - Fatal error exit
                                ;

025460                          STEP10:
025460  004537  034276                  JSR     R5,COPY                 ;COPY RCT LOGICAL BLOCK 0 DATA FROM
025464  043472                          .WORD   TBUFF                   ;TEMPORARY BUFFER TO
025466  042472                          .WORD   DBUFF                   ;DATA BUFFER.

025470  013704  002324                  MOV     HCOM,R4                 ; Load host comm area address
025474  013701  002340                  MOV     UADR,R1                 ;GET THE BEGINNING OF UNIBUS ADDRESS
025500  013761  002452  000020          MOV     RBN,RBNLO(R1)           ;STORE LO WORD OF RBN AND
025506  013761  002454  000022          MOV     RBN+2,RBNLO+2(R1)       ;HI WORD OF THE RBN REPLACEMENT.
025514  052761  040000  000010          BIS     #P2,RFLAGS(R1)          ;SET PHASE 2 FLAG IN REPLACEMENT WORD
025522  105737  002514                  TSTB    MATFLG                  ;SEE IF LBN'S MATCHED DURING SEARCH.
025526  001411                          BEQ     1$                      ;BRANCH IF NOT, ELSE
025530  052761  020000  000010          BIS     #BRF,RFLAGS(R1)         ;SET BAD RBN FLAG IN REPLACEMENT WORD.
025536  013761  002462  000024          MOV     MATRBN,BADRBN(R1)       ;STORE LO WORD OF RBN AND
025544  013761  002464  000026          MOV     MATRBN+2,BADRBN+2(R1)   ;HI WORD OF THE BAD RBN.
025552                          1$:
025552  042761  100000  000010          BIC     #P1,RFLAGS(R1)          ;CLEAR PHASE 1 FLAG IN REPLACEMENT WORD.
025560  012737  000000  002476          MOV     #0,RCTBLK               ;INIT THE RCT LOGICAL BLOCK TO 0 AND
025566  004737  030074                  JSR     PC,INITRW               ;SOME READ/WRITE PARAMETERS.
                                                                        ; Setup to issue MULTWR command
025572  004737  027514                  JSR     PC,MULTWR               ; Issue command to the xDA
025576  024250                          STEPFTL                         ; Here if fatal error.
025600                          EXIT10:
025600  012737  000013  002546          MOV     #11.,NXTSTEP            ; Next STEP is 11.
025606  000207                          RTS     PC                      ; Return
```

```
                        .SBTTL  STEP11  Replacement step 11
                        ;STEP11
                        ;
                        ;Compute RCT block number and offset for descriptor.
                        ;Read RCT, update descriptor for new RBN and rewrite.
                        ;Update RCT descriptor for bad RBN, if appropriate.
                        ;
                        ;Inputs:
                        ;       R4   Address of host comm area
                        ;       SFLAG - search status
                        ;       DBUFF - Scratch buffer
                        ;
                        ;Outputs:
                        ;
                        ;Externals:
                        ;       CALBLK, INITRW, MULTRD, MULTWR, COPY
                        ;
                        ;Exits:
                        ;       STEP12  - Successful exit
                        ;       STEP16  - RCT MULTIREAD error exit
                        ;       STEP15  - RCT MULTIWRITE error exit
                        ;       STEPERR - Fatal error exit
                        ;

025610                  STEP11:
025610  013704  002324          MOV     HCOM,R4                 ; Load host comm area address
025614  105037  002473          CLRB    VBUFF1                  ;ASSUME BUFFER 1 DATA AND
025620  105037  002474          CLRB    VBUFF2                  ;BUFFER 2 DATA ARE NOT VALID.
025624  013746  002454          MOV     RBN+2,-(SP)             ;;PUSH RBN+2 ON STACK
025630  013746  002452          MOV     RBN,-(SP)               ;;PUSH RBN ON STACK
025634  004737  031332          JSR     PC,CALBLK               ;CALCULATE THE RCT LOGICAL BLOCK AND
                                                                ;THE RBN OFFSET WITHIN THE BLOCK.
025640  011600                  MOV     (SP),R0                 ;GET OFFSET WITHIN RCT LOGICAL BLOCK
025642  012637  002502          MOV     (SP)+,RCTOFF            ;;POP STACK INTO RCTOFF
025646  062716  000002          ADD     #2,(SP)                 ;OFFSET TO THE BEGINNING OF THE RCT
                                                                ;DESCRIPTOR BLOCKS.
025652  012637  002476          MOV     (SP)+,RCTBLK            ;;POP STACK INTO RCTBLK
025656  013701  002340          MOV     UADR,R1                 ;GET BEGINNING ADDRESS OF BUFFER
025662  006300                  ASL     R0                      ;MULTPLY OFFSET
025664  006300                  ASL     R0                      ;BY 4
025666  060001                  ADD     R0,R1                   ;FIND RBN POSITION IN DESCRIPTOR TABLE

025670  004737  030074          JSR     PC,INITRW               ;SOME READ/WRITE PARAMETERS
025674  063764  002476  000140  ADD     RCTBLK,HC.CPK+P.LBN(R4) ;ADD THE RCT LOGICAL BLOCK TO STARTING
025702  005564  000142          ADC     HC.CPK+P.LBN+2(R4)      ;HOST LBN OF THE RCT AREA.

                                                                ; Setup to issue MULTRD command
025706  004737  027224          JSR     PC,MULTRD               ; Issue command to the xDA
025712  024250                  STEPFTL                         ; Here if fatal error.
025714                  2$:
025714  112737  000001  002473  MOVB    #1,VBUFF1               ;SET VALID BUFFER 1 DATA FLAG
025722  004537  034276          JSR     R5,COPY                 ;COPY RCT LOGICAL BLOCK DATA FROM
025726  042472                  .WORD   DBUFF                   ;DATA BUFFER TO
025730  045472                  .WORD   BUFF1                   ;BUFFER ONE.

025732  013721  002446          MOV     LBN,(R1)+               ;STORE LO WORD LBN AND
025736  013711  002450          MOV     LBN+2,(R1)              ;HI WORD LBN IN DESCRIPTOR ENTRY,
025742  052711  020000          BIS     #BIT13,(R1)             ;ASSUME PRIMARY RBN IN REPLACEMENT CODE.
```

```
                                                TSTB    SFLAG                   ;SEE IF THIS IS A PRIMARY REPLACEMENT,
                                                BEQ     3$                      ;BRANCH IF SO, ELSE
                                                BIS     #BIT12,(R1)             ;SET SECONDARY RBN IN REPLACEMENT CODE.
                                        3$:
                                                                                ; Setup to issue MULTWR command
                                                JSR     PC,MULTWR               ; Issue command to the xDA
                                                STEPFTL                         ; Here if fatal error,
                                        5$:
                                                TSTB    MATFLG                  ;SEE IF LBN'S MATCHED DURING SEARCH,
                                                BNE     55$                     ; Branch if match
                                                JMP     EXIT11                  ; Else, exit step
                                        55$:
                                                MOV     MATRBN+2,-(SP)          ;;PUSH MATRBN+2 ON STACK
                                                MOV     MATRBN,-(SP)            ;;PUSH MATRBN ON STACK
                                                JSR     PC,CALBLK               ;CALCULATE THE RCT LOGICAL BLOCK AND
                                                                                ;THE RBN OFFSET WITHIN THE BLOCK.
                                                MOV     (SP),R0                 ;GET OFFSET WITHIN RCT LOGICAL BLOCK
                                                MOV     (SP)+,MATOFF            ;;POP STACK INTO MATOFF
                                                ADD     #2,(SP)                 ;OFFSET TO THE BEGINNING OF THE RCT
                                                                                ;DESCRIPTOR BLOCKS.
                                                MOV     (SP)+,MATBLK            ;;POP STACK INTO MATBLK
                                                MOV     UADR,R1                 ;GET BEGINNING ADDRESS OF BUFFER
                                                ASL     R0                      ;MULTPLY OFFSET
                                                ASL     R0                      ;BY 4
                                                ADD     R0,R1                   ;FIND RBN POSITION IN DESCRIPTOR TABLE
                                                                                ;SET UNUSABLE RBN IN REPLACEMENT CODE.
                                                JSR     PC,INITRW               ;SOME READ/WRITE PARAMETERS
                                                ADD     MATBLK,HC.CPK+P.LBN(R4) ;ADD THE RCT LOGICAL BLOCK TO STARTING
                                                ADC     HC.CPK+P.LBN+2(R4)      ;HOST LBN OF THE RCT AREA.
                                                                                ; Setup to issue MULTRD command
                                                JSR     PC,MULTRD               ; Issue command to the xDA
                                                STEPFTL                         ; Here if fatal error,
                                        7$:
                                                MOVB    #1,VBUFF2               ;SET VALID BUFFER 2 DATA FLAG
                                                JSR     R5,COPY                 ;COPY RCT LOGICAL BLOCK DATA FROM
                                                .WORD   DBUFF                   ;DATA BUFFER TO
                                                .WORD   BUFF2                   ;BUFFER TWO.

                                                CLR     (R1)+                   ;STORE LO ORDER LBN AND
                                                MOV     #BIT14,(R1)             ;HI ORDER LBN AND UNUSABLE CODE IN
                                        8$:                                     ;DESCRIPTOR ENTRY,
                                                                                ; Setup to issue MULTWR command
                                                JSR     PC,MULTWR               ; Issue command to the xDA
                                                STEPFTL                         ; Here if fatal error,

                                        EXIT11:
                                                MOV     #12.,NXTSTEP            ; Next STEP is 12.
                                                RTS     PC                      ; and return
```

```
                                .SBTTL  STEP12  Replacement step 12
                                ;STEP12
                                ;
                                ;Issue REPLACE command to controller.  Rewrite LBN data using
                                ;WRITE-COMPARE modifier and FORCED ERROR if appropriate.
                                ;
                                ;Inputs:
                                ;       R4 - Address of host comm area
                                ;       LBN - LBN to replace
                                ;       RBN _ Replacement RBN
                                ;       SFLAG - Search status
                                ;       VIBUFF - Valid LBN daya flag
                                ;       RCT block 1 - LBN image
                                ;
                                ;Outputs:
                                ;
                                ;Externals:
                                ;       INTCPK, INITRW, ISSUE
                                ;
                                ;Exits:
                                ;       STEP15  - REPLACE error exit
                                ;       STEP9   - LBN verification error exit
                                ;       STEP13  - Successful exit
                                ;       STEPERR - Fatal error exit
                                ;

026132                          STEP12:
026132  013704  002324                  MOV     HCOM,R4                 ; Load host comm area address
026136  004737  030626                  JSR     PC,INTCPK               ;INITIALIZE THE COMMAND PACKET
026142  013764  002452  000120          MOV     RBN,HC.CPK+P.RBN(R4)     ;STUFF IN LO ORDER AND
026150  013764  002454  000122          MOV     RBN+2,HC.CPK+P.RBN+2(R4) ;HI ORDER RBN TO REPLACE LBN.
026156  013764  002446  000140          MOV     LBN,HC.CPK+P.LBN(R4)     ;STUFF IN LO ORDER AND
026164  013764  002450  000142          MOV     LBN+2,HC.CPK+P.LBN+2(R4) ;HI ORDER LBN BEING REPLACED.
026172  105737  002515                  TSTB    SFLAG                    ;SEE IF THIS IS A PRIMARY REPLACEMENT
026176  001003                          BNE     1$                       ;BRANCH IF NOT, ELSE
026200  012737  000001  002346          MOV     #MD.PRI,CMDMOD          ;PRIMARY REPLACEMENT MODIFIER IN PACKET
026206                          1$:
                                                                        ; Setup to issue OP.RPL command
026206  012700  000024                  MOV     #OP.RPL,R0              ; Load MSCP opcode
026212  004737  030204                  JSR     PC,ISSUE                ; Issue command to the xDA
026216  024250                          STEPFTL                         ; Here if fatal error,
026220  001414                          BEQ     3$                      ; Branch if command successful,

026222  012737  012313  002552          MOV     #ERM304,BASEMSG         ; "Failed REPLACE..."
026230  012737  000140  002370          MOV     #B.MSCP,EXTMSK          ; Flag all MSCP fields
026236  104456                          TRAP    C$ERHRD
026240  000460                          .WORD   304
026242  012043                          .WORD   HDR301
026244  015504                          .WORD   ERR301
026246  000137  024250                  JMP     STEPFTL                 ; Fatal exit
026252                          3$:
026252  012737  044472  002340          MOV     #IBUFF,UADR             ;GET BEGINNING ADDRESS OF IMAGE BUFFER
026260  012737  040000  002346          MOV     #MD.CMP,CMDMOD          ;STUFF COMPARE MODIFIER IN PACKET

026266  005737  002516                  TST     LBNSTAT                 ; Test for valid data
026272  100011                          BPL     4$                      ; Branch if no
026274  005737  002164                  TST     ENBWFE                  ; Test for WFE enabled
```

```
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STEP12  Replacement step 12

     51 026300  001406                          BEQ     4$                      ; Branch if NO
     52
     53 026302  052737  010000  002346          BIS     #MD.ERR,CMDMOD          ; Set FORCED ERROR modifier
     54 026310  052737  000400  002516          BIS     #TF.WFE,LBNSTAT         ; and WFE status
     55 026316                          4$:
     56 026316  004737  030074                  JSR     PC,INITRW               ;INIT SOME READ/WRITE PARAMETERS AND
     57 026322  013764  002446  000140          MOV     LBN,HC.CPK+P.LBN(R4)    ;GET THE REPLACED LBN ADDRESS.
     58 026330  013764  002450  000142          MOV     LBN+2,HC.CPK+P.LBN+2(R4)
     59                                                                         ; Setup to issue OP.WR command
        026336  012700  000042                  MOV     #OP.WR,R0               ; Load MSCP opcode
        026342  004737  030204                  JSR     PC,ISSUE                ; Issue command to the xDA
        026346  024250                          STEPFTL                         ; Here if fatal error,
        026350  001401                          BEQ     5$                      ; Branch if command successful,
        026352  003005                          BGT     50$                     ; Branch if command unsuccessful
     60
     61                                 ;       Success; test for BBR
     62 026354                          5$:
     63 026354  132737  000200  002356          BITB    #EF.BBR,FLAGS           ; Test for BBR
     64 026362  001456                          BEQ     EXIT12                  ; Branch if not SET
     65 026364  000451                          BR      6$                      ; Else, get new RBN
     66
     67                                 ;       Possible error
     68 026366                          50$:
     69 026366  013700  002354                  MOV     EMSTAT,R0               ; Reload emdmsg status
     70 026372  042700  177740                  BIC     #^CST.MSK,R0            ; Clear any subcodes
     71 026376  022700  000010                  CMP     #ST.DAT,R0              ; Test for Data error
     72 026402  001414                          BEQ     52$                     ; Branch if YES
     73
     74 026404  012737  012202  002552          MOV     #ERM302,BASEMSG         ; "Failed WRITE..."
     75 026412  012737  000140  002370          MOV     #8.MSCP,EXTMSK          ; Flag all MSCP fields
     76 026420  104456                          TRAP    C$ERHRD
        026422  000456                          .WORD   302
        026424  012043                          .WORD   HDR301
        026426  015504                          .WORD   ERR301
     77 026430  000137  024250                  JMP     STEPFTL                 ; Fatal error exit
     78 026434                          52$:
     79 026434  005737  002516                  TST     LBNSTAT                 ; Test LBN image data valid
     80 026440  100004                          BPL     55$                     ; Error if valid
     81 026442  022737  000010  002354          CMP     #ST.DAT,EMSTAT          ; Test for FER
     82 026450  001423                          BEQ     EXIT12                  ; OK if yes
     83 026452                          55$:                                    ; Report program error
     84 026452  012737  012361  002552          MOV     #ERM305,BASEMSG         ; "Failed verification..."
     85 026460  012737  000140  002370          MOV     #8.MSCP,EXTMSK          ; Flag all MSCP fields
     86 026466  104456                          TRAP    C$ERHRD
        026470  000461                          .WORD   305
        026472  012043                          .WORD   HDR301
        026474  015504                          .WORD   ERR301
     87 026476  000404                          BR      6$                      ; Branch if yes
     88 026500                          60$:
     89 026500  012737  177777  002546          MOV     #-1,NXTSTEP             ; Else, Fatal error
     90 026506  000207                          RTS     PC                      ; Return
     91 026510                          6$:
     92 026510  012737  000011  002546          MOV     #9.,NXTSTEP             ; Next STEP is 9.
     93 026516  000207                          RTS     PC                      ; and return
     94 026520                          EXIT12:
     95 026520  012737  000015  002546          MOV     #13.,NXTSTEP            ; Next STEP is 13.
     96 026526  000207                          RTS     PC                      ; Return
```

STEP12 Replacement step 12

97

```
                                .SBTTL  STEP13  Replacement step 13
                                ;STEP13
                                ;
                                ;Update RCT block 0 to indicate that replacement is complete.
                                ;
                                ;Inputs:
                                ;       R4 - Address of host comm area
                                ;       TBUFF - Working copy of RCT block 0
                                ;       RECOVR - Replacement recovery flag
                                ;
                                ;Outputs:
                                ;
                                ;Externals:
                                ;       INTCPK, INITRW, MULTWR
                                ;
                                ;Exits:
                                ;       EXIT13  - Successful exit
                                ;       STEP17  - RCT MULTIWRITE error exit
                                ;       STEPERR - Fatal error exit
                                ;

026530                          STEP13:
026530  013704  002324                  MOV     HCOM,R4                 ; Load host comm area address
026534  004737  030626                  JSR     PC,INTCPK               ;INITIALIZE THE COMMAND PACKET
026540  012701  043472                  MOV     #TBUFF,R1               ;GET ADDRESS OF TEMP buffer and
026544  010137  002340                  MOV     R1,UADR                 ;CHANGE THE UNIBUS ADDRESS FOR WRITE.
026550  062701  000010                  ADD     #RFLAGS,R1              ;SET OFFSET TO REPLACEMENT FLAG WORD
026554  005021                          CLR     (R1)+                   ;CLEAR REPLACEMENT WORD (#4) AND
026556  005721                          TST     (R1)+                   ;SKIP WORD #5.
026560  012700  000006                  MOV     #<CACHID-LBNLO/2>,R0    ;GET NUMBER OF ENTRIES TO CLEAR
026564  005021                  1$:     CLR     (R1)+                   ;CLEAR THAT LOCATION
026566  005300                          DEC     R0                      ;DECR REG. AND SEE IF DONE CLEARING,
026570  001375                          BNE     1$                      ;BRANCH IF NOT, ELSE

026572  012737  000000  002476          MOV     #0,RCTBLK               ;INIT THE RCT LOGICAL BLOCK TO 0 AND
026600  004737  030074                  JSR     PC,INITRW               ;SOME READ/WRITE PARAMETERS.
                                                                        ; Setup to issue MULTWR command
026604  004737  02751\                  JSR     PC,MULTWR               ; Issue command to the xDA
026610  024250                          STEPFTL                         ; Here if fatal error,

026612                          EXIT13:
026612  012737  000000  002546          MOV     #0,NXTSTEP              ; NO next STEP
026620  012737  000001  002520          MOV     #1,RPLSTAT              ; Set replacement true

026626  004737  020002                  JSR     PC,TYPSTAT              ; Type replacement status
026632  105037  002515                  CLRB    SFLAG                   ; Clear search flag
026636  000207                          RTS     PC                      ; Return
```

```
                        .SBTTL  STEP15  Replacement step 15
                        ;STEP15
                        ;
                        ;Rewrite updated RCT descriptor to indicate RBN usage.
                        ;
                        ;Inputs:
                        ;       R4 - Address of host comm area
                        ;       BUFF1 - RCT descriptor block
                        ;       BUFF2 - RCT descriptor block
                        ;       VBUFF2 - BUFF2 data is valid
                        ;       VBUFF1 - BUFF1 data is valid
                        ,
                        ;Outputs:
                        ;
                        ;Externals:
                        ;       INITCPK, INITRW, MULTWR
                        ;
                        ;Exits:
                        ;       STEP16  - Successful exit
                        ;       STEPERR - Fatal error exit
                        ;

026640                  STEP15:
026640  013704  002324          MOV     HCOM,R4                 ; Load host comm area address
026644  004737  030626          JSR     PC,INITCPK              ;INITIALIZE THE COMMAND PACKET
026650  105737  002473          TSTB    VBUFF1                  ;DATA VALID IN BUFFER 1 ?
026654  001415                  BEQ     2$                      ;BRANCH IF NO, ELSE
026656  012737  045472  002340  MOV     @BUFF1,UADR             ;GET BEGINNING ADDRESS OF BUFF1 BUFFER
026664  004737  030074          JSR     PC,INITRW               ;INIT SOME READ/WRITE PARAMETERS
026670  063764  002476  000140  ADD     RCTBLK,HC.CPK+P.LBN(R4) ;ADD THE RCT LOGICAL BLOCK TO STARTING
026676  005564  000142          ADC     HC.CPK+P.LBN+2(R4)      ;HOST LBN OF THE RCT AREA.
                                                                ; Setup to issue MULTWR command
026702  004737  027514          JSR     PC,MULTWR               ; Issue command to the xDA
026706  024250                  STEPFTL                         ; Here if fatal error.
026710                  2$:
026710  105737  002474          TSTB    VBUFF2                  ;DATA VALID IN BUFFER 2 ?
026714  001415                  BEQ     EXIT15                  ;BRANCH IF NO, ELSE
026716  012737  046472  002340  MOV     @BUFF2,UADR             ;GET BEGINNING ADDRESS OF BUFF2 BUFFER
026724  004737  030074          JSR     PC,INITRW               ;SOME READ/WRITE PARAMETERS
026730  063764  002500  000140  ADD     MATBLK,HC.CPK+P.LBN(R4) ;ADD THE RCT LOGICAL BLOCK TO STARTING
026736  005564  000142          ADC     HC.CPK+P.LBN+2(R4)      ;HOST LBN OF THE RCT AREA.
                                                                ; Setup to issue MULTWR command
026742  004737  027514          JSR     PC,MULTWR               ; Issue command to the xDA
026746  024250                  STEPFTL                         ; Here if fatal error.
026750                  EXIT15:
026750  012737  000020  002546  MOV     @16.,NXTSTEP            ; Next STEP is 16.
026756  000207                  RTS     PC                      ; Return
```

```
                                .SBTTL  STEP16  Replacement step 16
                                ;STEP16
                                ;
                                ;Write the saved LBN data to the original LBN with FORCED ERROR set,
                                ;if appropriate.
                                ;
                                ;Inputs:
                                ;       R4 - Address of host comm area
                                ;       LBN - LBN address
                                ;       IBUFF - LBN image
                                ;       VIBUFF - Image valid flag
                                ;
                                ;Outputs:
                                ;
                                ;Externals:
                                ;       INCPK, INITRW, ISSUE
                                ;
                                ;Exits:
                                ;       NXTSTEP = 0 - Successful exit
                                ;       STEPERR - Fatal error exit
                                ;

 026760                         STEP16:
 026760  013704  002324                MOV     HCOM,R4                 ; Load host comm area address
 026764  004737  030626                JSR     PC,INTCPK               ;INITIALIZE THE COMMAND PACKET
 026770  012737  044472  002340        MOV     #IBUFF,UADR             ;GET BEGINNING ADDRESS OF IMAGE BUFFER

 026776  005737  002516                TST     LBNSTAT                 ;SEE IF LBN IMAGE DATA WAS VALID,
 027002  100006                        BPL     1$                      ;BRANCH IF SO, ELSE
 027004  005737  002164                TST     ENBWFE                  ; Test for WFE enabled
 027010  001403                        BEQ     1$                      ; Branch if NO

 027012  052737  010000  002346        BIS     #MD.ERR,CMDMOD          ;STUFF FORCED ERROR MODIFIER IN PACKET.
 027020                         1$:
 027020  004737  030074                JSR     PC,INITRW               ; INIT SOME READ/WRITE PARAMETERS AND
 027024  013764  002446  000140        MOV     LBN,HC.CPK+P.LBN(R4)    ; GET THE REPLACED LBN ADDRESS.
 027032  013764  002450  000142        MOV     LBN+2,HC.CPK+P.LBN+2(R4)
                                                                        ; Setup to issue OP.WR command
 027040  012700  000042                MOV     #OP.WR,R0               ; Load MSCP opcode
 027044  004737  030204                JSR     PC,ISSUE                ; Issue command to the xDA
 027050  024250                        STEPFTL                         ; Here if fatal error,
 027052  001423                        BEQ     EXIT16                  ; Branch if command successful,

 027054  013700  002354                MOV     EMSTAT,R0               ; Reload emdmsg status
 027060  042700  177740                BIC     #^CST.MSK,R0            ; Clear any subcodes
 027064  022700  000010                CMP     #ST.DAT,R0              ; Test for Data error
 027070  001414                        BEQ     EXIT16                  ; Branch if YES

 027072  012737  012202  002552        MOV     #ERM302,BASEMSG         ; "Failed WRITE..."
 027100  012737  000140  002370        MOV     #B.MSCP,EXTMSK          ; Flag all MSCP fields
 027106  104456                        TRAP    C$ERHRD
 027110  000456                        .WORD   302
 027112  012043                        .WORD   HDR301
 027114  015504                        .WORD   ERR301
 027116  000137  024250                JMP     STEPFTL                 ; Fatal error exit

 027122                         EXIT16:
```

STEP16 Replacement step 16

```
     51 027122  012737  000021  002546          !OV     #17.,NXTSTEP            ; Next STEP is 17.
     52 027130  000207                          RTS     PC                      ; Return
     53
```

```
                                .SBTTL  STEP17  Replacement step 17
                                ;STEP17
                                ;
                                ;Update RCT block 0 to incidate that replacement is complete.
                                ;
                                ;Inputs:
                                ;       R4 - Address of host comm area
                                ;       TBUFF - Working copy of RCT block 0
                                ;
                                ;Outputs:
                                ;
                                ;Externals:
                                ;       INCPK, INITRW, MULTWR
                                ;
                                ;Exits:
                                ;       EXIT17  - Successful exit
                                ;       STEPERR - Fatal error exit
                                ;

027132                          STEP17:
027132  013704  002324                  MOV     HCOM,R4                 ; Load host comm area address
027136  004737  030626                  JSR     PC,INTCPK               ;INITIALIZE THE COMMAND PACKET
027142  012701  043472                  MOV     #TBUFF,R1               ;GET ADDRESS OF TEMP BUFFER AND
027146  010137  002340                  MOV     R1,UADR                 ;CHANGE THE UNIBUS ADDRESS FOR WRITE.
027152  062701  000010                  ADD     #RFLAGS,R1              ;SET OFFSET TO REPLACEMENT FLAG WORD
027156  005021                          CLR     (R1)+                   ;CLEAR REPLACEMENT WORD (#4) AND
027160  005721                          TST     (R1)+                   ;SKIP WORD #5.
027162  012700  000006                  MOV     #<CACHID-LBNLO/2>,R0    ;GET NUMBER OF ENTRIES TO CLEAR
027166  005021                  1$:     CLR     (R1)+                   ;CLEAR THAT LOCATION
027170  005300                          DEC     R0                      ;DECR REG. AND SEE IF DONE CLEARING,
027172  001375                          BNE     1$                      ;BRANCH IF NOT, ELSE

027174  012737  000000  002476          MOV     #0,RCTBLK               ;INIT THE RCT LOGICAL BLOCK TO 0 AND
027202  004737  030074                  JSR     PC,INITRW               ;SOME READ/WRITE PARAMETERS.

                                                                        ; Setup to issue MULTWR command
027206  004737  027514                  JSR     PC,MULTWR               ; Issue command to the xDA
027212  024250                          STEPFTL                         ; Here if fatal error.
027214                          EXIT17:
027214  012737  177777  002546          MOV     #-1,NXTSTEP             ; Else, load success
027222  000207                          RTS     PC                      ; Return
```

```
                                .SBTTL  MULTRD  RCT Multiread routine
                                ;MULTRD
                                ;
                                ;THIS ROUTINE WILL PERFORM MULTIPLE READS, IF A BLOCK IN THE RCT CANNOT
                                ;BE READ FROM THE 1ST COPY OF THE RCT.
                                ;
                                ;INPUTS:
                                ;       COPIES - NUMBER OF COPIES OF THE RCT AREA
                                ;       RCTSIZ - RCT SIZE (W/ PAD)
                                ;       R4 - ADDRESS OF HOST COMMUNICATION AREA
                                ;OUTPUTS:
                                ;       LOAD COMMAND PACKET WITH;
                                ;       COMPARE MODIFIER,
                                ;       @PC     - RETURN IF FATAL ERROR,
                                ;       PC+2    - RETURN IF COMMAND NOT SUCCESSFUL
                                ;
                                ;Calling Seq:
                                ;
                                ;       JSR     PC,MULTRD
                                ;       .WORD   <error exit>
                                ;
 027224                         MULTRD:
 027224  010146                        MOV     R1,-(SP)                ;;PUSH R1 ON STACK
 027226  112737  000001  002424        MOVB    #1,RCTCOPY              ; Start with copy 1
 027234  105037  002475                CLRB    ERRCNT                  ; Clear RCT error count
 027240  005037  002444                CLR     TMPSTAT                 ; Clear temp status
 027244  013704  002324                MOV     HCOM,R4                 ; Load host comm area address
 027250                         10$:
 027250  012737  040000  002346        MOV     #MD.CMP,CMDMOD          ; STUFF COMPARE MODIFIER IN PACKET
 027256  004737  034240                JSR     PC,CLRBUF               ; CLEAR THE BUFFER BEFORE READING
                                                                        ; Setup to issue OP.RD command
 027262  012700  000041                MOV     #OP.RD,R0               ; Load MSCP opcode
 027266  004737  030204                JSR     PC,ISSUE                ; Issue command to the xDA
 027272  027500                        70$                             ; Here if fatal error,
 027274  001450                        BEQ     50$                     ; Branch if command successful.
 027276                         20$:
 027276  013700  002354                MOV     EMSTAT,R0               ; Reload emdmsg status
 027302  042700  177740                BIC     #^C<ST.MSK>,R0          ; Clear any subcodes
 027306  022700  000010                CMP     #ST.DAT,R0              ; Test for Data error
 027312  001416                        BEQ     30$                     ; Branch if YES
                                
 027314  012737  013216  002552        MOV     #ERM601,BASEMSG         ; "Failed RCT READ..."
 027322  012737  000140  002370        MOV     #8.,MSCP,EXTMSK         ; Flag all MSCP fields
 027330  104456                        TRAP    C$ERHRD
 027332  001131                        .WORD   601
 027334  012043                        .WORD   HDR301
 027336  015504                        .WORD   ERR301
 027340  012737  177777  002442        MOV     #-1,STATUS              ; Set Fatal status
 027346  000454                        BR      70$                     ; Fatal error exit
 027350                         30$:
 027350  050037  002444                BIS     R0,TMPSTAT              ; Save status
 027354  105237  002475                INCB    ERRCNT                  ; Increment error count
 027360  004737  016370                JSR     PC,RCTERR               ; Check this block bad before
 027364  027446                        60$                             ; Fatal error return
 027366                         40$:
 027366  105237  002424                INCB    RCTCOPY                 ; Increment copy
```

```
     51 027372  123737  002423  002424          CMPB    COPIES,RCTCOPY          ; Test for last copy
     52 027400  002406                          BLT     50$                     ; Branch if none left
     53 027402  063764  002416  000140          ADD     RCTSIZ,HC.CPK+P.LBN(R4) ; Else, adjust LBN
     54 027410  005564  000142                  ADC     HC.CPK+P.LBN+2(R4)      ; To next copy of RCT
     55 027414  000715                          BR      10$                     ; And write next copy
     56
     57                                 ;       Normal exit
     58 027416                          50$:
     59 027416  012737  000000  002346          MOV     #0,CMDMOD               ; Clear command modifiers
     60 027424  013737  002444  002442          MOV     TMPSTAT,STATUS          ; Reload status
     61 027432  012601                          MOV     (SP)+,R1                ;;POP STACK INTO R1
     62 027434  062716  000002                  ADD     #2,(SP)                 ; Bump past error return
     63 027440  013700  002442                  MOV     STATUS,R0               ; Set condition codes for caller
     64 027444  000207                          RTS     PC                      ; and return
     65 027446                          60$:
     66 027446  012737  013267  002552          MOV     #ERM603,BASEMSG         ; "Failed READ of all RCT copies..."
     67 027454  012737  000000  002370          MOV     #0,EXTMSK               ; Flag RCT fields
     68 027462  104455                          TRAP    C$ERDF
        027464  001133                          .WORD   603
        027466  013173                          .WORD   HDR601
        027470  015720                          .WORD   ERR601
     69 027472  012737  177777  002442          MOV     #-1,STATUS              ; Set cond. codes
     70
     71                                 ;       Fatal Error Exit
     72 027500                          70$:
     73 027500  012601                          MOV     (SP)+,R1                ;;POP STACK INTO R1
     74 027502  017616  000000                  MOV     @(SP),(SP)              ; Load error return
     75 027506  013700  002442                  MOV     STATUS,R0               ; Set condition codes for caller
     76 027512  000207                          RTS     PC                      ; and return
     77
```

```
                                .SBTTL  MULTWR  RCT Multiwrite routine
                                ;MULTWR
                                ;
                                ;THIS ROUTINE WILL PERFORM MULTIPLE WRITES ON ALL COPIES OF A LOGICAL BLOCK
                                ;IN THE RCT AREA.
                                ;
                                ;INPUTS:
                                ;       COPIES - NUMBER OF COPIES OF THE RCT AREA
                                ;       RCTSIZ - RCT SIZE (W/ PAD)
                                ;       R4 - ADDRESS OF HOST COMMUNICATION AREA
                                ;OUTPUTS:
                                ;       LOAD COMMAND PACKET WITH;
                                ;       COMPARE MODIFIER,
                                ;       @PC     - RETURN IF FATAL ERROR,
                                ;       PC+2- RETURN IF COMMAND NOT SUCCESSFUL
                                ;
                                ;Calling Seq:
                                ;
                                ;       JSR     PC,MULTWR
                                ;       .WORD   <error exit>
                                ;

027514                          MULTWR:
027514  010146                         MOV     R1,-(SP)                ;;PUSH R1 ON STACK
027516  105037  002475                 CLRB    ERRCNT                  ;INIT THE ERROR COUNT
027522  005037  002444                 CLR     TMPSTAT                 ; Reset temp status
027526  112737  000001  002424         MOVB    #1,RCTCOPY              ; Start with first copy
027534  013704  002324                 MOV     HCOM,R4                 ; Load host comm area address
027540                          10$:
027540  012737  040000  002346         MOV     #MD.CMP,CMDMOD          ; STUFF COMPARE MODIFIER IN PACKET
                                                                        ; Setup to issue OP.WR command
027546  012700  000042                 MOV     #OP.WR,R0               ; Load MSCP opcode
027552  004737  030204                 JSR     PC,ISSUE                ; Issue command to the xDA
027556  030060                         70$                             ; Here if fatal error,
027560  001472                         BEQ     45$                     ; Branch if command successful,
027562                          20$:
027562  013700  002354                 MOV     EMSTAT,R0               ; Reload emdmsg status
027566  042700  177740                 BIC     #^tCST.MSK,R0           ; Clear any subcodes
027572  022700  000010                 CMP     #ST.DAT,R0              ; Test for Data error
027576  001416                         BEQ     25$                     ; Branch if YES

027600  012737  013242  002552         MOV     #ERM602,BASEMSG         ; "Failed RCT WRITE..."
027606  012737  000140  002370         MOV     #8.MSCP,EXTMSK          ; Flag all MSCP fields
027614  104456                         TRAP    C$ERHRD
027616  001132                         .WORD   602
027620  012043                         .WORD   HDR301
027622  015504                         .WORD   ERR301
027624  012737  177777  002442         MOV     #-1,STATUS              ; Set Fatal status
027632  000512                         BR      70$                     ; Fatal error exit
027634                          25$:
027634  050037  002444                 BIS     R0,TMPSTAT              ; Save status
027640  105237  002475                 INCB    ERRCNT                  ; COUNT THE NUMBER ERRORS DETECTED
027644  004737  016370                 JSR     PC,RCTERR               ; Test if new bad block
027650  030026                         60$                             ; Fatal error return
027652                          30$:
027652  052737  010000  002346         BIS     #MD.ERR,CMDMOD          ; STUFF FORCED ERROR MODIFIER IN PACKET
                                                                        ; Setup to issue OP.WR command
```

```
        027660  012700  000042                  MOV     #OP.WR,R0               ; Load MSCP opcode
        027664  004737  030204                  JSR     PC,ISSUE                ; Issue command to the xDA
        027670  030060                          70$                             ; Here if fatal error.
        027672  001425                          BEQ     45$                     ; Branch if command successful.
     51 027674                          35$:
     52 027674  013700  002354                  MOV     EMSTAT,R0               ; Reload emdmsg status
     53 027700  042700  177740                  BIC     #^CST.MSK,R0            ; Clear any subcodes
     54 027704  022700  000010                  CMP     #ST.DAT,R0              ; Test for Data error
     55 027710  001416                          BEQ     45$                     ; Branch if YES
     56 027712                          40$:
     57 027712  012737  013242  002552          MOV     #ERM602,BASEMSG         ; "Failed RCT WRITE..."
     58 027720  012737  000140  002370          MOV     #8.MSCP,EXTMSK          ; Flag all MSCP fields
     59 027726  104456                          TRAP    C$ERHRD
        027730  001132                          .WORD   602
        027732  012043                          .WORD   HDR301
        027734  015504                          .WORD   ERR301
     60 027736  012737  177777  002442          MOV     #-1,STATUS              ; Set Fatal status
     61 027744  000445                          B       70$                     ; Fatal error exit
     62 027746                          45$:
     63 027746  105237  002424                  INCB    RCTCOPY                 ; Increment copy
     64 027752  123737  002423  002424          CMPB    COPIES,RCTCOPY          ; Test for last copy
     65 027760  002406                          BLT     50$                     ; Branch if none left
     66 027762  063764  002416  000140          ADD     RCTSIZ,HC.CPK+P.LBN(R4) ; Else, adjust LBN
     67 027770  005564  000142                  ADC     HC.CPK+P.LBN+2(R4)      ; To next copy of RCT
     68 027774  000661                          BR      10$                     ; And write next copy
     69
     70                                 ;       Normal exit
     71 027776                          50$:
     72 027776  012737  000000  002346          MOV     #0,CMDMOD               ; Clear command modifiers
     73 030004  013737  002444  002442          MOV     TMPSTAT,STATUS          ; Reload status
     74 030012  012601                          MOV     (SP)+,R1                ;;POP STACK INTO R1
     75 030014  062716  000002                  ADD     #2,(SP)                 ; Bump past error return
     76 030020  013700  002442                  MOV     STATUS,R0               ; Set condition codes for caller
     77 030024  000207                          RTS     PC                      ; and return
     78 030026                          60$:
     79 030026  012737  013334  002552          MOV     #ERM604,BASEMSG         ; "Failed WRITE to all copies..."
     80 030034  012737  000000  002370          MOV     #0,EXTMSK               ; Flag RCT fields
     81 030042  104455                          TRAP    C$ERDF
        030044  001134                          .WORD   604
        030046  013173                          .WORD   HDR601
        030050  015720                          .WORD   ERR601
     82 030052  012737  177777  002442          MOV     #-1,STATUS              ; Set cond. codes
     83
     84                                 ;       Fatal Error Exit
     85 030060                          70$:
     86 030060  012601                          MOV     (SP)+,R1                ;;POP STACK INTO R1
     87 030062  017616  000000                  MOV     @(SP),(SP)              ; Load error return
     88 030066  013700  002442                  MOV     STATUS,R0               ; Set condition codes for caller
     89 030072  000207                          RTS     PC                      ; and return
     90
```

```
                                .SBTTL  INITRW  Initialize command packet for R/W
                                ;INITRW
                                ;
                                ;INITIALIZE SOME GENERAL PARAMETERS IN THE COMMAND PACKET FOR A
                                ;READ OR WRITE COMMAND.
                                ;
                                ;INPUTS:
                                ;       UADR - UNIBUS ADDRESS IN MEMORY,
                                ;       BCNT - BYTE COUNT,
                                ;       UNSIZ - LO ORDER WORD OF STARTING RCT LBN,
                                ;       UNSIZ+2 - HI ORDER WORD OF STARTING RCT LBN,
                                ;       R4 - ADDRESS OF HOST COMMUNICATION AREA
                                ;OUTPUTS:
                                ;       LOAD COMMAND PACKET WITH;
                                ;       UNIBUS ADDRESS,
                                ;       BYTE COUNT,
                                ;       STARTING RCT LBN
                                ;
                                ;Calling Seq:
                                ;
                                ;       JSR     PC,INITRW
                                ;

030074                          INITRW:
030074  013704  002324                  MOV     HCOM,R4                 ; Load host comm area address
030100  013764  002340  000124          MOV     UADR,HC.CPK+P.UADR(R4)  ;Load UNIBUS buffer address
030106  013764  002334  000120          MOV     BCNT,HC.CPK+P.BCNT(R4)  ;STUFF low order BYTE COUNT
030114  013764  002336  000122          MOV     BCNT+2,HC.CPK+P.BCNT+2(R4) ;STUFF high order BYTE COUNT
030122  013764  002430  000140          MOV     UNSIZ,HC.CPK+P.LBN(R4)     ;STUFF IN LO ORDER UNIT SIZE AND
030130  013764  002432  000142          MOV     UNSIZ+2,HC.CPK+P.LBN+2(R4) ;HI ORDER UNIT SIZE TO GET STARTING
                                                                        ;LBN OF THE RCT AREA.
030136  000207                          RTS     PC                      ;RETURN
```

```
                                .SBTTL  INITAC  Initialize command packet for ACCESS
                                ;INITAC
                                ;
                                ;Initialize command packet parameters for an ACESS command.
                                ;
                                ;Inputs:
                                ;       R4 - Address of host communications area
                                ;       UADR - Address of buffer
                                ;       GLBN - ACCESS group starting LBN
                                ;       GBCNT   ACCESS group byte count
                                ;
                                ;Outputs:
                                ;       Load command packets with:
                                ;         Zero buffer descriptor
                                ;         Starting LBN
                                ;         Byte count
                                ;
                                ;Calling Seq:
                                ;
                                ;       JSR     PC,INITAC
                                ;

030140                          INITAC:
030140  013704  002324                  MOV     HCOM,R4                 ; Load host comm area address
030144  012764  000000  000124          MOV     #0,HC.CPK+P.UADR(R4)    ; Load UNIBUS buffer address
030152  013764  002566  000120          MOV     GBCNT,HC.CPK+P.BCNT(R4) ; Load low order group byte count
030160  013764  002570  000122          MOV     GBCNT+2,HC.CPK+P.BCNT+2(R4) ; Load high order group byte count
030166  013764  002562  000140          MOV     GLBN,HC.CPK+P.LBN(R4)   ; Load group
030174  013764  002564  000142          MOV     GLBN+2,HC.CPK+P.LBN+2(R4) ; starting LBN address

030202  000207                          RTS     PC                      ; Return to caller
```

```
      1                                 .SBTTL  ISSUE   Issue command
      2                                 ;ISSUE
      3                                 ;
      4                                 ;ISSUE COMMAND TO xDA. CHECK THAT EXECUTION HAPPENED WITHOUT ERROR.
      5                                 ;
      6                                 ;INPUTS:
      7                                 ;       R0      MSCP command code
      8                                 ;       CTLRTBL Controller table address
      9                                 ;
     10                                 ;OUTPUTS:
     11                                 ;       R0 =    End message status
     12                                 ;                 0 = Success
     13                                 ;                >0 = Error
     14                                 ;                -1 = Fatal
     15                                 ;
     16                                 ;
     17                                 ;Calling Seq:
     18                                 ;
     19                                 ;       MOV     #OP_CODE,R0
     20                                 ;       JSR     PC,ISSUE
     21                                 ;       .WORD   <error exit>
     22                                 ;
     23
     24 030204                          ISSUE:
     25 030204  010037  002344                  MOV     R0,OPCODE               ; Save MSCP command
     26 030210  013704  002324                  MOV     HCOM,R4                 ; Reload comm area ptr
     27 030214  013705  002304                  MOV     CTLRTBL,R5              ; Load table start address
     28 030220  004737  030632                  JSR     PC,BLDCMD               ; Build command packet
     29 030224  004737  030744                  JSR     PC,SNDCMD               ; Send command to XDA
     30 030230                          5$:
     31 030230  004737  031072                  JSR     PC,WAIT                 ; Wait for message response
     32 030234  030474                          42$                             ; Error return
     33 030236  001100                          BNE     41$                     ; Branch if timeout
     34
     35                                 ;       Unload end packet fields
     36 030240                          10$:
     37 030240  013704  002324                  MOV     HCOM,R4                 ; Reload comm area ptr
     38 030244  013705  002304                  MOV     CTLRTBL,R5              ; Load table start address
     39 030250  042765  000004  000014          BIC     #CT.CMD,C.FLG(R5)       ; Clear command issued
     40 030256  016437  000020  002350          MOV     HC.MPK+P.CRF(R4),ENDREF ; Save endmsg reference number
     41 030264  016437  000032  002354          MOV     HC.MPK+P.STS(R4),EMSTAT ; Save endmsg status
     42 030272  116437  000031  002356          MOVB    HC.MPK+P.FLGS(R4),FLAGS ; Save endmsg flags
     43 030300  116437  000030  002352          MOVB    HC.MPK+P.OPCD(R4),ECODE ; Save endcode
     44
     45                                 ;       Test command reference and end code
     46 030306                          20$:
     47 030306  132737  000200  002352          BITB    #OP.END,ECODE           ; Test for end msg packet
     48 030314  001004                          BNE     25$                     ; Branch if YES
     49 030316  004737  016634                  JSR     PC,ERRLOG               ; Else, process error log packet
     50 030322  030614                          50$                             ; Error return
     51 030324  000741                          BR      5$                      ; Wait again
     52
     53                                 ;       Process error log packet
     54 030326                          25$:
     55 030326  122737  000207  002352          CMPB    #OP.END+OP.SEX,ECODE    ; Test for serious exception
     56 030334  001512                          BEQ     44$                     ; Branch if YES
     57
```

```
                                        ;       Process end message packet
                                30$:
030336  023737  002342  002350                CMP     CMDREF,ENDREF           ; Compare reference numbers
030344  001071                                BNE     43$                     ; Branch if different

030346  013700  002344                        MOV     OPCODE,R0               ; Reload MSCP command code
030352  052700  000200                        BIS     #OP.END,R0              ; Set end msg bit
030356  120037  002352                        CMPB    R0,ECODE                ; and compare
030362  001010                                BNE     40$                     ; Branch if different

                                        ;       SUCCESS exit
030364                          35$:
030364  062716  000002                        ADD     #2,(SP)                 ; Else, bump past error return
030370  013737  002354  002442                MOV     EMSTAT,STATUS           ; Set success status
030376  013700  002442                        MOV     STATUS,R0               ; Load status
030402  000207                                RTS     PC                      ; and return

                                        ;       Process unrecognized end packet
030404                          40$:
030404  012737  177777  002442                MOV     #-1,STATUS              ; Set fatal status
030412  012737  012617  002552                MOV     #ERM307,BASEMSG         ; "Unrecognized endcode"
030420  012737  000140  002370                MOV     #B.MSCP,EXTMSK          ; Flag all MSCP fields
030426  104455                                TRAP    C$ERDF
030430  000463                                .WORD   307
030432  012043                                .WORD   HDR301
030434  015504                                .WORD   ERR301
030436  000466                                BR      50$                     ; Exit

                                        ;       Process timeout
030440                          41$:
030440  012737  177777  002442                MOV     #-1,STATUS              ; Set fatal status
030446  012737  012727  002552                MOV     #ERM401,BASEMSG         ; "No interrupt received""
030454  012737  000003  002370                MOV     #B.SADDR!B.SAVAL,EXTMSK; Flag all address and value
030462  104455                                TRAP    C$ERDF
030464  000621                                .WORD   401
030466  012663                                .WORD   HDR401
030470  015650                                .WORD   ERR401
030472  000450                                BR      50$                     ; Exit

                                        ;       Report fatal controller error
030474                          42$:
030474  012737  177777  002442                MOV     #-1,STATUS              ; Set fatal status
030502  012737  013000  002552                MOV     #ERM402,BASEMSG         ; "Controller error reported..."
030510  012737  000003  002370                MOV     #B.SADDR!B.SAVAL,EXTMSK; Flag all address and value
030516  104455                                TRAP    C$ERDF
030520  000622                                .WORD   402
030522  012663                                .WORD   HDR401
030524  015650                                .WORD   ERR401
030526  000432                                BR      50$                     ; Exit

                                        ;       Report cmd reference error
030530                          43$:
030530  012737  177777  002442                MOV     #-1,STATUS              ; Set fatal status
030536  012737  012526  002552                MOV     #ERM306,BASEMSG         ; "Command refernce number error"
030544  012737  000151  002370                MOV     #B.CMDRF!B.EMREF!B.MSCP,EXTMSK  ; Flag all MSCP fields
030552  104455                                TRAP    C$ERDF
030554  000462                                .WORD   306
```

```
030556  012043                          .WORD   HDR301
030560  015504                          .WORD   ERR301
105
106                                     ;       Serious exception error
107 030562                              4$:
108 030562  012737  177777  002442              MOV     #-1,STATUS              ; Set fatal status
109 030570  012737  013050  002552              MOV     #ERM403,BASEMSG         ; "Serious exception"
110 030576  012737  000140  002370              MOV     #8.MSCP,EXTMSK          ; Flag all MSCP fields
111 030604  104455                              TRAP    C$ERDF
030606  000623                          .WORD   403
030610  012663                          .WORD   HDR401
030612  015650                          .WORD   ERR401
112
113                                     ;       Error exit
114 030614                              50$:
115 030614  017616  000000                      MOV     @(SP),(SP)              ; Load error erturn
116 030620  013700  002442                      MOV     STATUS,R0               ; Reload R0
117 030624  000207                              RTS     PC                      ; and return
118
```

```
                        .SBTTL  BLDCMD  Build command
                        ;BLDCMD
                        ;
                        ;BUILD A COMMAND IN COMMAND PACKET
                        ;
                        ;INPUTS:
                        ;       R0   COMMAND CODE
                        ;       R5 - CONTROLLER TABLE ADDRESS,
                        ;OUTPUTS:
                        ;       R4 - ADDRESS OF HOST COMMUNICATION AREA,
                        ;       SET COMMAND PACKET SIZE,
                        ;       SET CIRCUIT IDENT,
                        ;       IF 3$=1, CLEAR REST OF COMMAND PACKET FIELDS, ELSE
                        ;               DON'T CLEAR REST OF COMMAND PACKET,
                        ;       SET OPCODE,
                        ;       SET UNIT NUMBER,
                        ;       CLR 3$
                        ;
                        ;Calling Seq:
                        ;
                        ;       JSR     PC,INTCPK               ; Initialize packet/build command
                        ;or
                        ;       JSR     PC,BLDCMD               ; Build command
                        ;
                        
                        
030626                  INTCPK:
030626  005237  030742          INC     3$                      ;ENABLE COMMAND PACKET TO BE CLEARED
030632                  BLDCMD:
030632  010146                  MOV     R1,-(SP)                ;;PUSH R1 ON STACK
030634  010246                  MOV     R2,-(SP)                ;;PUSH R2 ON STACK
030636  013705  002304          MOV     CTLRTBL,R5              ; Load table start address
030642  013704  002324          MOV     HCOM,R4                 ; Load host comm area address
030646  010402                  MOV     R4,R2                   ;COPY TO R2
030650  062702  000100          ADD     #HC.CEV,R2              ;COMPUTE ADDRESS OF COMMAND ENVELOPE
030654  012722  000060          MOV     #HC.PSZ,(R2)+           ;LOAD PACKET SIZE
030660  012722  000000          MOV     #MSCP,(R2)+             ;LOAD MSCP CIRCUIT IDENTIFIER
030664  010122                  MOV     R1,(R2)+                ;PUT IDENTIFIER INTO PACKET
030666  012701  000030          MOV     #<HC.PSZ>/2,R1          ;GET WORDS TO CLEAR
030672  013764  002344  000114  MOV     OPCODE,HC.CPK+P.OPCD(R4); Load command code
030700  013764  002346  000116  MOV     CMDMOD,HC.CPK+P.MOD(R4) ; Load command modifiers
030706                  1$:
030706  005737  030742          TST     3$                      ;INITIALIZE REST OF COMMAND PACKET ?
030712  001403                  BEQ     2$                      ;BRANCH IF NO
030714  005022                  CLR     (R2)+                   ;CLEAR PACKET
030716  005301                  DEC     R1
030720  001372                  BNE     1$
030722                  2$:
030722  016564  000006  000110  MOV     C.DRVN(R5),HC.CPK+P.UNIT(R4) ;LOAD UNIT NUMBER
030730  005037  030742          CLR     3$                      ;DISABLE CLEAR FOR NEXT COMMAND
030734  012602                  MOV     (SP)+,R2                ;;POP STACK INTO R2
030736  012601                  MOV     (SP)+,R1                ;;POP STACK INTO R1
030740  000207                  RTS     PC

030742  000000          3$:     .WORD   0                       ;INIT PACKET FLAG GOES HERE
```

```
                        .SBTTL  SNDCMD  Send command
                        ;SNDCMD
                        ;
                        ;SEND A COMMAND TO THE xDA.
                        ;CLEAR THE RESPONSE PACKET. MARK BOTH PACKETS AVAILABLE TO THE
                        ;xDA. SET COMMAND ISSUED BIT IN CONTROLLER TABLE AND INITIALIZE
                        ;TIMEOUT COUNTER.
                        ;
                        ;INPUTS:
                        ;       R5   CONTROLLER TABLE ADDRESS
                        ;OUTPUTS:
                        ;       R4 - ADDRESS OF HOST COMMUNICATION AREA
                        ;
                        ;Calling Seq:
                        ;
                        ;       JSR     PC,SNDCMD
                        ;


030744                  SNDCMD:
030744  010046                  MOV     R0,-(SP)                ;;PUSH R0 ON STACK
030746  010146                  MOV     R1,-(SP)                ;;PUSH R1 ON STACK
030750  013705  002304          MOV     CTLRTBL,R5              ; Load table start address
030754  013704  002324          MOV     HCOM,R4                 ; Load host comm area address
030760  005237  002342          INC     CMDREF                  ; Increment command reference
030764  013764  002342  000104  MOV     CMDREF,HC.CPK+P.CRF(R4) ;PUT REFERENCE NUMBER IN PACKET
030772  012700  000014          MOV     #HC.MEV,R0              ;GET INDEX TO MESSAGE ENVELOPE
030776  060400                  ADD     R4,R0                   ;IN HOST COMMUNICATION AREA.
031000  010046                  MOV     R0,-(SP)                ;;PUSH R0 ON STACK
031002  062716  000004          ADD     #HC.ESZ,(SP)            ;AND ADD ENVELOPE SIZE TO INDEX.
031006  012701  000032          MOV     #<HC.PSZ+HC.ESZ>/2,R1   ;SIZE OF MESSAGE PACKET
031012                  1$:
031012  005020                  CLR     (R0)+                   ;CLEAR ENTIRE MESSAGE PACKET
031014  005301                  DEC     R1
031016  001375                  BNE     1$
031020  012600                  MOV     (SP)+,R0                ;;POP STACK INTO R0
031022  010064  000004          MOV     R0,HC.MSG(R4)             ;INSERT THE MESSAGE PACKET ADDRESS
031026  012764  140000  000006  MOV     #RG.OWN+RG.FLG,HC.MCT(R4) ;AND MARK THE OWNER/FLAG BITS IN
                                                                  ;THE MESSAGE RING.
031034  062700  000064          ADD     #<HC.PSZ+HC.ESZ>,R0     ;INDEX TO THE BEGINNING OF THE
031040  010064  000010          MOV     R0,HC.CMD(R4)           ;COMMAND PACKET, INSERT THE ADDRESS
031044  012764  100000  000012  MOV     #RG.OWN,HC.CCT(R4)      ;AND MARK THE OWNER BIT IN THE
                                                                ;COMMAND RING.
031052  005775  000000          TST     @(R5)                   ;TELL xDA TO START POLLING
031056  052765  000004  000014  BIS     #CT.CMD,C.FLG(R5)       ;MARK COMMAND ISSUED
031064  012601                  MOV     (SP)+,R1                ;;POP STACK INTO R1
031066  012600                  MOV     (SP)+,R0                ;;POP STACK INTO R0
031070  000207                  RTS     PC
```

```
                                .SBTTL  WAIT    Wait for xDA response
                                ;WAIT
                                ;
                                ;WAIT FOR xDA TO RESPOND WITH A MESSAGE PACKET
                                ;
                                ;INPUTS:
                                ;       R5 - ADDRESS OF CONTROLLER TABLE
                                ;OUTPUTS:
                                ;       Z SET   IF NO ERROR,
                                ;       Z CLR   IF timeout
                                ;
                                ;Calling Seq:
                                ;
                                ;       JSR     PC,WAIT
                                ;       .WORD   <error exit>
                                ;       BNE     <cmd timeout>
                                ;

031072                          WAIT:
031072  010046                         MOV     R0,-(SP)                ;;PUSH R0 ON STACK
031074  010146                         MOV     R1,-(SP)                ;;PUSH R1 ON STACK
031076  012700  000036                 MOV     #30.,R0                 ;SET TIMEOUT VALUE OF 30 SECONDS.
031102  010501                         MOV     R5,R1                   ;GET POINTER TO CONTROLLER TABLE AND
031104  062701  000022                 ADD     #C.TO,R1                ;INDEX TO TIMEOUT COUNTER SO THE
031110  004737  034334                 JSR     PC,SETTO                ;TIME CAN BE SAVED IN THE TABLE.
031114  013705  002304                 MOV     CTLRTBL,R5              ; Load table start address
031120                          1$:
031120  011500                         MOV     (R5),R0                 ;GET ADDRESS OF xDAIP REGISTER
031122  032765  000010  000014         BIT     #CT.MSG,C.FLG(R5)       ;LOOK IF INTERRUPT OCCURRED
031130  001031                         BNE     3$                      ;BRANCH IF SO
031132  016037  000002  002316         MOV     2(R0),SAVAL             ;LOOK AT xDASA REGISTER
031140  001037                         BNE     4$                      ;BRANCH IF ERROR CODE PRESENT

031142  000401                         BR      10$                     ; No console interrupt
                                                                        ;>>>>>>>>>BREAK BACK TO MONITOR<<<<<<<<<
031144  104422                         TRAP    C$BRK
031146                          10$:
031146  005737  002210                 TST     KW.CSR                  ;SEE IF A CLOCK ON SYSTEM
031152  001762                         BEQ     1$
031154  023765  002222  000024         CMP     KW.EL+2,C.TOH(R5)       ;CHECK IF TIMEOUT HAS HAPPENED
031162  101005                         BHI     2$
031164  001355                         BNE     1$
031166  023765  002220  000022         CMP     KW.EL,C.TO(R5)
031174  103751                         BLO     1$

                                ;       Controller timeout
031176                          2$:
031176  012601                         MOV     (SP)+,R1                ;;POP STACK INTO R1
031200  012600                         MOV     (SP)+,R0                ;;POP STACK INTO R0
031202  062716  000002                 ADD     #2,(SP)                 ; Bump past error return
031206  012700  000001                 MOV     #1,R0                   ; Set timeout status
031212  000207                         RTS     PC                      ; Return to caller

                                ;       Normal exit
031214                          3$:
031214  042765  000010  000014         BIC     #CT.MSG,C.FLG(R5)       ; Clear message received flag
031222  012601                         MOV     (SP)+,R1                ;;POP STACK INTO R1
```

```
        031224  012600                          MOV     (SP)+,R0                ;;POP STACK INTO R0
     56 031226  062716  000002                  ADD     #2,(SP)                 ; Bump past error return
     57 031232  012700  000000                  MOV     #0,R0                   ; Set success status
     58 031236  000207                          RTS     PC                      ; Return to caller
     59
     60                                 ;       Controller error
     61 031240                          4$:
     62 031240  012601                          MOV     (SP)+,R1                ;;POP STACK INTO R1
        031242  012600                          MOV     (SP)+,R0                ;;POP STACK INTO R0
     63 031244  017616  000000                  MOV     @(SP),(SP)              ; Load error return
     64 031250  012700  177777                  MOV     #-1,R0                  ; Set Fatal error status
     65 031254  000207                          RTS     PC                      ; Return to caller
     66
```

```
                                .SBTTL  CALRBN  Calculate RBN
                                ;CALRBN
                                ;
                                ;THIS ROUTINE CALCULATES A PHYSICAL RBN VALUE, FROM THE RCT LOGICAL BLOCK AND
                                ;OFFSET WITHIN THE RCT LOGICAL BLOCK.
                                ;
                                ;INPUTS:
                                ;       RCTBLK (RCT logical block),
                                ;       RCTOFF (RBN offset within RCT logical block)
                                ;
                                ;OUTPUTS:
                                ;       RBN (lo order word of RBN),
                                ;       RBN+2 (hi order word of RBN)
                                ;
                                ;Calling seq:
                                ;
                                ;       JSR     PC,CALRBN
                                ;

031256  013737  002476  002452 CALRBN: MOV     RCTBLK,RBN              ;GET RCT LOGICAL BLOCK NUMBER,
031264  162737  000002  002452         SUB     #2,RBN                  ;CALCULATE THE ACTUAL RBN,
031272  012746  000200                 MOV     #ENTRYS,-(SP)           ;PUT THE MULTIPLER ON THE STACK
031276  013746  002452                 MOV     RBN,-(SP)               ;PUT THE MULTIPLICAND ON THE STACK
031302  004737  034542                 JSR     PC,MULT                 ;CALL THE MULTPLY ROUTINE
031306  012637  002452                 MOV     (SP)+,RBN               ;GET THE LSB'S OF THE PRODUCT
031312  012637  002454                 MOV     (SP)+,RBN+2             ;GET THE MSB'S OF THE PRODUCT
031316  063737  002502  002452         ADD     RCTOFF,RBN              ;ADD THE RCT LOGICAL BLOCK OFFSET AND
031324  005537  002454                 ADC     RBN+2                   ;ADD THE CARRY BIT.
031330  000207                         RTS     PC                      ;RETURN
```

```
                        .SBTTL  CALBLK  Calculate RCT block
                        ;CALBLK
                        ;
                        ;THIS ROUTINE CALCULATES THE RCT LOGICAL BLOCK AND THE OFFSET OF THE RBN
                        ;WITHIN THAT LOGICAL BLOCK, FROM THE PHYSICAL RBN VALUE.
                        ;
                        ;SP = STACK POINTER
                        ;
                        ;INPUTS:
                        ;       SP+2 (Hi order word of RBN),
                        ;       SP (Lo order word of RBN)
                        ;
                        ;OUTPUTS:
                        ;       R0 (contents destroyed),
                        ;       SP+2 (RCT logical block of RBN),
                        ;       SP (RBN offset within the RCT logical block)
                        ;
                        ;Calling seq:
                        ;
                        ;       JSR     PC, #LBLK
                        ;
                        CALBLK:
031332  010346                 MOV     R3,-(SP)        ,;PUSH R3 ON STACK
031334  010446                 MOV     R4,-(SP)        ;;PUSH R4 ON STACK
031336  010546                 MOV     R5,-(SP)        ;;PUSH R5 ON STACK
031340  016603  000010         MOV     10(SP),R3       ;GET LO ORDER WORD AND
031344  016604  000012         MOV     12(SP),R4       ;HI ORDER WORD OF PRIMARY RBN.
031350  012700  000200         MOV     #ENTRYS,R0      ;GET # OF ENTRIES (128.) PER RCT BLOCK
031354  004737  034436         JSR     PC,DIVIDE       ;DIVIDE TO FIND THE APPROPRIATE
031360  010366  000012         MOV     R3,12(SP)       ;RCT LOGICAL BLOCK AND
031364  010566  000010         MOV     R5,10(SP)       ;THE RBN OFFSET WITHIN THE BLOCK.
031370  012605                 MOV     (SP)+,R5        ;;POP STACK INTO R5
031372  012604                 MOV     (SP)+,R4        ;;POP STACK INTO R4
031374  012603                 MOV     (SP)+,R3        ;;POP STACK INTO R3
031376  000207                 RTS     PC              ;RETURN
```

```
                                .SBTTL  SEARCH  RCT search
                                ;SEARCH
                                ;
                                ;THIS ROUTINE IMPLEMENTS THE RCT SEARCH ALGORITHM.  IT SEARCHES THE RCT
                                ;TO FIND AN AVAILABLE RBN FOR REPLACEMENT.
                                ;
                                ;INPUTS:
                                ;       LBN (Lo order word of LBN being replaced),
                                ;       LBN+2 (Hi order word of LBN being replaced),
                                ;       TRKSIZ (number of LBN'S per track),
                                ;       RBNS (number of REPLACEMENT BLOCKS per track),
                                ;
                                ;OUTPUTS:
                                ;       SFLAG (Search status flag),
                                ;       MATFLG (Match status flag),
                                ;       RBN (Lo order word of RBN replacement),
                                ;       RBN+2 (Hi order word of RBN replacement),
                                ;       MATRBN (Lo order word of RBN which matched the LBN being replaced),
                                ;       MATRBN+2 (Hi order word of RBN which matched the LBN being replaced)
                                ;
                                ;Calling seq:
                                ;
                                ;       JSR     PC,SEARCH
                                ;       BMI     <error exit>
                                ;
031400                          SEARCH:
031400  105037  002514                CLRB    MATFLG                  ;INIT THE MATCH FLAG,
031404  105037  002512                CLRB    EMPTY                   ;EMPTY STATUS FLAG AND
031410  105037  002513                CLRB    RESCAN                  ;RE-SCAN FLAG.
031414  010346                        MOV     R3,-(SP)                ;;PUSH R3 ON STACK
031416  010446                        MOV     R4,-(SP)                ;;PUSH R4 ON STACK
031420  010546                        MOV     R5,-(SP)                ;;PUSH R5 ON STACK
031422  013703  002446                MOV     LBN,R3                  ;GET LO WORD AND
031426  013704  002450                MOV     LBN+2,R4                ;HI WORD OF LBN BEING REPLACED.
031432  013700  002420                MOV     TRKSIZ,R0               ;GET THE TRACK SIZE,
031436  004737  034436                JSR     PC,DIVIDE               ; Divide to find LBN track
031442  113700  002422                MOVB    RBNS,R0                 ;GET NUMBER OF RBNS PER TRACK,
031446  010046                        MOV     R0,-(SP)                ;PUT THE MULTIPLER ON THE STACK
031450  010346                        MOV     R3,-(SP)                ;PUT THE MULTIPLICAND ON THE STACK
031452  004737  034542                JSR     PC,MULT                 ;CALL THE MULTPLY ROUTINE
031456  004737  031332                JSR     PC,CALBLK               ;CALCULATE THE RCT LOGICAL BLOCK AND
                                                                        ;THE RBN OFFSET WITHIN THE BLOCK.
031462  012637  002506                MOV     (SP)+,STROFF            ;;POP STACK INTO STROFF
031466  012637  002476                MOV     (SP)+,RCTBLK            ;;POP STACK INTO RCTBLK
031472  012605                        MOV     (SP)+,R5                ;;POP STACK INTO R5
031474  012604                        MOV     (SP)+,R4                ;;POP STACK INTO R4
031476  012603                        MOV     (SP)+,R3                ;;POP STACK INTO R3
031500  062737  000002  002476  1$:   ADD     #2,RCTBLK               ;OFFSET TO THE BEGINNING OF THE RCT
                                                                        ;DESCRIPTOR BLOCKS.
031506  004737  030074          2$:   JSR     PC,INITRW               ;SOME READ/WRITE PARAMETERS
031512  063764  002476  000140        ADD     RCTBLK,HC.CPK+P.LBN(R4) ;ADD THE RCT LOGICAL BLOCK TO STARTING
031520  005564  000142                ADC     HC.CPK+P.LBN+2(R4)      ;HOST LBN OF THE RCT AREA.
                                                                        ; Setup to issue MULTRD command
031524  004737  027224                JSR     PC,MULTRD               ; Issue command to the xDA
031530  032006                        10$                             ; Here if fatal error,
031532                          3$:
```

```
     51 031532  005037  002510                 CLR     DELTA                   ;INIT OFFSET TO PRIMARY RBN
     52 031536                          4$:
     53 031536  013701  002340                 MOV     UADR,R1                 ;GET THE BEGINNING OF UNIBUS ADDRESS
     54 031542  013700  002506                 MOV     STROFF,R0               ;GET STARTING OFFSET IN RCT BLOCK,
     55 031546  063700  002510                 ADD     DELTA,R0                ;SEE IF OFFSET EXCEEDED LO BLOCK LIMIT,
     56 031552  010037  002502                 MOV     R0,RCTOFF               ;STORE IT FOR LATER.
     57 031556  002475                         BLT     8$                      ;BRANCH IF SO, ELSE
     58 031560  020027  000200                 CMP     R0,#ENTRYS              ;SEE IF OFFSET EXCEEDED HI BLOCK LIMIT,
     59 031564  002072                         BGE     8$                      ;BRANCH IF SO, ELSE
     60 031566  006300                         ASL     R0                      ;MULTPLY OFFSET
     61 031570  006300                         ASL     R0                      ;BY 4
     62 031572  060001                         ADD     R0,R1                   ; Find RBN position in descriptor table
     63 031574  016100  000002                 MOV     2(R1),R0                ;GET HI ORDER LBN IN RBN DESCRIPTOR,
     64 031600  042700  007777                 BIC     #^C<170000>,R0          ;SEE IF THE RBN IS EMPTY OR A NULL,
     65 031604  001006                         BNE     5$                      ;BRANCH IF NOT EMPTY, ELSE
     66 031606  113737  002512  002515         MOVB    EMPTY,SFLAG             ;SET PRIMARY EMPTY SEARCH STATUS AND
     67 031614  004737  031256                 JSR     PC,CALRBN               ;CALCULATE THE RBN.
     68 031620  000475                         BR      12$
     69
     70 031622  042761  170000  000002  5$:    BIC     #170000,2(R1)           ;GET RID OF RBN REPLACEMENT CODE AND
     71 031630  112737  000001  002512         MOVB    #1,EMPTY                ;SET NOT PRIMARY EMPTY SEARCH STATUS.
     72 031636  032700  020000                 BIT     #BIT13,R0               ;PRIMARY OR SECONDARY REPLACEMENT ?
     73 031642  001422                         BEQ     6$                      ;BRANCH IF NO, ELSE
     74                                                                         ;SEE IF LBN BEING REPLACED MATCHES
     75 031644  021137  002446                 CMP     (R1),LBN                ;THE LBN IN THE LO WORD RBN DESCRIPTOR,
     76 031650  001017                         BNE     6$                      ;BRANCH IF NOT, ELSE
     77 031652  026137  000002  002450         CMP     2(R1),LBN+2             ;THE LBN IN THE HI WORD RBN DESCRIPTOR,
     78 031660  001013                         BNE     6$                      ;BRANCH IF NOT, ELSE
     79 031662  112737  000001  002514         MOVB    #1,MATFLG               ;SET THE MATCHED LBN FLAG.
     80 031670  004737  031256                 JSR     PC,CALRBN               ;CALCULATE THE PHYSICAL RBN
     81 031674  013737  002452  002462         MOV     RBN,MATRBN              ;STORE MATCHED RBN LO ORDER WORD AND
     82 031702  013737  002454  002464         MOV     RBN+2,MATRBN+2          ;RBN HI ORDER WORD.
     83
     84 031710  005700                  6$:    TST     R0                      ;IS THIS A NULL REPLACEMENT ?
     85 031712  100017                         BPL     8$                      ;BRANCH IF NO, ELSE
     86 031714  105737  002513                 TSTB    RESCAN                  ;SEE IF THIS IS A RE-SCAN OF THE RCT BLOCKS,
     87 031720  001404                         BEQ     7$                      ;BRANCH IF NOT, ELSE
     88 031722  112737  000002  002515         MOVB    #2,SFLAG                ;SET RCT FULL FLAG IN SEARCH STATUS AND
     89 031730  000431                         BR      12$                     ;EXIT.
     90
     91 031732  112737  000001  002513  7$:    MOVB    #1,RESCAN               ;SET SEQUENTIAL RE-SCAN FLAG AND
     92 031740  005037  002506                 CLR     STROFF                  ;START SEQUENCIAL SEARCH THRU THE
     93 031744  005037  002476                 CLR     RCTBLK                  ;FIRST RCT LOGICAL BLOCK.
     94 031750  000653                         BR      1$
     95
     96 031752  005437  002510          8$:    NEG     DELTA                   ;SEE WHICH DIRECTION SEARCH IS GOING,
     97 031756  100402                         BMI     9$                      ;BRANCH IF REVERSE, ELSE
     98 031760  005237  002510                 INC     DELTA                   ;INCREMENT TO NEXT RBN
     99                                                                         ;DESCRIPTOR FORWARD.
    100 031764  023727  002510  000200  9$:    CMP     DELTA,#ENTRYS           ;SEE IF STILL IN SAME RCT BLOCK,
    101 031772  002661                         BLT     4$                      ;BRANCH IF SO, ELSE
    102 031774  005037  002506                 CLR     STROFF                  ;START SEQUENCIAL SEARCH THRU THE
    103 032000  005237  002476                 INC     RCTBLK                  ;NEXT RCT LOGICAL BLOCK.
    104 032004  000640                         BR      2$
    105 032006                         10$:
    106 032006  012700  177777                 MOV     #-1,R0                  ; Set fatal error
    107 032012                         11$:
```

```
    108 032012  000207                        RTS     PC                      ; Return to caller
    109 032014                          12$:
    110 032014  012700  000000                MOV     #0,R0                   ; Load success
    111 032020  000207                        RTS     PC                      ; and return
```

```
                        .SBTTL  GETVSN  Get volume Serial Number
                        ;GETVSN
                        ;
                        ;Retrieve and format volume serial number
                        ;
                        ;Inputs:
                        ;       UADR:   Address of buffer containing RCT block 0 image
                        ;       VSNBUF: Twenty-four byte ASCII buffer
                        ;
                        ;Outputs:
                        ;       VNSPTR: Address of .ASCIZ string containing VSN
                        ;
                        ;Externals:
                        ;       DIV10:  Divide 4 byte positive biniary number by 10.
                        ;
                        ;Calling seq:
                        ;
                        ;       JSR     PC,GETVSN
                        ;

032022                  GETVSN:
032022  010146                MOV     R1,-(SP)                ;;PUSH R1 ON STACK
032024  010246                MOV     R2,-(SP)                ;;PUSH R2 ON STACK
032026  010346                MOV     R3,-(SP)                ;;PUSH R3 ON STACK
032030  010446                MOV     R4,-(SP)                ;;PUSH R4 ON STACK
032032  010546                MOV     R5,-(SP)                ;;PUSH R5 ON STACK
032034  013700  002340          MOV     UADR,R0                 ;GET THE BEGINNING OF UNIBUS ADDRESS
032040  012001                MOV     (R0)+,R1                ;PUT WORD 0,
032042  012002                MOV     (R0)+,R2                ;WORD 1,
032044  012003                MOV     (R0)+,R3                ;WORD 2 AND
032046  012004                MOV     (R0)+,R4                ;WORD 3 IN REGISTERS.
032050  012700  002620          MOV     #VSNBUF,R0              ; Load address of VSN text
032054  012705  000024          MOV     #20.,R5                 ;GET NUMBER OF CHARACTERS
032060                  3$:
032060  112720  000040          MOVB    #' ,(R0)+               ;INTIALIZE STORAGE WITH SPACES
032064  005305                DEC     R5                      ;DONE AREA YET ?
032066  001374                BNE     3$                      ;BR IF NO

032070  005010                CLR     (R0)                    ;INSERT NULL AS TERMINATOR
032072                  4$:
032072  004737  034474          JSR     PC,DIV10                ;CONVERT OCTAL TO DECIMAL AND
032076  062705  000060          ADD     #'0,R5                  ;MAKE IT ASCIZ.
032102  110540                MOVB    R5,-(R0)
032104  010146                MOV     R1,-(SP)
032106  050216                BIS     R2,(SP)
032110  050316                BIS     R3,(SP)
032112  050426                BIS     R4,(SP)+
032114  001366                BNE     4$                      ;BRANCH IF NOT DONE

032116  010037  002616          MOV     R0,VSNPTR               ; Save VSN pointer
032122  012605                MOV     (SP)+,R5                ;;POP STACK INTO R5
032124  012604                MOV     (SP)+,R4                ;;POP STACK INTO R4
032126  012603                MOV     (SP)+,R3                ;;POP STACK INTO R3
032130  012602                MOV     (SP)+,R2                ;;POP STACK INTO R2
032132  012601                MOV     (SP)+,R1                ;;POP STACK INTO R1
032134  000207                RTS     PC                      ; Return to caller
```

```
                                 SBTTL  GTDRVT  Get drive table pointer
                                ;GTDRVT
                                ;
                                ;GET DRIVE TABLE POINTER
                                ;
                                ;INPUTS:
                                ;       R1 - DRIVE NUMBER
                                ;       R5 - CONTROLLER TABLE ADDRESS
                                ;OUTPUTS:
                                ;       R4 - DRIVE TABLE ADDRESS
                                ;

032136  010504                  GTDRVT: MOV     R5,R4                   ;GET CONTROLLER TABLE ADRESS
032140  062704  000020                  ADD     #C.DRVT,R4              ;ADD OFFSET TO DRIVE TABLE ADDRESS
032144  011404                          MOV     (R4),R4                 ;GET ADDRESS OF TABLE
032146  000207                          RTS     PC
```

```
                                .SBTTL  DSPHELP Display operator help
                                ;
                                ;
                                ;       SUBROUTINE TO DUMP DOS HELP FILE TO CONSOLE
                                ;
                                ;       INPUT:          HLPFILE:  .ASCIZ "FILNAM.EXT"
                                ;
                                ;       OUTPUT:         PRINTS 72 CHARACTER BUFFER TO CONSOLE
                                ;
                                ;       REGISTER USAGE: R1  =   POINTER TO LINE TEXT BUFFER
                                ;                       R2  =   TAB POSITION COUNTER
                                ;                       R4  =   CHARACTER FROM FILE
                                ;
                                ;       CALLING SEQ:    JSR     PC,DPSHELP
                                ;
                                ;       FUNCTION:       DSPHELP WILL OPEN, READ AND CLOSE THE SELETED FILE
                                ;                       USING THE DIAG SUPERVISOR MACROS.  CHARACTERS
                                ;                       ARE READ ONE AT A TIME AND TRANSFERRED TO THE
                                ;                       LINE BUFFER, WHICH IS DUMPED TO THE CONSOLE
                                ;                       WHEN FULL.
                                
032150                          DSPHELP:
                                
032150  010146                          MOV     R1,-(SP)                ;;PUSH R1 ON STACK
032152  010246                          MOV     R2,-(SP)                ;;PUSH R2 ON STACK
032154  010446                          MOV     R4,-(SP)                ;;PUSH R4 ON STACK
                                
                                ;       OPEN FILE AND PRINT NULL LINE
032156                          100$:
032156  012700  014672                  MOV     #HLPFILE,R0
032162  104434                          TRAP    C$OPNRD
032164  012701  002716                  MOV     #LINBUF,R1              ;AND LOAD POINTER TO BUFFER
032170  112721  000015                  MOVB    #CR,(R1)+               ;MOVE CARRAGE RETURN
032174  112721  000012                  MOVB    #LF,(R1)+               ;AND LINE FEED TO BUFFER
032200  112704  000000                  MOVB    #0,R4                   ;FOLLOWED BY NULL
032204  004737  032270                  JSR     PC,600$                 ;PRINT BUFFER, RESET R1
                                
                                ;       GET NEXT CHARACTER FROM SUPERVISOR, AND TEST FOR END OF FILE
032210                          200$:
032210  104426                          TRAP    C$GETB
032212  010004                          MOV     R0,R4
032214  103004                          BCC     400$
032216  001405                          BEQ     425$                    ;OR IF CHARACTER = ZERO
                                
                                ;       TEST AND PROCESS TAB CHARACTER
032220                          300$:
032220  004737  032270                  JSR     PC,600$                 ;PRINT SPACES FOR TAB
032224  000771                          BR      200$                    ;AND RETRIEVE NEXT CHARACTER
                                
                                ;       LAST CHAR OR END OF FILE
032226                          400$:
032226  112704  000000                  MOVB    #0,R4                   ;INSURE NULL CHAR
032232                          425$:
032232  004737  032270                  JSR     PC,600$                 ;EMPTY
032236  112721  000015                  MOVB    #CR,(R1)+               ;OUTPUT CARRAGE RETURN
032242  112721  000012                  MOVB    #LF,(R1)+               ;AND LINE FEED
032246  112704  000000                  MOVB    #0,R4                   ;FOLLOWED BY NULL
```

```
     54 032252  004737  032270                JSR     PC,600$                 ;PRINT
     55
     56                                ;       CLOSE FILE AND RETURN TO MAIN
     57 032256                         500$:
     58 032256  104435                         TRAP    C$CLOS
     59 032260  012604                         MOV     (SP)+,R4                ;;POP STACK INTO R4
        032262  012602                         MOV     (SP)+,R2                ;;POP STACK INTO R2
        032264  012601                         MOV     (SP)+,R1                ;;POP STACK INTO R1
     60 032266  000207                         RTS     PC                      ;AND RETURN
     61
     62                                ;       MOVE CHAR TO BUFFER, TEST FOR NULL CHAR OR END OF BUFFER
     63 032270                         600$:
     64 032270  001415                         BEQ     800$                    ; Branch if null
     65
     66                                ;       TEST FOR CONTROL CHARS, TAB ACTIVE OR RETURN
     67 032272                         700$:
     68 032272  120427  000040                 CMPB    R4,#40                  ;COMPARE CHAR WITH BLANK
     69 032276  100010                         BPL     750$                    ;BRANCH IF CONTROL CHAR
     70 032300  120427  000015                 CMPB    R4,#15                  ; Test for CR
     71 032304  001006                         BNE     780$                    ; If not, ignore
     72
     73 032306  112721  000015                 MOVB    #15,(R1)+               ; Else, load CR
     74 032312  112721  000012                 MOVB    #12,(R1)+               ; and LF
     75 032316  000402                         BR      800$                    ; and print
     76 032320                         750$:
     77 032320  110421                         MOVB    R4,(R1)+                ;MOVE CHAR TO BUFFER
     78 032322                         780$:
     79 032322  000207                         RTS     PC                      ;NO:  JUST RETURN
     80
     81                                ;       RESET TAB COUNTER, TAB ACTIVE FLAG AND RETURN
     82 032324                         800$:
     83 032324  112721  000000                 MOVB    #0,(R1)+                ;MOVE CHAR TO BUFFER
     84 032330  012701  002716                 MOV     #LINBUF,R1              ;AND RESET POINTER
     85 032334  010146                         MOV     R1,-(SP)
        032336  012746  014220                 MOV     #F.TEXT,-(SP)
        032342  012746  000002                 MOV     #2,-(SP)
        032346  010600                         MOV     SP,R0
        032350  104414                         TRAP    C$PNTB
        032352  062706  000006                 ADD     #6,SP
     86 032356  012701  002716                 MOV     #LINBUF,R1              ;AND RESET POINTER
     87 032362  000207                         RTS     PC                      ;AND RETURN
     88
```

```
                                .SBTTL  DSPDSC  Display RCT descriptors
                                ;DSPDSC
                                ;
                                ;Read and display RBN descriptors in RCT.
                                ;
                                ;Inputs:
                                ;       DBUFF   Buffer for RCT blocks.
                                ;Outputs:
                                ;       Outputs replacement descriptors on console.
                                ;
                                ;Calling seq:
                                ;
                                ;       JSR     PC,DEPDSC
                                ;

032364                          DSPDSC:
032364  013705  002304                MOV     CTLRTBL,R5              ; Load table start address
032370  013704  002324                MOV     HCOM,R4                 ; Load host comm area address
                                                                      ; "RCT descriptor info..."
032374  013746  002074                MOV     L$LUN,-(SP)             ;PUSH L$LUN ON STACK
032400  012746  006170                MOV     #INF210,-(SP)           ;PUSH #INF210 ON STACK
032404  004137  033254                JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
032410  000004                       .WORD   ARG.CT                  ;ARGUMENT COUNT * 2

032412  004737  030626                JSR     PC,INTCPK               ;INITIALIZE THE COMMAND PACKET,
032416  005037  002434                CLR     PRIMRY                  ;THE PRIMARY RBN COUNT,
032422  005037  002436                CLR     SCNDRY                  ;THE SECONDARY RBN COUNT,
032426  005037  002440                CLR     UNUSE                   ;THE UNUSABLE RBN COUNT,
032432  012737  042472  002340        MOV     #DBUFF,UADR             ;GET BEGINNING ADDRESS OF DATA BUFFER
032440  012737  000001  002476        MOV     #1,RCTBLK               ;THE RCT LOGICAL BLOCK TO 1 AND
032446                          1$:
032446  005037  002502                CLR     RCTOFF                  ;THE OFFSET WITHIN THE RCT BLOCK.
032452  005237  002476                INC     RCTBLK                  ;INCREMENT RCT LOGICAL BLOCK AND
032456  023737  002476  002416        CMP     RCTBLK,RCTSIZ           ;SEE IF THE ENTIRE RCT WAS READ.
032464  002411                       BLT     2$                      ;BRANCH IF NOT, ELSE

032466  012737  013242  002552        MOV     #ERM602,BASEMSG         ; "No null entry..."
032474  104457                       TRAP    C$ERSOFT
032476  001132                       .WORD   602
032500  013173                       .WORD   HDR601
032502  015220                       .WORD   ERR001
032504  000137  033054                JMP     100$                    ;BRANCH TO EXIT ON ERROR
032510                          2$:
032510  004737  030074                JSR     PC,INITRW               ;INIT SOME READ/WRITE PARAMETERS
032514  063764  002476  000140        ADD     RCTBLK,HC.CPK+P.LBN(R4) ;ADD RCT LOGICAL BLOCK TO STARTING
032522  005564  000142                ADC     HC.CPK+P.LBN+2(R4)      ;HOST LBN OF THE RCT AREA.
                                                                      ; Setup to issue MULTRD command
032526  004737  027224                JSR     PC,MULTRD               ; Issue command to the xDA
032532  033054                       100$                            ; Here if fatal error.
032534                          4$:
032534  013701  002340                MOV     UADR,R1                 ;GET THE BEGINNING OF UNIBUS ADDRESS
032540                          5$:
032540  004737  031256                JSR     PC,CALRBN               ;CALCULATE THE PHYSICAL RBN
032544  016103  000002                MOV     2(R1),R3                ;GET HI ORDER LBN IN RBN DESCRIPTOR,
032550  042703  007777                BIC     #^C<170000>,R3          ;SEE IF THE RBN IS EMPTY OR A NULL,
032554  001521                       BEQ     9$                      ;BRANCH IF EMPTY,
```

```
     50 032556  100033                          BPL     6$                      ;BRANCH IF NOT NULL, ELSE
     51                                                                         ;THIS IS MUST BE THE END, SO
     52                                                                         ; "RCT descriptor summary..."
     53 032560  013701  002434                   MOV     PRIMRY,R1               ; Load primary
     54 032564  063701  002436                   ADD     SCNDRY,R1               ; Add secondary
     55 032570  063701  002440                   ADD     UNUSE,R1                ; Add unusable
     56 032574  012746  006452                   MOV     #INF220,-(SP)           ;PUSH #INF220 ON STACK
        032600  004137  033254                   JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
        032604  000002                           .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
     57 032606  013746  002422                   MOV     RBNS,-(SP)              ;PUSH RBNS ON STACK
        032612  010146                           MOV     R1,-(SP)                ;PUSH R1 ON STACK
        032614  013746  002440                   MOV     UNUSE,-(SP)             ;PUSH UNUSE ON STACK
        032620  013746  002436                   MOV     SCNDRY,-(SP)            ;PUSH SCNDRY ON STACK
        032624  013746  002434                   MOV     PRIMRY,-(SP)            ;PUSH PRIMRY ON STACK
        032630  012746  006523                   MOV     #INF221,-(SP)           ;PUSH #INF221 ON STACK
        032634  004137  033254                   JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
        032640  000014                           .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
     58
     59 032642  000137  033042                   JMP     90$                     ;BRANCH TO EXIT
     60
     61 032646  042761  170000  000002  6$:      BIC     #170000,2(R1)           ;GET RID OF THE REPLACEMENT BLOCK CODE,
     62                                                                         ;THE LBN CAN BE PRINTED LATER.
     63 032654  020327  020000                   CMP     R3,#BIT13               ;IS THIS A PRIMARY REPLACEMENT ?
     64 032660  001017                           BNE     7$                      ;BRANCH IF NO, ELSE
     65 032662  005237  002434                   INC     PRIMRY                  ;UPDATE # OF PRIMARY REPLACEMENT BLOCKS
     66                                                                         ; "RBN "D32". Primary replacement..."
     67 032666  016146  000002                   MOV     2(R1),-(SP)             ;PUSH 2(R1) ON STACK
        032672  011146                           MOV     (R1),-(SP)              ;PUSH (R1) ON STACK
        032674  013746  002454                   MOV     RBN+2,-(SP)             ;PUSH RBN+2 ON STACK
        032700  013746  002452                   MOV     RBN,-(SP)               ;PUSH RBN ON STACK
        032704  012746  006244                   MOV     #INF211,-(SP)           ;PUSH #INF211 ON STACK
        032710  004137  033254                   JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
        032714  000012                           .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
     68 032716  000440                           BR      9$
     69
     70 032720  020327  030000           7$:     CMP     R3,#BIT13!BIT12         ;IS THIS A SECONDARY REPLACEMENT ?
     71 032724  001017                           BNE     8$                      ;BRANCH IF NO, ELSE
     72 032726  005237  002436                   INC     SCNDRY                  ;UPDATE # OF SECONDARY
     73                                                                         ;REPLACEMENT BLOCKS
     74                                                                         ; "RBN "D32". Secondary replacement..."
     75 032732  016146  000002                   MOV     2(R1),-(SP)             ;PUSH 2(R1) ON STACK
        032736  011146                           MOV     (R1),-(SP)              ;PUSH (R1) ON STACK
        032740  013746  002454                   MOV     RBN+2,-(SP)             ;PUSH RBN+2 ON STACK
        032744  013746  002452                   MOV     RBN,-(SP)               ;PUSH RBN ON STACK
        032750  012746  006332                   MOV     #INF212,-(SP)           ;PUSH #INF212 ON STACK
        032754  004137  033254                   JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
        032760  000012                           .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
     76 032762  000416                           BR      9$
     77
     78 032764  020327  040000           8$:     CMP     R3,#BIT14               ;IS THIS AN UNUSABLE REPLACEMENT ?
     79 032770  103413                           BLO     9$                      ;BRANCH IF NO, ELSE
     80 032772  005237  002440                   INC     UNUSE                   ;UPDATE # OF UNUSABLE REPLACEMENT BLOCKS
     81                                                                         ; "RBN "D32". Unusable"
     82 032776  013746  002454                   MOV     RBN+2,-(SP)             ;PUSH RBN+2 ON STACK
        033002  013746  002452                   MOV     RBN,-(SP)               ;PUSH RBN ON STACK
        033006  012746  006420                   MOV     #INF213,-(SP)           ;PUSH #INF213 ON STACK
        033012  004137  033254                   JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
```

```
      033016  000006                          .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
   83
   84 033020  022121                  9$:     CMP     (R1)+,(R1)+             ;UPDATE POINTER IN THE TABLE
   85 033022  005237  002502                  INC     RCTOFF                  ;INCREMENT TO NEXT RBN DESCRIPTOR AND
   86 033026  023727  002502  000200          CMP     RCTOFF,#ENTRYS          ;SEE IF ALL ENTRIES DONE,
   87 033034  002641                          BLT     5$                      ;BRANCH IF NOT, ELSE
   88 033036  000137  032446                  JMP     1$                      ;CONTINUE TO READ NEXT BLOCK OF
   89                                                                         ;REPLACEMENT DESCRIPTORS.
   90 033042                          90$:
   91 033042  062716  000002                  ADD     #2,(SP)                 ; Bump past error return
   92 033046  012700  000000                  MOV     #0,R0                   ; Status is success
   93 033052  000207                          RTS     PC                      ; Return to caller
   94 033054                          100$:
   95 033054  017616  000000                  MOV     @(SP),(SP)              ; Load error return
   96 033060  012700  177777                  MOV     #-1,R0                  ; Status is failure
   97 033064  000207                          RTS     PC                      ; Return to caller
   98
```

```
                                .SBTTL  PRINTC  Print character
                                ;PRINTC
                                ;
                                ;PRINT A CHARACTER
                                ;
                                ;CALL WITH MACRO PRINT

033066  110037  033242  PRINTC: MOVB    R0,TTYOUT               ;SAVE CHARACTER FOR TTY OUTPUT
033072  010146                  MOV     R1,-(SP)                ;;PUSH R1 ON STACK
033074  012701  014220          MOV     #F.TEXT,R1              ;PICKUP FORMATTED ASCIZ STRING STATEMENT
033100  120027  000015          CMPB    R0,#CR                  ;IF NOT A CARRIAGE RETURN, THEN
033104  001002                  BNE     1$                      ;PRINT SOME OTHER CHARACTER, ELSE
033106  012701  014215          MOV     #F.CRLF,R1              ;PICKUP FORMATTED ASCIZ STRING STATEMENT
                                                                ;GO PRINT CR-LF.
033112  004777  000232  1$:     JSR     PC,@PTYPE               ;PRINT THE ASCIZ STRING,
033116  012601                  MOV     (SP)+,R1                ;;POP STACK INTO R1
033120  000207                  RTS     PC
033122                  PF:
033122  012746  033242          MOV     #TTYOUT,-(SP)
033126  010146                  MOV     R1,-(SP)
033130  012746  000002          MOV     #2,-(SP)
033134  010600                  MOV     SP,R0
033136  104417                  TRAP    C$PNTF
033140  062706  000006          ADD     #6,SP
033144  000207                  RTS     PC
033146                  PB:
033146  012746  033242          MOV     #TTYOUT,-(SP)
033152  010146                  MOV     R1,-(SP)
033154  012746  000002          MOV     #2,-(SP)
033160  010600                  MOV     SP,R0
033162  104414                  TRAP    C$PNTB
033164  062706  000006          ADD     #6,SP
033170  000207                  RTS     PC
033172                  PX:
033172  012746  033242          MOV     #TTYOUT,-(SP)
033176  010146                  MOV     R1,-(SP)
033200  012746  000002          MOV     #2,-(SP)
033204  010600                  MOV     SP,R0
033206  104415                  TRAP    C$PNTX
033210  062706  000006          ADD     #6,SP
033214  000207                  RTS     PC
033216                  PS:
033216  012746  033242          MOV     #TTYOUT,-(SP)
033222  010146                  MOV     R1,-(SP)
033224  012746  000002          MOV     #2,-(SP)
033230  010600                  MOV     SP,R0
033232  104416                  TRAP    C$PNTS
033234  062706  000006          ADD     #6,SP
033240  000207                  RTS     PC

033242      000         TTYOUT: .BYTE   0                       ;TTY OUTPUT BUFFER
033243      000                 .BYTE   0                       ;TERMINATOR FOR ASCIZ STRING
                                .EVEN
```

```
                                        .SBTTL  LPNTx   Print formatted message
                                        ;PRINT FORMATTED MESSAGE
                                        ;
                                        ;CALL WITH MACRO PNT, PNTF, PNTB, PNTX, OR PNTS

033244  012737  033122  033350  LPNTF:  MOV     #PF,PTYPE
033252  000413                          BR      LPNT

033254  012737  033146  033350  LPNTB:  MOV     #PB,PTYPE
033262  000407                          BR      LPNT

033264  012737  033172  033350  LPNTX:  MOV     #PX,PTYPE
033272  000403                          BR      LPNT

033274  012737  033216  033350  LPNTS:  MOV     #PS,PTYPE

033302                          LPNT:
033302  010246                          MOV     R2,-(SP)        ;;PUSH R2 ON STACK
033304  010346                          MOV     R3,-(SP)        ;;PUSH R3 ON STACK
033306  010446                          MOV     R4,-(SP)        ;;PUSH R4 ON STACK
033310  010546                          MOV     R5,-(SP)        ;;PUSH R5 ON STACK
                                ;       MOV     (R1)+,R2        ;GET ADDRESS OF ASCIZ STRING
033312  010604                          MOV     SP,R4           ;COMPUTE ADDRESS OF 1ST ARGUMENT AND
033314  062704  000012                  ADD     #12,R4          ;SAVE IT IN R4.
033320  012402                          MOV     (R4)+,R2        ; Load address of ASCII string
033322  010146                          MOV     R1,-(SP)        ;;PUSH R1 ON STACK
033324  004737  033352                  JSR     PC,OSTRNG       ;PRINT THE FORMATTED MESSAGE
033330  012600                          MOV     (SP)+,R0        ;;POP STACK INTO R0
033332  012605                          MOV     (SP)+,R5        ;;POP STACK INTO R5
033334  012604                          MOV     (SP)+,R4        ;;POP STACK INTO R4
033336  012603                          MOV     (SP)+,R3        ;;POP STACK INTO R3
033340  012602                          MOV     (SP)+,R2        ;;POP STACK INTO R2
033342  012601                          MOV     (SP)+,R1        ;;POP STACK INTO R1
033344  062006                          ADD     (R0)+,SP        ;ADJUST STACK POINTER OVER ARGUMENTS
033346  000110                          JMP     @R0             ;RETURN

033350  033122                  PTYPE:  .WORD   PF              ;PRINT TYPE
```

```
                                .SBTTL  OSTRNG  Formatted message output
                               ;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

033352  112201                 OSTRNG: MOVB    (R2)+,R1                ;SEE IF TERMINATOR IN ASCIZ STRING.
033354  001422                         BEQ     OSTRE                   ;EXIT
033356  012700  033632                 MOV     @ERRC,R0                ;GET POINTER TO CHARACTER TABLE
033362  120110                 NCONS:  CMPB    R1,(R0)                 ;COMPARE CHARACTER WITH TABLE ENTRY
033364  001410                         BEQ     NCONF                   ;BRANCH IF MATCH FOUND
033366  105720                         TSTB    (R0)+                   ;INCREMENT POINTER
033370  001374                         BNE     NCONS                   ;CONTINUE SEARCH IF NOT END OF TABLE
033372  012746  014427                 MOV     @ERRME1,-(SP)           ;PUSH @ERRME1 ON STACK
033376  004137  033244                 JSR     R1,LPNTF                        ;CALL LPNTF PRINT ROUTINE
033402  000002                         .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
033404  000406                         BR      OSTRE
033406  162700  033632         NCONF:  SUB     @ERRC,R0                ;GET INCREMENT INTO TABLE
033412  006300                         ASL     R0                      ;DOUBLE TO WORD COUNT
033414  004770  033644                 JSR     PC,@ERRD(R0)            ;DISPATCH TO PRINT ROUTINE
033420  000754                         BR      OSTRNG                  ;GET NEXT
033422  000207                 OSTRE:  RTS     PC
```

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

033424  112200              CON.QU: MOVB    (R2)+,R0                ;GET CHARACTER
033426  120027  000042              CMPB    R0,#'"                  ;CHECK IF ENDING QUOTE
033432  001403                      BEQ     CON.QX                  ;IF SO, GO GET NEXT CONTROL CHARACTER
033434  004737  033066              JSR     PC,PRINTC               ;PRINT THE CHARACTER.
033440  000771                      BR      CON.QU                  ;CONTINUE PRINTING
033442  000207              CON.QX: RTS     PC

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

033444  004737  033664      CON.A:  JSR     PC,GETCNT               ;GET COUNT OF CHARACTERS
033450  012401                      MOV     (R4)+,R1                ; GET STRING ADDRESS
033452  105711              CON.A1: TSTB    (R1)                    ; TEST FOR NULL
033454  001404                      BEQ     CON.A2                  ; BRANCH IF YES
033456  112100                      MOVB    (R1)+,R0                        ;STORE (R1)+ IN R0 AND
033460  004737  033066              JSR     PC,PRINTC               ;PRINT THE CHARACTER.
033464  000772                      BR      CON.A1                  ; CONTINUE
033466  000207              CON.A2: RTS     PC                      ;NOW GET NEXT CONTROL CHARACTER

                                        ;CONTROL CHARACTER WAS A 'D', SO PRINT A DECIMAL NUMBER.

033470  012701  000012      CON.D:  MOV     #10.,R1                 ;LOAD RADIX
033474  004737  033742              JSR     PC,PNTNUM               ;PRINT NUMBER
033500  000207                      RTS     PC                      ;NOW GET NEXT CONTROL CHARACTER

                                        ;CONTROL CHARACTER WAS AN 'H', SO PRINT A HEX NUMBER.

033502  012701  000020      CON.H:  MOV     #16.,R1                 ;LOAD RADIX
033506  004737  033742              JSR     PC,PNTNUM               ;PRINT NUMBER
033512  000207                      RTS     PC                      ;NOW GET NEXT CONTROL CHARACTER
```

```
 1
 2                                          ;CONTROL CHARACTER WAS AN 'O', SO PRINT AN OCTAL NUMBER.
 3
 4 033514  012701  000010          CON.O:  MOV     #8.,R1                  ;LOAD RADIX
 5 033520  004737  033742                  JSR     PC,PNTNUM               ;PRINT NUMBER
 6 033524  000207                         RTS     PC                      ;NOW GET NEXT CONTROL CHARACTER
 7
 8                                          ;CONTROL CHARACTER WAS AN 'N', SO PRINT A CARRIAGE RETURN-LINE FEED.
 9
10 033526  004737  033664          CON.N:  JSR     PC,GETCNT               ;GET COUNT
11 033532                          CON.N1:
   033532  112700  000015                  MOVB    #CR,R0                  ;STORE #CR IN R0 AND
   033536  004737  033086                  JSR     PC,PRINTC               ;PRINT THE CHARACTER.
12 033542  005301                         DEC     R1                      ;COUNT THE SEQUENCES
13 033544  001372                         BNE     CON.N1
14 033546  000207                         RTS     PC                      ;NOW GET NEXT CONTROL CHARACTER
15
16                                          ;CONTROL CHARACTER WAS AN 'R', SO CALL ONE OF THE PRE-PROGRAMMED
17                                          ;ROUTINE.
18
19 033550  004737  033664          CON.R:  JSR     PC,GETCNT               ;GET ROUTINE NUMBER
20 033554  020127  000010                  CMP     R1,#ERR.SZ              ;CHECK IF DEFINED ROUTINE NUMBER
21 033560  101004                         BHI     CON.R1
22 033562  060101                         ADD     R1,R1                   ;DOUBLE COUNT TO GET WORD INDEX
23 033564  004771  016132                 JSR     PC,@ERR.TB-2(R1)        ;CALL ROUTINE
24 033570  000207                         RTS     PC                      ;NOW GET NEXT CONTROL CHARACTER
25
26 033572                          CON.R1:
   033572  012746  014427                  MOV     #ERRME1, (SP)           ;PUSH #ERRME1 ON STACK
   033576  004137  033244                  JSR     R1,LPNTF                        ;CALL LPNTF PRINT ROUTINE
   033602  000002                         .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
27 033604  012601                         MOV     (SP)+,R1                ;;POP STACK INTO R1
28 033606  000207                         RTS     PC
29
30                                          ;CONTROL CHARACTER WAS AN 'S', SO PRINT SOME NUMBER OF SPACES.
31
32 033610  004737  033664          CON.S:  JSR     PC,GETCNT               ;GET COUNT
33 033614                          CON.S1:
   033614  112700  000040                  MOVB    #' ,R0                  ;STORE #'  IN R0 AND
   033620  004737  033066                  JSR     PC,PRINTC               ;PRINT THE CHARACTER.
34 033624  005301                         DEC     R1                      ;COUNT THE SPACES
35 033626  001372                         BNE     CON.S1
36 033630  000207                         RTS     PC                      ;NOW GET NEXT CONTROL CHARACTER
37
```

```
      1                                 .SBTTL  FAO VECTOR TABLE
      2                                 ;BUILD TWO TABLES
      3                                 ;       FIRST CONTAINING CONTROL CHARACTERS
      4                                 ;       SECOND CONTAINING ROUTINE ADDRESSES
      5
     22
     23                                 ;       ERRC:   CONTROL CHARACTER TABLE
     24
     34
     35 033632                          ERRC:
        033632      042                         .BYTE   '"
        033633      101                         .BYTE   'A
        033634      104                         .BYTE   'D
        033635      110                         .BYTE   'H
        033636      117                         .BYTE   'O
        033637      116                         .BYTE   'N
        033640      122                         .BYTE   'R
        033641      123                         .BYTE   'S
     36 033642      000                         .BYTE   0                       ;FOLLOW WIT'I A NULL BYTE
     37                                         .EVEN
     38
     39                                 ;       ERRD:   PROCESSING ROUTINE TABLE
     40
     50
     51 033644                          ERRD:
        033644  033424                          .WORD   CON.QU
        033646  033444                          .WORD   CON.A
        033650  033470                          .WORD   CON.D
        033652  033502                          .WORD   CON.H
        033654  033514                          .WORD   CON.O
        033656  033526                          .WORD   CON.N
        033660  033550                          .WORD   CON.R
        033662  033610                          .WORD   CON.S
     52
```

```
                                .SBTTL  GETCNT  GET CHARACTER COUNT
                                ;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
                                
033664                          GETCNT:
033664  010046                         MOV     R0,-(SP)                ;;PUSH R0 ON STACK
033666  005001                         CLR     R1                      ;START WITH ZERO COUNT
033670  121227  000060         GETCNX: CMPB    (R2),#'0                ;CHECK IF CHARACTER A DIGIT
033674  103415                         BLO     GETCDN                  ;BRANCH IF LOWER THAN ZERO
033676  121227  000071                 CMPB    (R2),#'9
033702  101012                         BHI     GETCDN                  ;BRANCH IF HIGHER THAN NINE
033704  006301                         ASL     R1                      ;MULTIPLY NUMBER BY 10
033706  010100                         MOV     R1,R0                   ; SAVE 2N
033710  006301                         ASL     R1                      ; COMPUTE 4N
033712  006301                         ASL     R1                      ; COMPUTE 8N
033714  060001                         ADD     R0,R1                   ; 8N + 2N = 10N
033716  112200                         MOVB    (R2)+,R0                ;GET DIGIT FROM STING
033720  162700  000060                 SUB     #'0,R0                  ;GET RID OF ASCII
033724  060001                         ADD     R0,R1                   ;ADD TO NUMBER
033726  000760                         BR      GETCNX                  ;GO TO NEXT CHARACTER
033730  005701                 GFTCDN: TST     R1                      ;CHECK IF NUMBER IS ZERO
033732  001001                         BNE     GETCXX                  ;IF ZERO, CHANGE
033734  005201                         INC     R1                      ; TO DEFAULT OF ONE
033736                          GETCXX:
033736  012600                         MOV     (SP)+,R0                ;;POP STACK INTO R0
033740  000207                         RTS     PC
```

```
                        .SBTTL  PNTNUM  PRINT NUMBER
                        ;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 (LEFT JUSTIFIED).
                        ;       R0 - CONTENTS DESTROYED
                        ;
033742  010100          PNTNUM: MOV     R1,R0                   ;SAVE RADIX
033744  004737  033664          JSR     PC,GETCNT               ;GET COUNT OF BITS
033750                  PNTNUS:
033750  010246                  MOV     R2,-(SP)                ;;PUSH R2 ON STACK
033752  010346                  MOV     R3,-(SP)                ;;PUSH R3 ON STACK
033754  010546                  MOV     R5,-(SP)                ;;PUSH R5 ON STACK
033756  012403                  MOV     (R4)+,R3                ;GET ONE PARAMETER WORD
033760  005005                  CLR     R5                      ;CLEAR STORAGE FOR OTHER
033762  020127  000020          CMP     R1,#16.                 ;MORE THAN 16 BITS IN NUMBER?
033766  003401                  BLE     1$
033770  012405                  MOV     (R4)+,R5                ;YES, GET SECOND PARAMETER WORD
033772                  1$:
033772  010446                  MOV     R4,-(SP)                ;;PUSH R4 ON STACK
033774  010504                  MOV     R5,R4                   ;PUT HIGH WORD IN R4
033776  012702  000020          MOV     #16.,R2                 ;COMPUTE BITS NOT WANTED
034002  160102                  SUB     R1,R2                   ;BY SUBTRACTING BITS TO USE
034004  002002                  BGE     2$                      ;FROM 16.
034006  062702  000020          ADD     #16.,R2                 ;IF NEGATIVE, ADD 16 FOR FIRST WORD
034012  001414          2$:     BEQ     6$                      ;IF ZERO, NO BITS NEED BE CLEARED
034014  012705  100000          MOV     #BIT15,R5               ;START MASK WITH SIGN BIT SET
034020  005302          3$:     DEC     R2                      ;COUNT BITS IN MASK
034022  001402                  BEQ     4$
034024  006205                  ASR     R5                      ;SHIFT MORE BITS TO RIGHT
034026  000774                  BR      3$
034030  020127  000020  4$:     CMP     R1,#16.                 ;MORE THAN 16 BITS IN NUMBER?
034034  003402                  BLE     5$
034036  040504                  BIC     R5,R4                   ;YES, CLEAR IN HIGH WORD
034040  000401                  BR      6$
034042  040503          5$:     BIC     R5,R3                   ;NO, CLEAR IN LOW WORD
034044  004737  034436  6$:     JSR     PC,DIVIDE               ;DIVIDE BY RADIX IN R0
034050  010546                  MOV     R5,-(SP)                ;;PUSH R5 ON STACK
034052  005202                  INC     R2                      ;COUNT DIGITS ON STACK
034054  005703                  TST     R3                      ;CHECK IF QUOTIENT IS ZERO
034056  001372                  BNE     6$
034060  005704                  TST     R4
034062  001370                  BNE     6$
```

PNTNUM PRINT NUMBER

```
    1 034064  020027  000012            CMP     R0,#10.             ;IF RADIX IS DECIMAL
    2 034070  001424                    BEQ     90$                 ; JUST GO PRINT DIGITS ON STACK
    3 034072  010103                    MOV     R1,R3               ;OTHERWISE COMPUTE NUMBER OF LEADING ZEROS
    4 034074  162700  000014            SUB     #12.,R0             ;DIVIDEND IS BITS IN NUMBER
    5 034100  003002                    BGT     7$                  ;DIVISOR IS BITS PER DIGIT PRINTED
    6 034102  012700  000003            MOV     #3,R0               ;   (3 OR 4)
    7 034106                    7$:
    8 034106  004737  034436            JSR     PC,DIVIDE
    9 034112  005705                    TST     R5                  ;IF REMAINDER NOT ZERO
   10 034114  001401                    BEQ     8$                  ;INCREMENT QUOTIENT
   11 034116  005203                    INC     R3
   12 034120                    8$:
   13 034120  160203                    SUB     R2,R3               ;SUBTRACT DIGITS ON STACK
   14 034122  001424                    BEQ     10$                 ;NO LEADING ZEROS IF ZERO
   15 034124                    9$:
   16 034124  112700  000060            MOVB    #'0,R0              ;STORE #'0 IN R0 AND
      034130  004737  033066            JSR     PC,PRINTC           ;PRINT THE CHARACTER.
   17 034134  005303                    DEC     R3
   18 034136  001372                    BNE     9$                  ;REPEAT UNTIL COUNT REACHES ZERO
   19 034140  000415                    BR      10$                 ; NOW PRINT NUMBER
   20 034142                    90$:
   21 034142  022701  000034            CMP     #28.,R1             ; TEST FOR D28 SPEC (LBN)
   22 034146  001012                    BNE     10$                 ; BRANCH IF NO
   23 034150  012703  000011            MOV     #9.,R3              ; MAX LBN FIELD SIZE IS 9.
   24 034154  160203                    SUB     R2,R3               ; SUBTRACT CHARS ON STACK
   25 034156  003406                    BLE     10$                 ; BRANCH IF <= ZERO
   26 034160                    99$:
   27 034160  112700  000040            MOVB    #' ,R0              ; LOAD BLANK
   28 034164  004737  033066            JSR     PC,PRINTC           ; AND PRINT
   29 034170  005303                    DEC     R3                  ; DECREMENT
   30 034172  001372                    BNE     99$                 ; AND CONTINUE UNTIL ZERO
   31 034174                    10$:
   32 034174  012605                    MOV     (SP)+,R5            ;;POP STACK INTO R5
   33 034176  062705  000060            ADD     #'0,R5              ;CNVERT TO ASCII DIGIT
   34 034202  020527  000071            CMP     R5,#'9              ;IF GREATER THAN A 9
   35 034206  003402                    BLE     11$                 ; CONVERT TO A OR HIGHER
   36 034210  062705  000007            ADD     #<'A-'9-1>,R5       ; FOR HEX DIGIT
   37 034214                    11$:
   38 034214  110500                    MOVB    R5,R0               ;STORE R5 IN R0 AND
      034216  004737  033066            JSR     PC,PRINTC           ;PRINT THE CHARACTER.
   39 034222  005302                    DEC     R2                  ;REPEAT FOR ALL DIGITS
   40 034224  001363                    BNE     10$                 ; ON STACK
   41 034226  012604                    MOV     (SP)+,R4            ;;POP STACK INTO R4
      034230  012605                    MOV     (SP)+,R5            ;;POP STACK INTO R5
      034232  012603                    MOV     (SP)+,R3            ;;POP STACK INTO R3
      034234  012602                    MOV     (SP)+,R2            ;;POP STACK INTO R2
   42 034236  000207                    RTS     PC
   43
```

```
                                .SBTTL  CLRBUF  CLEAR BUFFER
                                ;CLRBUF
                                ;
                                ;CLEAR A 512(10) BYTE BUFFER, STARTING AT THE UNIBUS ADDRESS CONTAINED IN
                                ;THE COMMAND PACKET OF THE HOST COMM AREA.
                                ;
                                ;INPUTS:
                                ;       R4 - ADDRESS OF HOST COMM AREA
                                ;OUTPUTS:
                                ;       512(10) BYTE BUFFER CLEARED

034240                          CLRBUF:
034240  010046                         MOV     R0,-(SP)                ;;PUSH R0 ON STACK
034242  010146                         MOV     R1,-(SP)                ;;PUSH R1 ON STACK
034244  013704  002324                 MOV     HCOM,R4                 ; LOAD HOST COMM AREA ADDRESS
034250  016400  000124                 MOV     HC.CPK+P.UADR(R4),R0    ;GET STARTING UNIBUS ADDRESS
034254  013701  002334                 MOV     BCNT,R1                 ;NUMBER OF BYTES TO CLEAR.
034260  006201                         ASR     R1                      ;MAKE R1 WORDS AND
034262  005020                 1$:     CLR     (R0)+                   ;CLEAR THE ENTIRE BUFFER.
034264  005301                         DEC     R1
034266  001375                         BNE     1$
034270  012601                         MOV     (SP)+,R1                ;;POP STACK INTO R1
034272  012600                         MOV     (SP)+,R0                ;;POP STACK INTO R0
034274  000207                         RTS     PC

```

```
                                .SBTTL  COPY    COPY BUFFER
                                ;COPY
                                ;
                                ;COPY 512(10) BYTES OF DATA FROM ONE BUFFER TO ANOTHER BUFFER
                                ;
                                ;INPUTS:
                                ;       (R5) - ADDRESS OF SOURCE BUFFER
                                ;       2(R5) - ADDRESS OF DESTINATION BUFFER
                                ;OUTPUTS:
                                ;       512(10) BYTES COPIED FROM 'SOURCE' BUFFER TO 'DESTINATION' BUFFER

034276                          COPY:
034276  010046                          MOV     R0,-(SP)                ;;PUSH R0 ON STACK
034300  010146                          MOV     R1,-(SP)                ;;PUSH R1 ON STACK
034302  010246                          MOV     R2,-(SP)                ;;PUSH R2 ON STACK
034304  012500                          MOV     (R5)+,R0                ;GET STARTING ADDRESS OF SOURCE
034306  012501                          MOV     (R5)+,R1                ; AND DESTINATION BUFFERS.
034310  013702  002334                  MOV     BCNT,R2                 ;NUMBER OF BYTES TO COPY
034314  006202                          ASR     R2                      ;MAKE R1 WORDS AND
034316  012021                  1$:     MOV     (R0)+,(R1)+             ;COPY HIS LOCATION TO OTHER BUFFER
034320  005302                          DEC     R2
034322  001375                          BNE     1$
034324  012602                          MOV     (SP)+,R2                ;;POP STACK INTO R2
034326  012601                          MOV     (SP)+,R1                ;;POP STACK INTO R1
034330  012600                          MOV     (SP)+,R0                ;;POP STACK INTO R0
034332  000205                          RTS     R5
```

```
                        .SBTTL  SETTO   SET TIMEOUT
                        ,SETTO
                        ;
                        ;SET TIMEOUT COUNTER TO SOME NUMBER OF SECONDS FROM CURRENT TIME.
                        ;
                        ;       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

034334                  SETTO:
034334  010246                  MOV     R2,-(SP)                ;;PUSH R2 ON STACK
034336  010346                  MOV     R3,-(SP)                ;;PUSH R3 ON STACK
034340  005002                  CLR     R2                      ;CLEAR PRODUCT
034342  013703  002216          MOV     KW.HZ,R3                ;GET MULTIPLICAND
034346  006200          1$:     ASR     R0                      ;SHIFT MULTIPLIER TO RIGHT
034350  103001                  BCC     2$                      ;IF A ONE BIT SHIFTED OUT
034352  060302                  ADD     R3,R2                   ;ADD MULTIPLICAND TO PRODUCT
034354  006303          2$:     ASL     R3                      ;DOUBLE THE MULTIPLICAND
034356  005700                  TST     R0
034360  001372                  BNE     1$                      ;CONTINUE UNTIL MULTIPLIER IS ZERO

                                ;GET CURRENT TIME

034362  013700  002220  3$:     MOV     KW.EL,R0                ;GET TIME
034366  013703  002222          MOV     KW.EL+2,R3
034372  020037  002220          CMP     R0,KW.EL                ;IF CHANGED DURING RETRIEVAL
034376  001371                  BNE     3$                      ;GET IT AGAIN

                                ;ADD TIME TIL TIMEOUT

034400  060200                  ADD     R2,R0                   ;ADD
034402  005503                  ADC     R3

                                ;PUT RESULT IN STORAGE

034404  010021                  MOV     R0,(R1)+
034406  010311                  MOV     R3,(R1)
034410  012603                  MOV     (SP)+,R3                ;;POP STACK INTO R3
034412  012602                  MOV     (SP)+,R2                ;;POP STACK INTO R2
034414  000207                  RTS     PC
```

```
                                .SBTTL  CLOG    COMPUTE BASE 2 LOG
                                ;CLOG
                                ;
                                ;COMPUTE LOGARITHMIC VALUE OF NUMBER TO BASE 2.
                                ;
                                ;INPUTS:
                                ;       R0 - LOGARITHM TO BE CONVERTED
                                ;OUTPUTS:
                                ;       R1 - VALUE OF 2 RAISED TO POWER OF INPUT NUMBER

034416                          CLOG:
034416  010046                          MOV     R0,-(SP)                ;;PUSH R0 ON STACK
034420  005001                          CLR     R1                      ;SET UP ZERO START VALUE
034422  000261                          SEC                             ;WITH CARRY READY TO SHIFT IN
034424  006101                  1$:     ROL     R1                      ;SHIFT TO LEFT
034426  005300                          DEC     R0                      ;UNTIL R0
034430  100375                          BPL     1$                      ;GOES NEGATIVE
034432  012600                          MOV     (SP)+,R0                ;;POP STACK INTO R0
034434  000207                          RTS     PC
```

```
                                .SBTTL  DIVIDE  DIVIDE NUMBER
                                ;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
                                
 034436                         DIVIDE:
 034436  010246                        MOV     R2,-(SP)                ;;PUSH R2 ON STACK
 034440  012702  000040                 MOV     #32.,R2                 ;SET UP SHIFT COUNT
 034444  005005                        CLR     R5                      ;START WITH ZERO REMAINDER
 034446  006303                 1$:    ASL     R3                      ;SHIFT LEFT INTO R5
 034450  006104                        ROL     R4
 034452  006105                        ROL     R5
 034454  020005                        CMP     R0,R5                   ;WILL DIVISOR GO INTO REMAINDER
 034456  101002                        BHI     2$                      ;ONLY SUBTRACT IF IT WILL
 034460  160005                        SUB     R0,R5                   ;SUBTRACT DIVISOR
 034462  005203                        INC     R3                      ;PUT A ONE INTO QUOTIENT
 034464  005302                 2$:    DEC     R2                      ;COUNT THE SHIFTS
 034466  001367                        BNE     1$
 034470  012602                        MOV     (SP)+,R2                ;;POP STACK INTO R2
 034472  000207                        RTS     PC
```

```
                                .SBTTL  DIV10   DIVIDE BY TEN
                                ;DIV10
                                ;
                                ;DIVIDE A 64 BIT UNSIGNED NUMBER BY A 10.
                                ;REPLACE DIVIDEND WITH QUOTIENT AND RETURN REMAINDER.
                                ;WILL NOT CHECK FOR DIVIDE BY ZERO.
                                ;
                                ;INPUTS:
                                ;       R1 - LOW  16 BITS OF DIVIDEND
                                ;       R2 - NEXT 16 BITS OF DIVIDEND
                                ;       R3 - NEXT 16 BITS OF DIVIDEND
                                ;       R4 - HIGH 16 BITS OF DIVIDEND
                                ;OUTPUTS:
                                ;       R1 - QUOTIENT,
                                ;       R2 - QUOTIENT,
                                ;       R3 - QUOTIENT,
                                ;       R4 - QUOTIENT,
                                ;       R5 - REMAINDER
                                
034474                          DIV10:
034474  010046                          MOV     R0,-(SP)                ;;PUSH R0 ON STACK
034476  012700  000100                  MOV     #64.,R0                 ;SET UP SHIFT COUNT
034502  005005                          CLR     R5                      ;START WITH ZERO REMAINDER
034504  006301                  1$:     ASL     R1
034506  006102                          ROL     R2                      ;SHIFT LEFT INTO R5
034510  006103                          ROL     R3
034512  006104                          ROL     R4
034514  006105                          ROL     R5
034516  022705  000012                  CMP     #10.,R5                 ;SILL DIVISOR GO INTO REMAINDER?
034522  101003                          BHI     2$                      ;ONLY SUBTRACT IF IT WILL
034524  162705  000012                  SUB     #10.,R5                 ;SUBTRACT DIVISOR
034530  005201                          INC     R1                      ;PUT A ONE INTO QUOTIENT
034532  005300                  2$:     DEC     R0                      ;COUNT THE SHIFTS
034534  001363                          BNE     1$
034536  012600                          MOV     (SP)+,R0                ;;POP STACK INTO R0
034540  000207                          RTS     PC                      ;  <R4,R3,R2,R1> AND REMAINDER IN R5
```

```
                                        .SBTTL  MULT    INTEGER MULTIPLY ROUTINE
                                        ;MULT
                                        ;
                                        ;CALL
                                        ;       MOV     MULTIPLER, (SP)
                                        ;       MOV     MULTIPLICAND,-(SP)
                                        ;       JSR     PC,MULT
                                        ;       RETURN                          ;PRODUCT IS ON THE STACK
                                        ;
                                        ;       STACK   PRODUCT
                                        ;       - ---   -------
                                        ;       TOP     LSB'S
                                        ;       +2      MSB'S

034542                                  MULT:
034542  010046                                  MOV     R0,-(SP)                ;;PUSH R0 ON STACK
034544  010146                                  MOV     R1,-(SP)                ;;PUSH R1 ON STACK
034546  010246                                  MOV     R2,-(SP)                ;;PUSH R2 ON STACK
034550  005046                                  CLR     -(SP)                   ;CLEAR THE SIGN KEY
034552  016601  000012                          MOV     12(SP),R1               ;GET THE MULTIPLICAND
034556  100002                                  BPL     1$                      ;BR IF PLUS
034560  005216                                  INC     (SP)                    ;SET THE SIGN KEY
034562  005401                                  NEG     R1                      ;MAKE THE MULTIPLICAND POSTIVE
034564  016602  000014          1$:             MOV     14(SP),R2               ;GET THE MULTIPLIER
034570  100002                                  BPL     2$                      ;BR IF PLUS
034572  005316                                  DEC     (SP)                    ;UPDATE THE SIGN KEY
034574  005402                                  NEG     R2                      ;MAKE THE MULTIPLIER POSTIVE
034576  012746  000021          2$:             MOV     #17.,-(SP)              ;SET THE LOOP COUNT
034602  005000                                  CLR     R0                      ;SETUP FOR THE MULTIPLY LOOP
034604  103001                  3$:             BCC     4$                      ;DON'T ADD IF MULTIPLICAND = 0
034606  060200                                  ADD     R2,R0
034610  006000                  4$:             ROR     R0                      ;POSITION THE PARITIAL PRODUCT AND
034612  006001                                  ROR     R1                      ;THE MULTIPLICAND
034614  005316                                  DEC     (SP)                    ;HAS ALL BITS OF THE MULTIPLICAND BEEN DONE?
034616  001372                                  BNE     3$                      ;BR IF NO
034620  022616                                  CMP     (SP)+,(SP)              ;SHOULD PRODUCT BE NEGATIVE?
034622  001403                                  BEQ     5$                      ;GO TO EXIT IF NO
034624  005400                                  NEG     R0                      ;YES--SO MAKE IT SO
034626  005401                                  NEG     R1
034630  005600                                  SBC     R0
034632  005726                  5$:             TST     (SP)+                   ;CLEAR SIGN INFO. OFF OF STACK
034634  010066  000012                          MOV     R0,12(SP)               ;PUT THE PRODUCT ON THE STACK (MSB'S)
034640  010166  000010                          MOV     R1,10(SP)               ;LSB'S
034644  012602                                  MOV     (SP)+,R2                ;;POP STACK INTO R2
034646  012601                                  MOV     (SP)+,R1                ;;POP STACK INTO R1
034650  012600                                  MOV     (SP)+,R0                ;;POP STACK INTO R0
034652  000207                                  RTS     PC
```

```
                                .SBTTL  BLD28   BUILD 28-BIT NUMBER
                                ;BLD28
                                ;
                                ;BUILD DEFAULT 28-BIT NUMBER
                                ;
                                ;INPUT:
                                ;       R4 - ADDRESS OF LO ORDER WORD OF DEFAULT NUMBER
                                ;OUTPUT:
                                ;       TTYIN - ADDRESS OF ASCIZ STRING INPUT BUFFER

 034654                         BLD28:
 034654  010046                        MOV     R0,-(SP)                ;;PUSH R0 ON STACK
 034656  010146                        MOV     R1,-(SP)                ;;PUSH R1 ON STACK
 034660  010346                        MOV     R3,-(SP)                ;;PUSH R3 ON STACK
 034662  010446                        MOV     R4,-(SP)                ;;PUSH R4 ON STACK
 034664  010546                        MOV     R5,-(SP)                ;;PUSH R5 ON STACK
 034666  011403                        MOV     (R4),R3                 ;GET NUMBER
 034670  016404  000002                MOV     2(R4),R4
 034674  012700  000012                MOV     #10.,R0                 ;DIVISOR IS 10.
 034700  005001                        CLR     R1                      ;CLEAR CHARACTER COUNT
 034702  004737  034436          1$:   JSR     PC,DIVIDE
 034706  062705  000060                ADD     #'0,R5                  ;CONVERT REMAINDER TO ASCII CHARACTER
 034712  010546                        MOV     R5,-(SP)                ;;PUSH R5 ON STACK
 034714  005201                        INC     R1                      ;COUNT THE CHARACTER
 034716  010305                        MOV     R3,R5                   ;REPEAT UNTIL QUOTIENT IS ZERO
 034720  050405                        BIS     R4,R5
 034722  001367                        BNE     1$
 034724  012700  002666                MOV     #TTYIN,R0               ;GET POINTER TO STRING
 034730                          2$:
 034730  012605                        MOV     (SP)+,R5                ;;POP STACK INTO R5
 034732  110520                        MOVB    R5,(R0)+
 034734  005301                        DEC     R1
 034736  001374                        BNE     2$
 034740  105020                        CLRB    (R0)+                   ;END WITH NULL
 034742  012605                        MOV     (SP)+,R5                ;;POP STACK INTO R5
 034744  012604                        MOV     (SP)+,R4                ;;POP STACK INTO R4
 034746  012603                        MOV     (SP)+,R3                ;;POP STACK INTO R3
 034750  012601                        MOV     (SP)+,R1                ;;POP STACK INTO R1
 034752  012600                        MOV     (SP)+,R0                ;;POP STACK INTO R0
 034754  000207                        RETURN
```

```
                                .SBTTL  CNV28   CONVERT ASCIZ TO 28-BIT BINARY
                                ;CNV28
                                ;
                                ;CONVERT ASCIZ STRING TO 28-BIT NUMBER
                                ;
                                ;INPUTS:
                                ;       TTYIN - ASCIZ STRING INPUT UP TO 9. CHARACTERS
                                ;       R4 - ADDRESS OF LO ORDER WORD OF STORAGE LOCATION
                                ;OUTPUTS:
                                ;       IF STRING IS VALID NUMBER
                                ;         TWO WORDS AT R4 LOADED WITH NUMBER
                                ;         CARRY CLEAR
                                ;       IF STRING INVALID
                                ;         ERROR MESSAGE PRINTED
                                ;         CARRY SET
                                
034756                          CNV28:
034756  010046                        MOV     R0,-(SP)                ;;PUSH R0 ON STACK
034760  010146                        MOV     R1,-(SP)                ;;PUSH R1 ON STACK
034762  010246                        MOV     R2,-(SP)                ;;PUSH R2 ON STACK
034764  010346                        MOV     R3,-(SP)                ;;PUSH R3 ON STACK
034766  005000                        CLR     R0                      ;CLEAR LO ORDER WORD
034770  005001                        CLR     R1                      ;CLEAR HI ORDER WORD
034772  012702  002666                MOV     #TTYIN,R2               ;GET BEGINNING ADDRESS OF TYPED INPUT
034776  112203                1$:     MOVB    (R2)+,R3                ;GET A CHARACTER FROM ASCIZ LINE
035000  001443                        BEQ     4$                      ;IF NULL CHARACTER, ALL DONE
035002  162703  000060                SUB     #'0,R3                  ;SUBTRACT CHARACTER 0
035006  100431                        BMI     2$
035010  022703  000011                CMP     #9.,R3
035014  103426                        BLO     2$
035016  006300                        ASL     R0                      ;*2
035020  006101                        ROL     R1
035022  010146                        MOV     R1,-(SP)                ;;PUSH R1 ON STACK
035024  010046                        MOV     R0,-(SP)                ;;PUSH R0 ON STACK
035026  006300                        ASL     R0                      ;*4
035030  006101                        ROL     R1
035032  006300                        ASL     R0                      ;*8.
035034  006101                        ROL     R1
035036  062600                        ADD     (SP)+,R0                ;*10.
035040  005501                        ADC     R1
035042  062601                        ADD     (SP)+,R1
035044  060300                        ADD     R3,R0                   ;ADD CURRENT DIGIT
035046  005501                        ADC     R1
035050  032701  170000                BIT     #170000,R1              ;CHECK SIZE OF NUMBER
035054  001750                        BEQ     1$                      ;MUST NOT BE MORE THAN 28 BITS
                                                                      ;PRINT ' ?EXCEEDED 28 BIT INPUT LIMIT'
035056  012746  014277                MOV     #LMT28,-(SP)            ;PUSH #LMT28 ON STACK
035062  004137  033244                JSR     R1,LPNTF                        ;CALL LPNTF PRINT ROUTINE
035066  000002                        .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
035070  000405                        BR      3$
                                                                      ;PRINT ' ?INVALID CHARACTER'
035072                          2$:
035072  012746  014340                MOV     #INVCHR,-(SP)           ;PUSH #INVCHR ON STACK
035076  004137  033244                JSR     R1,LPNTF                        ;CALL LPNTF PRINT ROUTINE
035102  000002                        .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
035104  000261                3$:     SEC                             ;SET CARRY FOR ERROR
035106  000404                        BR      5$
```

```
 48
 49 035110  010014                4$:     MOV     R0,(R4)                 ;MOVE LO ORDER WORD AND
 50 035112  010164  000002                MOV     R1,2(R4)                ;HI ORDER WORD TO STORAGE AREA.
 51 035116  000241                        CLC                             ;CLEAR CARRY FOR NO ERROR
 52 035120                        5$:
    035120  012603                        MOV     (SP)+,R3                ;;POP STACK INTO R3
    035122  012602                        MOV     (SP)+,R2                ;;POP STACK INTO R2
    035124  012601                        MOV     (SP)+,R1                ;;POP STACK INTO R1
    035126  012600                        MOV     (SP)+,R0                ;;POP STACK INTO R0
 53 035130  000207                        RETURN
 54                               .SBTTL  REPORT CODING SECTION
 55
 57                               ;++
 58                               ; THE REPORT CODING SECTION CONTAINS THE
 59                               ; "PRINTS" CALLS THAT GENERATE STATISTICAL REPORTS.
 60                               ;--
 61
 62 035132                        L$RPT::
 63
 64 035132  013705  002304                MOV     CTLRTBL,R5              ; LOAD TABLE PTR
 65 035136  013704  002324                MOV     HCOM,R4                 ; LOAD COMM PTR
 66 035142                        10$:                                    ; "REPLACEMENT INFORMATION..."
 67 035142  012746  005271                MOV     #INF200,-(SP)           ;PUSH #INF200 ON STACK
    035146  004137  033254                JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
    035152  000002                        .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
 68 035154  013746  002542                MOV     WFECNT,-(SP)            ;PUSH WFECNT ON STACK
    035160  013746  002530                MOV     FERCNT,-(SP)            ;PUSH FERCNT ON STACK
    035164  013746  002536                MOV     ECCCNT,-(SP)            ;PUSH ECCCNT ON STACK
    035170  013746  002534                MOV     DSTCNT,-(SP)            ;PUSH DSTCNT ON STACK
    035174  013746  002532                MOV     HCECNT,-(SP)            ;PUSH HCECNT ON STACK
    035200  013746  002540                MOV     BBRCNT,-(SP)            ;PUSH BBRCNT ON STACK
    035204  012746  005343                MOV     #INF201,-(SP)           ;PUSH #INF201 ON STACK
    035210  004137  033254                JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
    035214  000016                        .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
 69
 70 035216  013703  002434                MOV     PRIMRY,R3               ; LOAD PRIMARY COUNT
 71 035222  063703  002436                ADD     SCNDRY,R3               ; ADD SECONDARY COUNT
 72
 73 035226  010346                        MOV     R3,-(SP)                ;PUSH R3 ON STACK
    035230  013746  002440                MOV     UNUSE,-(SP)             ;PUSH UNUSE ON STACK
    035234  013746  002436                MOV     SCNDRY,-(SP)            ;PUSH SCNDRY ON STACK
    035240  013746  002434                MOV     PRIMRY,-(SP)            ;PUSH PRIMRY ON STACK
    035244  012746  005725                MOV     #INF202,-(SP)           ;PUSH #INF202 ON STACK
    035250  004137  033254                JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
    035254  000012                        .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
 74
 75 035256  005737  002650                TST     DEBUG                   ; TEST DEBUG FLAG
 76 035262  001007                        BNE     100$                    ; BRANCH IF YES
 77
 78 035264  012746  004731                MOV     #INF103,-(SP)           ;PUSH #INF103 ON STACK
    035270  004137  033254                JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
    035274  000002                        .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
 79 035276  000167                        .WORD   J$JMP
    035300  000414                        .WORD   L10017-2-.
 80
```

```
 1
 2                                      ;       DEBUG REPORTING
 3 035302                               100$:
 4
 5                                      ;       PRINT RCT ERROR TABLE
 6
 7 035302  013746  002312                      MOV     RCTTBL,-(SP)            ;PUSH RCTTBL ON STACK
   035306  012746  035470                      MOV     #DBM01,-(SP)            ;PUSH #DBM01 ON STACK
   035312  004137  033254                      JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
   035316  000004                              .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
 8
 9 035320  005003                              CLR     R3
10 035322  013702  002312                      MOV     RCTTBL,R2
11 035326                               110$:
12 035326  011201                              MOV     (R2),R1
13 035330  001411                              BEQ     120$
14
15 035332  010146                              MOV     R1,-(SP)                ;PUSH R1 ON STACK
   035334  012746  000000                      MOV     #0,-(SP)                ;PUSH #0 ON STACK
   035340  010346                              MOV     R3,-(SP)                ;PUSH R3 ON STACK
   035342  012746  035556                      MOV     #DBM02,-(SP)            ;PUSH #DBM02 ON STACK
   035346  004137  033254                      JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
   035352  000010                              .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
16 035354                               120$:
17 035354  062702  000002                      ADD     #2,R2
18 035360  005203                              INC     R3
19 035362  023703  002416                      CMP     RCTSIZ,R3
20 035366  003357                              BGT     110$
21
22                                      ;       PRINT CACHE TABLE CONTENTS
23
24 035370  013746  002310                      MOV     CACHTBL,-(SP)           ;PUSH CACHTBL ON STACK
   035374  012746  035601                      MOV     #DBM03,-(SP)            ;PUSH #DBM03 ON STACK
   035400  004137  033254                      JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
   035404  000004                              .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
25
26 035406  005003                              CLR     R3
27 035410  013704  002310                      MOV     CACHTBL,R4
28 035414                               130$:
29 035414  016402  000002                      MOV     2(R4),R2
30 035420  100413                              BMI     140$
31
32 035422  011401                              MOV     (R4),R1
33 035424  010246                              MOV     R2,-(SP)                ;PUSH R2 ON STACK
   035426  010146                              MOV     R1,-(SP)                ;PUSH R1 ON STACK
   035430  012746  000000                      MOV     #0,-(SP)                ;PUSH #0 ON STACK
   035434  010346                              MOV     R3,-(SP)                ;PUSH R3 ON STACK
   035436  012746  035667                      MOV     #DBM04,-(SP)            ;PUSH #DBM04 ON STACK
   035442  004137  033254                      JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
   035446  000012                              .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
34 035450                               140$:
35 035450  062704  000004                      ADD     #4,R4
36 035454  005203                              INC     R3
37 035456  022703  000620                      CMP     #CACHESIZE,R3
38 035462  003354                              BGT     130$
39
40 035464  000167                              .WORD   J$JMP
```

```
    035466  000226                          .WORD   L10017-2-.
41
42                                          .NLIST  BEX
43 035470     116     062     042   DBM01:  .ASCII  /N2"RCT ERROR TABLE:  "O16/
44 035521     116     062     042           .ASCIZ  /N2"  RCT BLOCK.     CONTENTS"/
45 035556     116     042     040   DBM02:  .ASCIZ  /N"  "D28".     "O16/
46
47 035601     116     062     042   DBM03:  .ASCII  /N2"CACHING TABLE:  "O16/
48 035630     116     062     042           .ASCIZ  /N2"   ENTRY NO.      BLOCK NO."/
49 035667     116     042     040   DBM04:  .ASCIZ  /N"  "D28".     "D28"."/
50                                          .EVEN
51
52 035716                             L10017:
   035716  104425                           TRAP    C$RPT
```

```
      1
      2                                 .SBTTL  PROTECTION TABLE
      3
      4                                 ;++
      5                                 ; THIS TABLE IS USED BY THE RUNTIME SERVICES
      6                                 ; TO PROTECT THE LOAD MEDIA.
      7                                 ;--
      8
      9 035720                          L$PROT::
     10
     11 035720  177777                          -1                              ;OFFSET INTO P-TABLE FOR CSR ADDRESS
     12 035722  177777                          -1                              ;OFFSET INTO P-TABLE FOR MASSBUS ADDRESS
     13 035724  177777                          -1                              ;OFFSET INTO P-TABLE FOR DRIVE NUMBER
     14
     16
```

```
                                .SBTTL  INITIALIZATION SECTION

                                ;++
                                ; THE INITIALIZE SECTION CONTAINS THE CODING THAT IS PERFORMED
                                ; AT THE BEGINNING OF EACH PASS.
                                ;--

                                ;;*****************************************************************************
                                ;    RESET THE WORLD
                                ;    IF HERE FROM START, RESTART, OR NEW PASS COMMAND
                                ;       THEN
                                ;           INITIALIZE LOGICAL UNIT NUMBER
                                ;       ENDIF
                                ;    SELECT A LOGICAL UNIT FOR TEST
                                ;    ESTABLISH FREE MEMORY
                                ;    INITIALIZE TABLES
                                ;    INITIALIZE KW11 CLOCK
                                ;    PRINT DRIVE ON-LINE
                                ;    PRINT NUMBER LOGICAL BLOCKS IN DRIVE
                                ;    END
                                ;;*****************************************************************************
         000001                 I$SECTION               = 1

 035726                         L$INIT::
                                                                ; RESET SYSTEM
 035726  104433                        TRAP    C$RESET
 035730                         10$:
 035730  005737  002202                TST     LOADFLG         ; TEST FOR FIRST TIME THROUGH
 035734  001020                        BNE     20$             ; BRANCH IF NO
 035736  005237  002202                INC     LOADFLG         ; ELSE, SET FLAG
 035742                         15$:                           ; RESET START OF FREE MEMORY
 035742  104431                        TRAP    C$MEM
 035744  010037  002176                MOV     R0,FFREE
 035750  017737  144222  002200        MOV     @FFREE,FSIZE    ; RESET SIZE OF FREE MEMORY
 035756                         18$:                           ; READ BUS TYPE
 035756  104407                        TRAP    C$RDBU
 035760  103006                        BCC     20$

 035762  012737  000001  002614        MOV     #1,BUSFLAG      ; SET FLAG FOR QBUS
 035770  112737  000113  014225        MOVB    #'K,DEVNAME     ; SET CONTROLLER "KDA"
```

```
                                .SBTTL  INITIALIZE THE KW11

                        20$:
035776  005037  002220                CLR     KW.EL                   ;CLEAR ELAPSED TIME
036002  005037  002222                CLR     KW.EL+2
036006  012700  000114                MOV     #'L,R0
036012  104462                        TRAP    C$CLCK
036014  103414                        BCS     25$
036016  012700  000120                MOV     #'P,R0
036022  104462                        TRAP    C$CLCK
036024  103410                        BCS     25$
036026  005037  002210                CLR     KW.CSR                  ;IF NEITHER, CLEAR CSR STORAGE WORD
036032  012746  004546                MOV     #INF101,-(SP)           ;PUSH #INF101 ON STACK
036036  004137  033244                JSR     R1,LPNTF                        ;CALL LPNTF PRINT ROUTINE
036042  000002                        .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
036044  000426                        BR      30$
036046                          25$:
036046  012037  002210                MOV     (R0)+,KW.CSR            ;STORE DATA RETURNED
036052  012037  002212                MOV     (R0)+,KW.BRL
036056  012037  002214                MOV     (R0)+,KW.VEC
036062  012037  002216                MOV     (R0)+,KW.HZ
036066  012746  000340                MOV     #PRI07,-(SP)
036072  012746  016174                MOV     #KW11I,-(SP)
036076  013746  002214                MOV     KW.VEC,-(SP)
036102  012746  000003                MOV     #3,-(SP)
036106  104437                        TRAP    C$SVEC
036110  062706  000010                ADD     #10,SP
036114  012777  000105  144066        MOV     #KW.OUT,@KW.CSR         ;START THE CLOCK

036122                          30$:
```

```
                                .SBTTL  DETERMINE INITIALIZATION ENTRY

                                ;       TEST FOR OPERATOR "START"
036122                          50$:
036122  012700  000040                  MOV     @EF.STA,R0
036126  104447                          TRAP    C$REFG
036130  103412                          BCS     100$

                                ;       TEST FOR OPERATOR "RESTART"
036132                          60$:
036132  012700  000037                  MOV     @EF.RES,R0
036136  104447                          TRAP    C$REFG
036140  103455                          BCS     120$

                                ;       TEST FOR NEW PASS
036142                          70$:
036142  012700  000035                  MOV     @EF.NEW,R0
036146  104447                          TRAP    C$REFG
036150  103455                          BCS     124$

036152  000137  036646                  JMP     300$                    ; ELSE, EXIT
```

```
                                .SBTTL  OPERATOR "START"

                                ;OPERATOR "START" COMMAND
                                ;
                                ;       INITIALIZE FREE MEMORY (FFREE,FSIZE)

036156                          100$:
036156  012746  004362                MOV     @INF100,-(SP)           ;PUSH @INF100 ON STACK
036162  004137  033244                JSR     R1,LPNTF                        ;CALL LPNTF PRINT ROUTINE
036166  000002                        .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
036170  012701  022464                MOV     @BACKMSG,R1             ; LOAD QUESTION ADDRESS
036174  012702  002652                MOV     @BACKUP,R2              ; LOAD REPLY ADDRESS
036200  012712  000000                MOV     #0,(R2)                 ; DEFAULT IS "NO"
036204  004737  023126                JSR     PC,GETLOG               ; ASK OPERATOR
036210  005737  002652                TST     BACKUP                  ; TEST FOR BACKUP
036214  001001                        BNE     105$                    ; BRANCH IF YES

036216  104444                        TRAP    C$DCLN
036220                          105$:
036220  104431                        TRAP    C$MEM
036222  010037  002176                MOV     R0,FFREE
036226  017737  143744  002200        MOV     @FFREE,FSIZE            ; RESET SIZE OF FREE MEMORY

036234  012700  000010                MOV     #8.,R0                  ; LOAD COUNTER
036240  012701  002230                MOV     #CTLRLST,R1             ; LOAD CONTROLLER TABLE LIST
036244  012702  002254                MOV     #CACHLST,R2             ; LOAD CACHING TABLE LIST
036250                          110$:
036250  005021                        CLR     (R1)+                   ; CLEAR CONTROLLER TABLE ENTRY
036252  005022                        CLR     (R2)+                   ; CLEAR CACHE TABLE ENTRY
036254  005300                        DEC     R0                      ; DECREMENT
036256  003374                        BGT     110$                    ; AND CONTINUE

036260  004737  040004                JSR     PC,HCOMM                ; ALLOCATE SPACE FOR HOST COMM AREA
036264  012701  000010                MOV     #8.,R1                  ; LOAD SIZE
036270  004737  040054                JSR     PC,ALOCM                ; AND ALLOCATE
```

```
 1                                  .SBTTL  OPERATOR "RESTART"
 2                                  ;
 3                                  ;OPERATOR "RESTART"COMMAND
 4                                  ;
 5
 6 036274                           120$:
 7 036274  104450                           TRAP    C$MANI
 8 036276  103002                           BCC     124$
 9 036300  004737  022206                    JSR     PC,INISWP               ; INITIALIZE SW PARMS
10 036304                           124$:
11 036304  005737  002150                    TST     MANRPL                  ; TEST FOR MANUAL MODE
12 036310  001403                           BEQ     125$                    ; BRANCH IF NO
13 036312  012737  000001  002012           MOV     #1,L$UNIT               ; ELSE, SET LAST UNIT TO ZERO
14 036320                           125$:
15 036320  012737  177777  002074           MOV     #-1,L$LUN               ; INITIALIZE LOGICAL UNIT NUMBER
16 036326  012737  177776  002300           MOV     #-2,TBLNDX              ; INITIALIZE ADDRESS TABLE INDEX
17 036334                           130$:
18 036334  005237  002074                    INC     L$LUN                   ; INCREMENT TO NEXT LOGICAL UNIT
19 036340  062737  000002  002300           ADD     #2,TBLNDX               ; INCREMENT ADDRESS TABLE INDEX
20
21 036346  023737  002074  002012           CMP     L$LUN,L$UNIT            ; TEST IF LOGICAL UNITS ARE EXHAUSTED
22 036354  002134                           BGE     300$                    ; BRANCH IF YES
23                                                                          ; ELSE, GET PTABLE POINTER
24 036356  013700  002074                    MOV     L$LUN,R0
   036362  104442                           TRAP    C$GPHRD
   036364  010037  002302                    MOV     R0,PTABLE
25 036370  103361                           BCC     130$
26
```

```
 1
 2                                          ;       ALLOCATE CONTROLLER TABLE
 3 036372                                   150$:
 4 036372  013702  002300                        MOV     TBLNDX,R2               ; LOAD TABLE INDEX
 5 036376  016201  002230                        MOV     CTLRLST(R2),R1          ; LOAD TABLE ADDRESS
 6 036402  001402                                BEQ     155$                    ; BRANCH IF NO ADDRESS
 7 036404  000137  036334                        JMP     130$                    ; ELSE, NEXT UNIT
 8 036410                                   155$:
 9 036410  012701  000016                        MOV     #<C.SIZE+4>/2,R1        ; LOAD TABLE SIZE + 2
10 036414  004737  040054                        JSR     PC,ALOCM                ; AND ALLOCATE
11 036420  010162  002230                        MOV     R1,CTLRLST(R2)          ; SAVE TABLE ADDRESS
12 036424  013761  002324  000016                MOV     HCOM,C.HCOM(R1)         ; SAVE COMM AREA ADDRESS
13 036432  012761  000000  000020                MOV     #0,C.DRVT(R1)           ; ZERO DRIVE TABLE PTR
14
15                                          ;       INITIALIZE CONTROLLER TABLE
16 036440                                   160$:
17 036440  010137  002304                        MOV     R1,CTLRTBL              ; SAVE CONTROLLER TABLE ADDRESS
18 036444  013703  002302                        MOV     PTABLE,R3               ; LOAD PTABLE ADDRESS
19 036450  011321                                MOV     (R3),(R1)+              ; STORE XDA IP ADDRESS
20 036452  016304  000004                        MOV     H.BRL(R3),R4            ; GET THE BR LEVEL
21 036456  000304                                SWAB    R4                      ; SWAP TO HIGH BYTE,
22 036460  006104                                ROL     R4                      ; SHIFT ONE MORE TO LEFT,
23 036462  056304  000002                        BIS     H.VEC(R3),R4            ; ADD VECTOR ADDRESS AND
24 036466  010421                                MOV     R4,(R1)+                ; STORE IT IN THE CONTROLLER TABLE.
25 036470  016321  000006                        MOV     H.BST(R3),(R1)+         ; STORE BURST RATE AND
26 036474  016321  000010                        MOV     H.DRV(R3),(R1)+         ; DRIVE NUMBER TO THE CONTROLLER TABLE.
27 036500  012721  004037                        MOV     #4037,(R1)+             ; STORE THE 'JSR R0' INSTRUCION AND
28 036504  012721  016164                        MOV     #XDASRV,(R1)+           ; STORE ISR ADDRESS
29
30 036510  013701  002304                        MOV     CTLRTBL,R1              ; RELOAD TABLE START
31 036514  005061  000014                        CLR     C.FLG(R1)               ; CLEAR FLAGS
32 036520  005061  000022                        CLR     C.TO(R1)                ; CLEAR TIMEOUT (LOW)
33 036524  005061  000024                        CLR     C.TOH(R1)               ; CLEAR TIMEOUT (HIGH)
34 036530  005061  000026                        CLR     C.REF(R1)               ; CLEAR CMD REF
35
```

```
                                        ;       ALLOCATE DRIVE TABLE
036534                                  170$:
036534  013705  002304                          MOV     CTLRTBL,R5              ; LOAD CONTROLLER TABLE ADDRESS
036540  016501  000020                          MOV     C.DRVT(R5),R1           ; LOAD DRIVE TABLE ADDRESS
036544  001006                                  BNE     180$                    ; BRANCH IF PRESENT

036546  012701  000074                          MOV     #<D.SIZE+4>/2,R1        ; LOAD DRIVE TABLE SIZE + 2
036552  004737  040054                          JSR     PC,ALOCM                ; ALLOCATE
036556  010165  000020                          MOV     R1,C.DRVT(R5)           ; AND STORE OIN CONTROLLER TABLE

                                        ;       INITIALIZE DRIVE TABLE
036562                                  180$:
036562  012700  000072                          MOV     #<D.SIZE>/2,R0          ; LOAD DRIVE TABLE SIZE
036566                                  185$:
036566  005021                                  CLR     (R1)+                   ; CLEAR LOCATION
036570  005300                                  DEC     R0                      ; AND CONTINUE
036572  003375                                  BGT     185$                    ; UNTIL TABLE EN.

```

```
 1
 2                                          ;       ALLOCATE CACHING TABLE
 3 036574                                   200$:
 4 036574  013702  002300                          MOV     TBLNDX,R2               ; LOAD TABLE INDEX
 5 036600  016201  002254                          MOV     CACHLST(R2),R1          ; LOAD TABLE ADDRESS
 6 036604  001006                                   BNE     220$                    ; BRANCH IF ADDRESS PRESENT
 7
 8 036606  012701  001442                          MOV     #<CACHESIZE+1>*2,R1     ; LOAD TABLE SIZE + 2
 9 036612  004737  040054                          JSR     PC,ALOCM                ; AND ALLOCATE
10 036616  010162  002254                          MOV     R1,CACHLST(R2)          ; SAVE TABLE ADDRESS
11
12                                          ;       INITIALIZE CACHE TABLE
13 036622                                   220$:
14 036622  010137  002310                          MOV     R1,CACHTBL              ; SAVE CONTROLLER TABLE ADDRESS
15 036626  012700  001440                          MOV     #<CACHESIZE>*2,R0       ; LOAD TABLE SIZE
16 036632                                   225$:
17 036632  012721  177777                          MOV     #-1,(R1)+               ; INITIALIZE ENTRY
18 036636  005300                                  DEC     R0                      ; DECREMENT
19 036640  001374                                  BNE     225$                    ; CONTINUE UNTIL ZERO
20
21 036642  000137  036334                          JMP     130$                    ; CONTINUE WITH NEXT UUT
22
23                                          ;       EXIT INITIALIZATION
24 036646                                   300$:
25 036646  005737  002652                          TST     BACKUP                  ; TEST FLAG
26 036652  001001                                  BNE     305$                    ; BRANCH IF SET
27
28 036654  104444                                  TRAP    C$DCLN
29 036656                                   305$:                                  ; SET PRIORITY TO ZERO
30 036656  012700  000000                          MOV     #PRI00,R0
   036662  104441                                  TRAP    C$SPRI
31
32         000000                           I$SECTION               = 0
33
34 036664  104432                                  TRAP    C$EXIT
   036666  001232                                  .WORD   L10021-.
35
```

```
                                .SBTTL  XDAINT  INITIALIZE XDA
                                ;XDAINT
                                ;
                                ;FUNCTIONAL DESCRIPTION:
                                ;       SUBROUTINE TO INITIALIZE A XDA 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 - LENGTH, INTERRUPT AND VECTOR FIELDS TO SEND TO XDA
                                ;IMPLICIT INPUTS:
                                ;       HCOM    - HOST COMMUNICATIONS AREA
                                ;       FFREE - FIRST FREE ADDRESS OF MEMORY. THIS ADDRESS IS GIVEN TO XDA
                                ;               AS START OF RING BUFFER.
                                ;       FSIZE - SIZE OF FREE MEMORY AVAILABLE IN WORDS.
                                ;OUTPUTS:
                                ;       R1 - SIZE OF RING BUFFER IN WORDS IF NO ERROR,
                                ;       R4 - ADDRESS OF XDAIP REGISTER IN XDA,
                                ;       R5 - UNCHANGED,
                                ;
                                ;       Z CLR   IF NO ERROR,
                                ;       Z SET   IF ANY ERROR REPORTED
                                ;
                                ;CHECK IF ENOUGH FREE MEMORY FOR RING BUFFER

036670                          XDAINT:
036670  010346                          MOV     R3,-(SP)                ;;PUSH R3 ON STACK
036672  010400                          MOV     R4,R0                   ;GET MESSAGE LENGTH
036674  000300                          SWAB    R0
036676  042700  177770                  BIC     #177770,R0
036702  004737  034416                  JSR     PC,CLOG                 ;COMPUTE LOGARITHMIC VALUE
036706  010102                          MOV     R1,R2                   ;SAVE RESULT IN R2
036710  010400                          MOV     R4,R0                   ;GET COMMAND LENGTH
036712  000300                          SWAB    R0
036714  006000                          ROR     R0
036716  006000                          ROR     R0
036720  006000                          ROR     R0
036722  042700  177770                  BIC     #177770,R0
036726  004737  034416                  JSR     PC,CLOG                 ;COMPUTE LOGARITHMIC VALUE
036732  060201                          ADD     R2,R1                   ;ADD THE TWO RESULTS
036734  006301                          ASL     R1                      ;MULTIPLY BY 2 WORDS PER RING
036736  062701  000002                  ADD     #<HC.ISZ>/2,R1          ;ADD SPACE FOR INTERRUPT INDICATORS
036742  020137  002200                  CMP     R1,FSIZE                ;COMPARE WITH SIZE OF FREE MEMORY
036746  101402                          BLOS    1$
036750  000137  040100                  JMP     FMERR                   ;FATAL ERROR IF NOT ENOUGH MEMORY

                                        ;FILL HOST COMMUNICATION AREA WITH ALL ONES

036754  013702  002324          1$:     MOV     HCOM,R2                 ; LOAD COMM AREA ADDRESS
036760  010103                          MOV     R1,R3                   ;GET SIZE OF RING BUFFER
036762  012722  177777          2$:     MOV     #-1,(R2)+               ;WRITE ONES TO BUFFER
036766  005303                          DEC     R3                      ;COUNT THE WORDS IN BUFFER
036770  003374                          BGT     2$                      ;LOOP UNTIL ENTIRE BUFFER WRITTEN

                                        ;DO THE INITIALIZATION
```

```
     58 036772  004737  037200                JSR     PC,XDAIST               ;DO FIRST THREE STEPS
     59 036776  103475                        BCS     9$                      ;GET OUT IF MICROCODE REPORTED FAILURE
     60 037000  012364  000002                MOV     (R3)+,2(R4)             ;WRITE NEXT WORD TO XDASA REGISTER
     61 037004  012700  000310                MOV     #200.,R0                ;GET TRY COUNTER
     62 037010                          3$:
     63 037010  016402  000002                MOV     2(R4),R2                ;LOOK AT XDASA
     64 037014  001420                        BEQ     5$
     65 037016  100015                        BPL     4$
     66
     67 037020  010237  002316                MOV     R2,SAVAL                ; SAVE CONTENTS
     68 037024  012737  011061  002552        MOV     #ERM102,BASEMSG         ; "SA ERROR DURING STEP 3"
     69 037032  012737  000003  002370        MOV     #B.SADDR!B.SAVAL,EXTMSK ; FLAG ADDRESS AND VALUE
     70 037040  104455                        TRAP    C$ERDF
        037042  000146                        .WORD   102
        037044  010667                        .WORD   HDR101
        037046  015266                        .WORD   ERR101
     71 037050  000450                        BR      9$
     72
     73 037052  005300                  4$:   DEC     R0
     74 037054  001355                        BNE     3$
     75 037056  010264  000002          5$:   MOV     R2,2(R4)                ;WRITE 0 TO XDASA (PURGE)
     76 037062  011402                        MOV     (R4),R2                 ;READ FROM XDAIP (POLL)
     77 037064  004737  037606                JSR     PC,XDARSP               ;WAIT FOR STEP OR ERROR BIT
     78 037070  103440                        BCS     9$                      ;GET OUT IF MICROCODE REPORTED FAILURE
     79 037072  010146                        MOV     R1,-(SP)                ;;PUSH R1 ON STACK
     80 037074  004733                        JSR     PC,@(R3)+               ;CALL LAST ROUTINE
     81 037076  012601                        MOV     (SP)+,R1                ;;POP STACK INTO R1
     82
     83                                       ;CHECK HOST COMMUNICATION AREA FOR ALL ZEROS
     84
     85 037100  013702  002324                MOV     HCOM,R2                 ; LOAD COMM AREA ADDRESS
     86 037104  010103                        MOV     R1,R3                   ;GET SIZE OF RING BUFFER
     87 037106  005722                  6$:   TST     (R2)+                   ;CHECK WORD IN BUFFER
     88 037110  001003                        BNE     7$                      ;GO TO ERROR REPORTER IF NOT ZERO
     89 037112  005303                        DEC     R3                      ;COUNT THE WORDS IN BUFFER
     90 037114  003374                        BGT     6$                      ;LOOP UNTIL ALL WORDS CHECKED
     91 037116  000412                        BR      8$
     92 037120                          7$:
     93 037120  016402  000002                MOV     2(R4),,R2
     94 037124  012737  011145  002552        MOV     #ERM103,BASEMSG         ; "DID NOT CLEAR MEMORY"
     95 037132  104455                        TRAP    C$ERDF
        037134  000147                        .WORD   103
        037136  010667                        .WORD   HDR101
        037140  015266                        .WORD   ERR101
     96 037142  000413                        BR      9$
     97
     98                                       ;SEND GO BIT TO XDASA REGISTER TO END INITIALIZATION
     99
    100 037144  016500  000004          8$:   MOV     C.BST(R5),R0            ;GET BURST VALUE
    101 037150  006300                        ASL     R0                      ;SHIFT TO POSITION
    102 037152  006300                        ASL     R0
    103 037154  052700  000001                BIS     #SA.GO,R0               ;SET THE GO BIT
    104 037160  010064  000002                MOV     R0,2(R4)                ;SEND TO XDA
    105 037164  012603                        MOV     (SP)+,R3                ;;POP STACK INTO R3
    106 037166  000244                        CLZ                             ;CLEAR Z AS NO ERROR INDICATION
    107 037170  000207                        RTS     PC
    108
```

```
    109                                         ;ERROR RETURN
    110
    111 037172                          9$:
        037172  012603                         MOV     (SP)+,R3            ;;POP STACK INTO R3
    112 037174  000264                         SEZ                         ;SET Z TO INDICATE ERROR OCCURRED
    113 037176  000207                         RTS     PC
```

```
                                .SBTTL  XDAIST  START XDA INITIALIZE SEQUENCE
                                ;XDAIST
                                ;
                                ;START THE INITIALIZATION PROCESS ON THE SELECTED XDA.
                                ;STOP BEFORE WRITING THE THIRD WORD SO XDA DOES NOT
                                ;ATTEMPT ANY UNIBUS TRANSFERS.
                                ;
                                ;INPUTS:
                                ;       R5 - ADDRESS OF CONTROLLER TABLE
                                ;       R4 - LEN, INTI AND VECTOR FIELDS TO SEND TO XDA
                                ;
                                ;LOAD TABLE OF DATA TO SEND TO XDASA REGISTER

037200                          XDAIST:                                 ;>>>>>>>>>BREAK BACK TO MONITOR<<<<<<<<<
037200  104422                          TRAP    C$BRK
037202  010146                          MOV     R1,-(SP)                ;;PUSH R1 ON STACK
037204  052704  100000                  BIS     #SA.STP,R4              ;SET STEP BIT IN DATA WORD
037210  010437  037424                  MOV     R4,SND.S1               ;LOAD SEND DATA FOR STEP 1 OF XDA INIT
037214  013737  002324  037430          MOV     HCOM,SND.S2             ; LOAD COMM AREA ADDRESS
037222  062737  000004  037430          ADD     #HC.MSG,SND.S2          ;LOAD SEND DATA FOR STEP 2 OF XDA INIT
037230  012737  100000  037434          MOV     #SA.TST,SND.S3          ;LOAD SEND DATA FOR STEP 3 OF XDA INIT

                                ;START THE INITIALIZATION BY WRITING TO XDAIP REGISTER

037236  016504  000000                  MOV     C.UADR(R5),R4           ;GET ADDRESS OF XDAIP REGISTER
037242  005037  002224                  CLR     NXMAD                   ;CLEAR MEMORY ERROR FLAG
037246  012746  000340                  MOV     #PRI07,-(SP)
037252  012746  016154                  MOV     #NXMI,-(SP)
037256  012746  000004                  MOV     #4,-(SP)
037262  012746  000003                  MOV     #3,-(SP)
037266  104437                          TRAP    C$SVEC
037270  062706  000010                  ADD     #10,SP
037274  005764  000002                  TST     2(R4)                   ;ACCESS XDASA REGISTER
037300  005014                          CLR     (R4)                    ;WRITE TO XDAIP
037302  012700  000004                  MOV     #4,R0
037306  104436                          TRAP    C$CVEC
037310  005737  002224                  TST     NXMAD                   ;SEE IF A MEMORY ERROR OCCURRED
037314  001414                          BEQ     1$

037316  012737  010727  002552          MOV     #ERM101,BASEMSG         ; "MEMORY ERROR"
037324  012737  000001  002370          MOV     #B.SADDR,EXTMSK         ; FLAG ADDRESS
037332  104455                          TRAP    C$ERDF
037334  000145                          .WORD   101
037336  010667                          .WORD   HDR101
037340  015266                          .WORD   ERR101
037342  000261                          SEC
037344  000424                          BR      4$

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

037346  012737  004000  040002  1$:     MOV     #SA.S1,XDARSD           ;STORE RESPONSE MASK
037354  012703  037422                  MOV     #INITBL,R3              ;GET INDEX TO XDA
                                                                        ; SEND/REPOND INITIALIZE TABLE

                                ;WAIT FOR AND CHECK RESPONSE DATA

037360  004737  037606          2$:     JSR     PC,XDARSP               ;WAIT FOR STEP OR ERROR BITS
```

```
     037364  103414                          BCS     4$                      ;EXIT IF ERROR
     037366  004733                          JSR     PC,@(R3)+               ;CALL RESPONSE CHECKER FOR STEP
     037370  103412                          BCS     4$                      ;GET OUT IF ERROR
     037372  006337  040002                  ASL     XDARSD                  ;SHIFT TO NEXT STEP BIT
     037376  032737  040000  040002          BIT     #SA.S4,XDARSD           ;CHECK IF NOW AT STEP 4
     037404  001003                          BNE     3$                      ;GET OUT IF SO
     037406  012364  000002                  MOV     (R3)+,2(R4)             ;WRITE DATA TO XDASA REGISTER
     037412  000762                          BR      2$                      ;STAY IN LOOP

     037414  000241                  3$:     CLC                             ;CLEAR CARRY FOR NO ERROR INDICATION
     037416                           4$:
     037416  012601                          MOV     (SP)+,R1                ;;POP STACK INTO R1
     037420  000207                          RTS     PC

                                              ;DATA TO BE SENT AND RECEIVED BY XDA INITIALIZATION

     037422  037440                  INITBL: .WORD   RSP.S1                  ;1ST WORD RESPONSE CHECK ROUTINE
     037424  000000                  SND.S1: .WORD   0                       ;1ST WORD TO SEND TO XDASA
     037426  037452                          .WORD   RSP.S2                  ;2ND WORD RESPONSE CHECK ROUTINE
     037430  000000                  SND.S2: .WORD   0                       ;2ND WORD TO SEND TO XDASA
     037432  037472                          .WORD   RSP.S3                  ;3RD WORD RESPONSE CHECK ROUTINE
     037434  000000                  SND.S3: .WORD   0                       ;3RD WORD TO SEND TO XDASA
     037436  037510                          .WORD   RSP.S4                  ;4TH WORD RESPONSE CHECK ROUTINE

                                      ;       RESPONSE CHECK FOR FIRST WORD (STEP 1) FROM XDASA
                                      ;       CHECK FOR PROPER CONTROLLER TYPE
     037440                           RSP.S1:
     037440  012701  004400                  MOV     #SA.S1+SA.DI,R1         ;SET STEP 1 & ENHANCED DIAGNOSTIC BITS
     037444  042702  001140                  BIC     #SA.QB+SA.MP+40,R2      ;IGNORE 22 BIT ADRS & MAPPING BITS
     037450                           10$:
     037450  000434                          BR      RSP.CK                  ;NOW DO A RESPONSE CHECK

                                      ;       RESPONSE CHECK FOR SECOND WORD (STEP 2) FROM XDASA
                                      ;       CHECK FOR ECHO OF INTI AND VECTOR
     037452                           RSP.S2:
     037452  013701  037424                  MOV     SND.S1,R1               ;GET WORD SENT TO XDASA
     037456  000301                          SWAB    R1                      ;GET HIGH 8 BITS
     037460  042701  177400                  BIC     #177400,R1
     037464  052701  010000                  BIS     #SA.S2,R1               ;SET STEP 2 BIT
     037470  000424                          BR      RSP.CK                  ;NOW DO A RESPONSE CHECK

                                      ;       RESPONSE CHECK FOR THIRD WORD (STEP 3) FROM XDASA
                                      ;       CHECK FOR ECHO OF MESSAGE AND COMMAND RING LENGTHS
     037472                           RSP.S3:
     037472  013701  037424                  MOV     SND.S1,R1               ;GET WORD SENT TO XDASA
     037476  042701  177400                  BIC     #177400,R1              ;JUST LOW 8 BITS
     037502  052701  020000                  BIS     #SA.S3,R1               ;SET STEP 3 BIT
     037506  000415                          BR      RSP.CK                  ;NOW DO A RESPONSE CHECK

                                      ;       RESPONSE CHECK FOR FOURTH WORD (STEP 4) FROM XDASA
                                      ;       CHECK FOR ECHO OF PURGE AND LFAIL BITS
     037510                           RSP.S4:
     037510  010201                          MOV     R2,R1                   ;GET RESPONSE FROM XDA
     037512  042701  137400                  BIC     #^C<SA.S4+SA.CNT+SA.MCV>,R1 ;KEEP MICROCODE VERSION AND STEP 4
     037516  032701  000360                  BIT     #SA.CNT,R1              ;CHECK WITH CONTROLLER MODEL
     037522  001404                          BEQ     1$                      ;IF ZERO, XDA50(M7161)
     037524  042765  000040  000014          BIC     #CT.U50,C.FLG(R5)       ;ELSE, XDA52(M7485)
```

```
    105 037532  000403                        BR      2$                      ;AND BRANCH
    106 037534                          1$.
    107 037534  052765  000040  000014        BIS     #CT.U50,C.FLG(R5)
    108 037542                          2$:
    109
    110                                 ;       RESPONSE CHECK, COMPARE EXPECTED DATA IN R1 WITH ACTUAL DATA IN R2
    111 037542                          RSP.CK:
    112 037542  020102                        CMP     R1,R2                   ;COMPARE THE DATA
    113 037544  001417                        BEQ     1$                      ;EXIT IF COMPARED CORRECTLY
    114
    115 037546  010137  002320                MOV     R1,SAEXP                ; SAVE EXPECTED VALUE
    116 037552  010237  002316                MOV     R2,SAVAL                ; SAVE ACTUAL CONTENTS
    117 037556  012737  011061  002552        MOV     #ERM102,BASEMSG         ; "SA REGISTER ERROR"
    118 037564  012737  000007  002370        MOV     #B.SADDR!B.SAVAL!B.SAEXP,EXTMSK; FLAG ALL FIELDS
    119 037572  104455                        TRAP    C$ERDF
        037574  000146                        .WORD   102
        037576  010667                        .WORD   HDR101
        037600  015266                        .WORD   ERR101
    120 037602  000261                        SEC
    121 037604                          1$:
    122 037604  000207                        RTS     PC
```

```
                                .SBTTL  XDARSP  WAIT FOR XDA INITIALIZE RESPONSE
                                ;XDARSP
                                ;
                                ;WAIT FOR XDA TO RESPOND WITH DATA IN XDASA REGISTER.
                                ;EITHER STEP BIT FROM MASK IN LOCATION XDARSD OR ERROR BIT
                                ;WILL CAUSE A TERMINATION.
                                ;AN ERROR MESSAGE WILL BE PRINTED IF THE XDA DOES NOT RESPOND
                                ;IN 10 SECONDS OR IF ERROR SETS.
                                ;
                                ;INPUTS:
                                ;       XDASRD - MASK OF STEP BIT TO LOOK FOR
                                ;       R5 - ADDRESS OF CONTROLLER TABLE
                                ;       R4 - ADDRESS OF XDAIP REGISTER
                                ;OUTPUTS:
                                ;       ERROR MESSAGE IF TIME OUT ON RESPONSE OR ERROR BIT SETS
                                ;       R2 - DATA FROM XDASA REGISTER
                                ;       CARRY SET IF ERROR BIT SETS OR TIME OUT

037606                          XDARSP:
037606  010146                          MOV     R1,-(SP)                ;;PUSH R1 ON STACK
037610  013737  040002  002320          MOV     XDARSD,SAEXP            ; SAVE EXPECTED VALUE
037616  052737  100000  040002          BIS     #SA.ERR,XDARSD          ;SET ERROR BIT IN MASK WORD
037624  012700  000012                  MOV     #10.,R0                 ;SET UP FOR 10 SECOND TIMEOUT
037630  010501                          MOV     R5,R1                   ;POINT TO COUNTER IN CONTROLLER TABLE
037632  062701  000022                  ADD     #C.TO,R1
037636  004737  034334                  JSR     PC,SETTO
037642  012601                          MOV     (SP)+,R1                ;;POP STACK INTO R1
037644                          1$:
037644  016402  000002                  MOV     2(R4),R2                ; READ SA REGISTER
037650  010237  002316                  MOV     R2,SAVAL                ; AND SAVE CONTENTS
037654  033702  040002                  BIT     XDARSD,R2               ; LOOK AT ERROR AND STEP BIT
037660  001030                          BNE     3$                      ;BRANCH IF EITHER SET
                                                                        ;>>>>>>>>>BREAK BACK TO MONITOR<<<<<<<<<
037662  104422                          TRAP    C$BRK
037664  005737  002210                  TST     KW.CSR                  ;SEE IF CLOCK ON SYSTEM
037670  001765                          BEQ     1$
037672  023765  002222  000024          CMP     KW.EL+2,C.TOH(R5)       ;CHECK IF TIME OUT OCCURRED
037700  101005                          BHI     2$
037702  001360                          BNE     1$
037704  023765  002220  000022          CMP     KW.EL,C.TO(R5)
037712  103754                          BLO     1$
037714                          2$:                                     ; REPORT FATAL ERROR
037714  012737  011061  002552          MOV     #ERM102,BASEMSG         ; "STEP BIT ERROR"
037722  012737  000007  002370          MOV     #B.SADDR!B.SAVAL!B.SAEXP,EXTMSK; FLAG ALL FIELDS
037730  104455                          TRAP    C$ERDF
037732  000146                          .WORD   102
037734  010667                          .WORD   HDR101
037736  015266                          .WORD   ERR101
037740  000414                          BR      4$

                                ;       CHECK IF ERROR BIT SET
037742                          3$:
037742  005702                          TST     R2                      ; READ TEST CONTENTS
037744  100014                          BPL     5$                      ; EXIT IF ERROR NOT SET

037746  012737  011061  002552          MOV     #ERM102,BASEMSG         ; "RESIDENT DIAG FAILURE"
037754  012737  000003  002370          MOV     #B.SADDR!B.SAVAL,EXTMSK ; FLAG ADDRESS AND VALUE
```

XDARSP WAIT FOR XDA INITIALIZE RESPONSE

```
    54 037762  104455                    TRAP    C$ERDF
       037764  000146                    .WORD   102
       037766  010667                    .WORD   HDR101
       037770  015266                    .WORD   ERR101
    55 037772                       4$:
    56 037772  000261                    SEC
    57 037774  000207                    RTS     PC
    58
    59                                  ;NORMAL EXIT
    60
    61 037776  000241                 5$:CLC                          ;CLEAR CARRY AS NO ERROR INDICATION
    62 040000  000207                    RTS     PC
    63
    64                                  ;LOCATION FOR STEP BIT MASK
    65
    66 040002  000000                 XDARSD: .WORD   0                ;LOAD BY CALLING ROUTINE
    67
```

```
                                .SBTTL  HCOMM   INITIALIZE HOST COMM AREA
                                ;HCOMM
                                ;
                                ;ALLOCATES MEMORY FOR HOST COMMUNICATION 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 COMMUNICATION AREA,
                                ;       RING POINTERS TO PACKETS,
                                ;       R4 - ADDRESS OF HOST COMMUNICATION AREA

040004  012701  000074  HCOMM:  MOV     #<HC.SIZ+4>/2,R1        ; LOAD COMM AREA SIZE + 2
040010  004737  040054          JSR     PC,ALOCM                ; ALLOCATE
040014  010104                  MOV     R1,R4                   ; SAVE ADDRESS
040016  010437  002324          MOV     R4,HCOM                 ; LOCALLY
040022  062701  000020          ADD     #HC.MPK,R1              ; COMPUTE START OF MESSAGE PACKET
040026  010164  000004          MOV     R1,HC.MSG(R4)           ; PLACE IN RING
040032  010137  002330          MOV     R1,MSGPCK               ; AND SAVE LOCALLY
040036  062701  000064          ADD     #<HC.CPK-HC.MPK>,R1     ; COMPUTE START OF COMMAND PACKET
040042  010164  000010          MOV     R1,HC.CMD(R4)           ; PLACE IN RING
040046  010137  002326          MOV     R1,CMDPCK               ; AND SAVE LOCALLY
040052  000207                  RTS     PC
```

```
                                .SBTTL  MEMORY ALLOCATION ROUTINES
                                ;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.

040054                          ALOCM:
040054  013746  002176                  MOV     FFREE,-(SP)             ;;PUSH FFREE ON STACK
040060  160137  002200                  SUB     R1,FSIZE                ;REDUCE SIZE OF FREE MEMORY
040064  002405                          BLT     FMERR                   ;REPORT ERROR IF NOT ENOUGH MEMORY
040066  060101                          ADD     R1,R1                   ;CHANGE WORDS TO BYTES
040070  060137  002176                  ADD     R1,FFREE                ;CALCULATE NEW START OF FREE MEMORY
040074  012601                          MOV     (SP)+,R1                ;;POP STACK INTO R1
040076  000207                          RTS     PC

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

040100                          FMERR:
040100  012737  010527  002552          MOV     @ERM001,BASEMSG         ; "MEMORY ALLOCATION ERROR"
040106  104454                          TRAP    C$ERSF
040110  000001                          .WORD   1
040112  010472                          .WORD   HDR001
040114  015220                          .WORD   ERR001
040116  104444                          TRAP    C$DCLN

                                        .EVEN

040120                          L1:0021:
040120  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 RESPON .  THOSE THAT DON'T ARE IMMEDIATELY
                                ; DROPPED FROM TESTING.
                                ;--

040122                          L$AUTO::

040122                          L10022:
040122  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.
                                ;--

040124                          L$CLEAN::

040124  112700  000015                  MOVB    @CR,R0                  ;STORE @CR IN R0 AND
040130  004737  033066                  JSR     PC,PRINTC               ;PRINT THE CHARACTER
040134  004737  016224                  JSR     PC,RESET                ;RESET ALL UNITS

040140  104432                          TRAP    C$EXIT
040142  000002                          .WORD   L10023-.

                                        .EVEN

040144                          L10023:
040144  104412                          TRAP    C$CLEAN
```

```
                                .SBTTL  DROP UNIT SECTION

                                ;++
                                ; THE DROP-UNIT SECTION CONTAINS THE CODING THAT CAUSES A DEVICE
                                ; TO NO LONGER BE TESTED.
                                ;--

040146                          L$DU::

040146  005737  002442                  TST     STATUS                  ; TEST EXIT STATUS
040152  100410                          BMI     20$                     ; BRANCH IF FATAL
040154                          10$:                                    ; "TEST COMPLETE."
040154  013746  002074                  MOV     L$LUN,-(SP)             ;PUSH L$LUN ON STACK
040160  012746  040216                  MOV     #CMPUUT, (SP)           ;PUSH #CMPUUT ON STACK
040164  004137  033244                  JSR     R1,LPNTF                        ;CALL LPNTF PRINT ROUTINE
040170  000004                          .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
040172  000407                          BR      30$
040174                          20$:                                    ; "DROPPED."
040174  013746  002074                  MOV     L$LUN,-(SP)             ;PUSH L$LUN ON STACK
040200  012746  040254                  MOV     #DRPUUT,-(SP)           ;PUSH #DRPUUT ON STACK
040204  004137  033244                  JSR     R1,LPNTF                        ;CALL LPNTF PRINT ROUTINE
040210  000004                           WORD   ARG.CT                  ;ARGUMENT COUNT * 2
040212                          30$:
040212  000167                          .WORD   J$JMP
040214  000066                          .WORD   L10024-2-.

                                        .NLIST  BEX
040216     116      062     042 CMPUUT: .ASCIZ  /N2"UNIT "D8" TEST COMPLETE."N/
040254     116      062     042 DRPUUT: .ASCIZ  /N2'UNIT "D8" DROPPED."N/
                                        .LIST   BEX
                                        .EVEN

040304                          L10024:
040304  104453                          TRAP    C$DU
```

```
                                .SBTTL  ADD UNIT SECTION
                                ;++
                                ; THE ADD-UNIT SECTION CONTAINS ANY CODE THE PROGRAMMER WISHES
                                ;  TO BE EXECUTED IN CONJUNCTION WITH THE ADDING OF A UNIT BACK
                                ;  TO THE TEST CYCLE.
                                ;--

040306                          L$AU::

040306  000167                          .WORD   J$JMP
040310  000000                          .WORD   L10025-2-.

                                        .EVEN

040312                          L10025:
040312  104452                          TRAP    C$AU
```

```
                                        .SBTTL  TEST1:  MANUAL BAD BLOCK REPLACEMENT

040314                                  T1::

040314  005737  002150                        TST     MANRPL                  ; TEST FOR MANUAL REPLACEMENT
040320  001002                                BNE     10$                     ; BRANCH IF YES
040322  104432                                TRAP    C$EXIT
040324  000276                                .WORD   L10026-.
040326                                  10$:
040326  104450                                TRAP    C$MANI
040330  103402                                BCS     15$
040332  104432                                TRAP    C$EXIT
040334  000266                                .WORD   L10026-.
040336                                  15$:
040336  012746  007061                        MOV     @INF310,-(SP)           ;PUSH @INF310 ON STACK
040342  004137  033244                        JSR     R1,LPNTF                        ;CALL LPNTF PRINT ROUTINE
040346  000002                                .WORD   ARG.CT                  ;ARGUMENT COUNT * 2

040350  012737  000000  002074                MOV     #0,L$LUN                ; ZERO LUN
040356  013737  002230  002304                MOV     CTLRLST,CTLRTBL         ; LOAD TABLE ADDRESS
040364                                  20$:
040364  004737  021050                        JSR     PC,UNITINI              ; INITIALIZE UNIT UNDER TEST
040370  040602                                1200$                           ; ERROR EXIT
040372                                  50$:
040372  012701  022707                        MOV     @SWMSG4,R1              ; LOAD QUESTION ADDRESS
040376  012702  002654                        MOV     @REPLY,R2               ; LOAD ANSWER ADDRESS
040402  012712  000000                        MOV     #0,(R2)                 ; DEFAULT IS "NO"
040406  004737  023126                        JSR     PC,GETLOG               ; ASK OPERATOR
040412  105737  002654                        TSTB    REPLY                   ; TEST REPLY
040416  001403                                BEQ     100$                    ; BRANCH IF "NO"

040420  004737  032364                        JSR     PC,DSPDSC               ; ELSE, DISPLAY DESCRIPTORS
040424  040602                                1200$                           ; ERROR EXIT

                                        ;       MANUAL BAD BLOCK REPLACEMENT.
                                        ;       FETCH LBN FROM OPERATOR; CHECK LIMITS.
040426                                  100$:
040426  012701  014705                        MOV     @TXT000,R1              ; LOAD MESSAGE ADDRESS
040432  012704  002446                        MOV     @LBN,R4                 ; LOAD LBN ADDRESS
040436  004737  023410                        JSR     PC,GETLBN               ; GET LBN FROM OPERATOR
040442  001425                                BEQ     200$                    ; EXIT IF TTYIN = 0
040444                                  110$:
040444  004737  023604                        JSR     PC,READLBN              ; READ SUSPECT LBN
040450  040602                                1200$                           ; ERROR EXIT
040452  004737  017562                        JSR     PC,CACHTST              ; UPDATE CACHING TABLE
040456  040602                                1200$                           ; ERROR EXIT

                                        ;       REPLACE LBN IF REPLACEMENT ENABLED.
040460                                  130$:
040460  005737  002160                        TST     ENBRPL                  ; TEST FOR REPLACEMENT ENABLED
040464  001004                                BNE     150$                    ; BRANCH IF YES
040466  004737  020002                        JSR     PC,TYPSTAT              ; TYPE REPLACEMENT INFO
040472  000137  040426                        JMP     100$
040476                                  150$:
040476  012737  000006  002546                MOV     #6,NXTSTEP              ; ENTRY IS STEP6
040504  004737  024156                        JSR     PC,REPLACE              ; REPLACE LBN
040510  040602                                1200$                           ; ERROR RETURN
```

```
     54 040512  000137  040426                    JMP     100$                    ; CONTINUE
     55 040516                              200$:
     56 040516  012746  007135                    MOV     @INF311,-(SP)           ;PUSH @INF311 ON STACK
        040522  004137  033244                    JSR     R1,LPNTF                        ;CALL LPNTF PRINT ROUTINE
        040526  000002                            .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
     57 040530  104424                            TRAP    C$DRPT
     58
     59 040532  012701  022707                    MOV     @SWMSG4,R1              ; LOAD QUESTION ADDRESS
     60 040536  012702  002654                    MOV     @REPLY,R2               ; LOAD ANSWER ADDRESS
     61 040542  012712  000000                    MOV     #0,(R2)                 ; DEFAULT IS "NO"
     62 040546  004737  023126                    JSR     PC,GETLOG               ; ASK OPERATOR
     63 040552  001403                            BEQ     400$                    ; BRANCH IF NO
     64
     65 040554  004737  032364                    JSR     PC,DSPDSC               ; ELSE, DISPLAY DESCRIPTORS
     66 040560  040602                            1200$                           ; ERROR EXIT
     67
     68                                     ;     NORMAL EXIT
     69 040562                              400$:
     70 040562  012737  000000  002442            MOV     #0,STATUS               ; SET SUCCESS
     71 040570  013700  002074                    MOV     L$LUN,R0
        040574  104451                            TRAP    C$DODU
     72 040576  104432                            TRAP    C$EXIT
        040600  000022                            .WORD   L10026-.
     73
     74                                     ;     ERROR EXIT
     75 040602                              1200$:
     76 040602  012737  177777  002442            MOV     #-1,STATUS              ; SET FATAL STATUS
     77 040610  013700  002074                    MOV     L$LUN,R0
        040614  104451                            TRAP    C$DODU
     78 040616  104432                            TRAP    C$EXIT
        040620  000002                            .WORD   L10026-.
     79
     80                                           .EVEN
     81
     82 040622                              L10026:
        040622  104401                            TRAP    C$ETST
     83
```

```
                                        .SBTTL  TEST2:  AUTOMATIC BAD BLOCK REPLACEMENT

040624                                  T2::

040624  005737  002150                        TST     MANRPL                  ; TEST FOR MANUAL REPLACEMENT
040630  001402                                BEQ     10$                     ; BRANCH IF NO
040632  104432                                TRAP    C$EXIT
040634  001306                                .WORD   L10027-.
040636                                  10$:
040636  012746  007164                        MOV     #INF320,-(SP)           ;PUSH #INF320 ON STACK
040642  004137  033244                        JSR     R1,LPNTF                        ;CALL LPNTF PRINT ROUTINE
040646  000002                                .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
040650  012746  007242                        MOV     #INF321,-(SP)           ;PUSH #INF321 ON STACK
040654  004137  033254                        JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
040660  000002                                .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
040662  012746  007630                        MOV     #INF322,-(SP)           ;PUSH #INF322 ON STACK
040666  004137  033254                        JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
040672  000002                                .WORD   ARG.CT                  ;ARGUMENT COUNT * 2

040674  012737  177777  002074                MOV     #-1,L$LUN               ; INITIALIZE LUN
040702  012737  177776  002300                MOV     #-2,TBLNDX              ; INITIALIZE TABLE INDEX
040710                                  100$:
040710  005237  002074                        INC     L$LUN                   ; INCREMENT LUN
040714  023737  002074  002012                CMP     L$LUN,L$UNIT            ; TEST IF ALL UNITS DONE
040722  002402                                BLT     105$                    ; BRANCH IF NO
040724  000137  042136                        JMP     1200$                   ; ELSE, FINISHED
040730                                  105$:
040730  062737  000002  002300                ADD     #2,TBLNDX               ; INCREMENT TABLE INDEX
040736  013702  002300                        MOV     TBLNDX,R2               ; LOAD INDEX
040742  016237  002230  002304                MOV     CTLRLST(R2),CTLRTBL     ; LOAD ADDRESS
040750  001757                                BEQ     100$                    ; BRANCH IF NONE
040752                                  120$:
040752  004737  021050                        JSR     PC,UNITINI              ; INITIALIZE UNIT UNDER TEST
040756  042104                                1000$                           ; ERROR EXIT

                                        ;       AUTOMATIC BAD BLOCK REPLACEMENT.
                                        ;       INITIALIZE TEST VARIABLES
040760                                  300$:                                   ; HEADER
040760  012746  007027                        MOV     #INF302,-(SP)           ;PUSH #INF302 ON STACK
040764  004137  033254                        JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
040770  000002                                .WORD   ARG.CT                  ;ARGUMENT COUNT * 2

040772  104450                                TRAP    C$MANI
040774  103033                                BCC     305$

040776  005737  002650                        TST     DEBUG                   ; TEST DEBUG FLAG
041002  001430                                BEQ     305$                    ; BRANCH IF NOT SET

                                        ;       GET MINIMUM AND MAXIMUM LBN'S FOR DEBUG
041004                                  301$:
041004  012737  000000  002600                MOV     #0,MINLBN
041012  012737  000000  002602                MOV     #0,MINLBN+2
041020  012701  015060                        MOV     #TX.LB1,R1
041024  012704  002600                        MOV     #MINLBN,R4
041030  004737  023410                        JSR     PC,GETLBN
041034                                  302$:
041034  013737  002430  002604                MOV     UNSIZ,MAXLBN
```

TEST2: AUTOMATIC BAD BLOCK REPLACEMENT

```
     49 041042  013737  002432  002606          MOV     UNSIZ+2,MAXLBN+2
     50 041050  012701  015100                  MOV     #TX.LB2,R1
     51 041054  012704  002604                  MOV     #MAXLBN,R4
     52 041060  004737  023410                  JSR     PC,GETLBN
     53
     54                                 ;       INITIALIZE STARTING GLBN
     55 041064                          305$:
     56 041064  013737  002600  002562          MOV     MINLBN,GLBN             ; LOAD INITIAL LBN (LOW)
     57 041072  013737  002602  002564          MOV     MINLBN+2,GLBN+2         ; LOAD INITIAL LBN (HIGH)
     58 041100  012737  000200  001000          MOV     #GRPSIZ,BLKSIZ          ; INITIALIZE FOR ' .8 BLOCK GROUPS
     59 041106  000137  041630                  JMP     600$                    ; TEST FOR EOM BEFORE ACCESS
     60
```

```
 1
 2                                          ;       ACCESS NEXT GROUP OF BLOCKS
 3 041112                                   310$:
 4 041112  104422                                   TRAP    C$BRK
 5 041114  005037  002446                         CLR     LBN                     ; RESET TEST LBN (LOW)
 6 041120  005037  002450                         CLR     LBN+2                   ; RESET TEST LBN (HIGH)
 7 041124  005037  002516                         CLR     LBNSTAT                 ; RESET LBN STATUS
 8 041130  005037  002520                         CLR     RPLSTAT                 ; RESET REPLACEMENT STATUS
 9 041134  105037  002515                         CLRB    SFLAG                   ; RESET SEARCH FLAG
10
11 041140  012737  044472  002340                MOV     #IBUFF,UADR             ; LOAD IMAGE BUFFER ADDRESS
12 041146  004737  030140                         JSR     PC,INITAC               ; INITIALIZE ACCESS PARAMETERS
13
14 041152  012737  000000  002346                MOV     #0,CMDMOD               ; CLEAR MODIFIERS
15                                                                                 ; SETUP TO ISSUE OP.ACC COMMAND
   041160  012700  000020                         MOV     #OP.ACC,R0              ; LOAD MSCP OPCODE
   041164  004737  030204                         JSR     PC,ISSUE                ; ISSUE COMMAND TO THE XDA
   041170  042104                                 1000$                           ; HERE IF FATAL ERROR,
   041172  001520                                 BEQ     500$                    ; BRANCH IF COMMAND SUCCESSFUL,
16
17                                          ;       ERROR RETURN:  CALCULATE ERROR LBN.
18 041174                                   320$:
19 041174  013701  002324                         MOV     HCOM,R1                 ; LOAD COMM AREA ADDRESS
20 041200  016103  000034                         MOV     HC.MPK+P.BCNT(R1),R3    ; UNLOAD ACCESS
21 041204  016104  000036                         MOV     HC.MPK+P.BCNT+2(R1),R4  ;  BYTE COUNT
22 041210  012700  001000                         MOV     #512.,R0                ; DIVISOR IS BYTES PER BLOCK
23 041214  004737  034436                         JSR     PC,DIVIDE               ; DIVIDE
24 041220  060337  002562                         ADD     R3,GLBN                 ; ADVANCE LBN
25 041224  005537  002564                         ADC     GLBN+2                  ;  TO BAD BLOCK
26 041230  013737  002562  002446                MOV     GLBN,LBN                ; TRANSFER GROUP START
27 041236  013737  002564  002450                MOV     GLBN+2,LBN+2            ;  TO LBN
28
29                                          ;       CHECK FOR DATA ERROR.
30 041244                                   350$:
31 041244  013700  002354                         MOV     EMSTAT,R0               ; LOAD STATUS
32 041250  042700  177740                         BIC     #^C<ST.MSK>,R0          ; CLEAR ANY SUBCODES
33 041254  022700  000010                         CMP     #ST.DAT,R0              ; TEST FOR DATA ERROR
34 041260  001414                                 BEQ     400$                    ; BRANCH IF YES
35
36                                          ;       UNRECOGNIZED ERROR CODE
37 041262                                   380$:
38 041262  012737  012246  002552                MOV     #ERM303,BASEMSG         ; "FAILED ACCESS..."
39 041270  012737  000140  002370                MOV     #8.MSCP,EXTMSK          ; FLAG ALL FIELDS
40 041276  104455                                 TRAP    C$ERDF
   041300  000457                                 .WORD   303
   041302  012043                                 .WORD   HDR301
   041304  015570                                 .WORD   ERR302
41 041306  000137  042104                         JMP     1000$                   ; EXIT TEST
42
```

```
 1
 2                                          ;       PROCESS DATA ERROR.
 3 041312                                   400$:
 4 041312  004737  023604                        JSR     PC,READLBN              ; READ SUSPECT LBN
 5 041316  042104                                 1000$                           ; ERPOR RETURN
 6 041320  001004                                 BNE     420$                    ; BRANCH IF REPLACE
 7
 8 041322  004737  017562                        JSR     PC,CACHTST              ; UPDATE CACHING TABLE
 9 041326  042104                                 1000$                           ; ERROR EXIT
10 041330  001407                                 BEQ     440$                    ; BRANCH IF NO REPLACE
11 041332                                   420$:
12 041332  032737  000200  002516                  BIT     #TF.BBR,LBNSTAT         ; TEST FOR BBR
13 041340  001403                                 BEQ     440$                    ; BRANCH IF NO
14 041342                                   425$:
15 041342  005737  002160                        TST     ENBRPL                  ; TEST FOR REPLACEMENT ENABLED
16 041346  001011                                 BNE     450$                    ; BRANCH IF YES
17 041350                                   440$:
18 041350  004737  020002                        JSR     PC,TYPSTAT              ; ELSE, TYPE INFO
19 041354  062737  000001  002562                  ADD     #1,GLBN                 ; BUMP TO NEXT LBN
20 041362  005537  002564                        ADC     GLBN+2                  ; ADD CARRY
21 041366  000137  041630                        JMP     600$                    ; CONTINUE WITH NEXT LBN
22
23                                          ;       REPLACE LBN.
24 041372                                   450$:
25 041372  012737  000006  002546                  MOV     #6,NXTSTEP              ; ENTRY IS STEP6
26 041400  004737  024156                        JSR     PC,REPLACE              ; CALL REPLACEMENT ALGORITHM
27 041404  042104                                 1000$                           ; ERROR RETURN
28 041406  032737  000400  002516                  BIT     #TF.WFE,LBNSTAT         ; TEST FOR WFE
29 041414  001405                                 BEQ     455$                    ; BRANCH IF NO
30 041416  062737  000001  002562                  ADD     #1,GLBN                 ; ELSE, BUMP LBN
31 041424  005537  002564                        ADC     GLBN+2                  ; PAST FER
32 041430                                   455$:
33 041430  000137  041630                        JMP     600$                    ; CONTINUE
34
```

```
                                        ;       NORMAL RETURN; CHECK FLAGS
041434                                  500$:
041434  132737  000200  002356                  BITB    @EF.BBR,FLAGS           ; TEST FLAGS FOR BBR
041442  001007                                  BNE     510$                    ; BRANCH IF YES
041444  063737  002572  002562                  ADD     BLKCNT,GLBN             ; ELSE, MOVE TO NEXT GROUP
041452  005537  002564                          ADC     GLBN+2                  ; ADD CARRY
041456  000137  041630                          JMP     600$                    ; CONTINUE WITH NEXT LBN

                                        ;       PROCESS BBR.
041462                                  510$:
041462  013704  002324                          MOV     HCOM,R4                 ; LOAD HOST COMM AREA ADDRESS
041466  016437  000054  002446                  MOV     HC.MPK+P.FBBK(R4),LBN   ; UNLOAD FIRST BAD BLOCK
041474  016437  000056  002450                  MOV     HC.MPK+P.FBBK+2(R4),LBN+2
041502  013737  002446  002562                  MOV     LBN,GLBN
041510  013737  002450  002564                  MOV     LBN+2,GLBN+2

                                        ;       REREAD LBN.
041516                                  520$:
041516  004737  023604                          JSR     PC,READLBN              ; READ SUSPECT LBN
041522  042104                                  1000$                           ; ERROR RETURN
041524  001004                                  BNE     530$                    ; BRANCH IF REPLACE

041526  004737  017562                          JSR     PC,CACHTST              ; UPDATE CACHING TABLE
041532  042104                                  1000$                           ; ERROR RETURN
041534  001403                                  BEQ     540$                    ; BRANCH IF NO REPLACE
041536                                  530$:
041536  005737  002160                          TST     ENBRPL                  ; TEST FOR REPLACEMENT ENABLED
041542  001011                                  BNE     550$                    ; BRANCH IF YES
041544                                  540$:
041544  004737  020002                          JSR     PC,TYPSTAT              ; ELSE, TYPE INFO
041550  062737  000001  002562                  ADD     @1,GLBN                 ; BUMP TO NEXT LBN
041556  005537  002564                          ADC     GLBN+2                  ; ADD CARRY
041562  000137  041630                          JMP     600$                    ; CONTINUE WITH NEXT LBN

                                        ;       REPLACE LBN.
041566                                  550$:
041566  012737  000006  002546                  MOV     @6,NXTSTEP              ; ENTRY IS STEP6
041574  004737  024156                          JSR     PC,REPLACE              ; CALL REPLACEMENT ALGORITHM
041600  042104                                  1000$                           ; ERROR RETURN
041602  032737  000400  002516                  BIT     @TF.WFE,LBNSTAT         ; TEST FOR WFE
041610  001405                                  BEQ     555$                    ; BRANCH IF NO
041612  062737  000001  002562                  ADD     @1,GLBN                 ; ELSE, BUMP LBN
041620  005537  002564                          ADC     GLBN+2                  ; PAST FER
041624                                  555$:
041624  000137  041630                          JMP     600$                    ; CONTINUE
```

```
                                        ;       TEST FOR END OF MEDIA; RESET BYTE COUNT
041630                                  600$:
041630  013701  002604                          MOV     MAXLBN,R1               ; LOAD TOTAL LBN'S (LOW)
041634  013702  002606                          MOV     MAXLBN+2,R2             ; LOAD TOTAL LBN'S (HIGH)
041640                                  605$:
041640  163702  002564                          SUB     GLBN+2,R2               ; SUBTRACT START LBN (HIGH)
041644  103466                                  BLO     800$                    ; DONE IF GLBN+2 > UNSIZ+2
041646  101030                                  BHI     630$                    ; CONTINUE IF GLBN+2 < UNSIZ+2

041650  163701  002562                          SUB     GLBN,R1                 ; ELSE, SUBTRACT START LBN (LOW)
041654  101462                                  BLOS    800$                    ; DONE IF GLBN >= UNSIZ
041656                                  610$:
041656  000240                                  NOP
041660  022701  000200                          CMP     #GRPSIZ,R1              ; COMPARE REMAINDER WITH GROUP SIZE
041664  101421                                  BLOS    630$                    ; BRANCH IF REMAINING >= GRPSIZ
041666  012737  000000  002566                  MOV     #0,GBCNT                ; ELSE, RESET
041674  012737  000000  002570                  MOV     #0,GBCNT+2              ; GROUP BYTE COUNT
041702  010137  002572                          MOV     R1,BLKCNT               ; USE REMAINDER FOR BLOCK COUNT
041706                                  620$:
041706  062737  001000  002566                  ADD     #BLKSIZ,GBCNT           ; INCREMENT BYTE COUNT (LOW)
041714  005537  002570                          ADC     GBCNT+2                 ; ADD CARRY
041720  005301                                  DEC     R1                      ; DECREMENT BLOCKS LEFT
041722  001371                                  BNE     620$                    ; CONTINUE IF NOT ZERO
041724  000240                                  NOP
041726  000411                                  BR      640$                    ;
041730                                  630$:
041730  012737  000000  002566                  MOV     #0,GBCNT                ; ELSE, RESET
041736  012737  000001  002570                  MOV     #1,GBCNT+2              ; BYTE COUNT
041744  012737  000200  002572                  MOV     #GRPSIZ,BLKCNT          ; AND BLOCK COUNT
041752                                  640$:
041752  062737  000001  002574                  ADD     #1,ACCESS               ; BUMP ACCESS COUNT
041760  032737  000777  002574                  BIT     #777,ACCESS             ; IS IT MOD 512.?
041766  001013                                  BNE     650$                    ; BRANCH IF NO
                                                                                ; ELSE, PRINT CURRENT LBN
041770  013746  002564                          MOV     GLBN+2,-(SP)            ;PUSH GLBN+2 ON STACK
041774  013746  002562                          MOV     GLBN,-(SP)              ;PUSH GLBN ON STACK
042000  012746  010166                          MOV     #INF405,-(SP)           ;PUSH #INF405 ON STACK
042004  004137  033254                          JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
042010  000006                                  .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
042012  004737  020650                          JSR     PC,RNTIME               ; AND RUNTIME
042016                                  650$:
042016  000137  041112                          JMP     310$                    ; ACCESS NEXT GROUP
```

```
      1
      2 042022                                  800$:
      3 042022  013746  002564                        MOV     GLBN*2,-(SP)            ;PUSH GLBN*2 ON STACK
        042026  013746  002562                        MOV     GLBN,-(SP)              ;PUSH GLBN ON STACK
        042032  012746  010166                        MOV     @INF405,-(SP)           ;PUSH @INF405 ON STACK
        042036  004137  033254                        JSR     R1,LPNTB                        ;CALL LPNTB PRINT ROUTINE
        042042  000006                                .WORD   ARG.CT                  ;ARGUMENT COUNT * 2
      4 042044  004737  020650                        JSR     PC,RNTIME               ; DISPLAY RUNTIME
      5
      6 042050  104424                                TRAP    C$DRPT
      7 042052  005737  002650                        TST     DEBUG                   ; TEST FOR DEBUG
      8 042056  001402                                BEQ     810$                    ; BRAANCH IF NO
      9 042060  000137  041064                        JMP     305$                    ; ELSE LOOP
     10 042064                                  810$:
     11 042064  005737  002156                        TST     DSPRCT                  ; TEST FOR DISPLAY
     12 042070  001403                                BEQ     820$                    ; BRANCH IF NO
     13 042072  004737  032364                        JSR     PC,DSPDSC               ; ELSE, DISPLAY DESCRIPTORS
     14 042076  042100                                820$                            ; ERROR EXIT
     15 042100                                  820$:
     16 042100  000137  040710                        JMP     100$                    ; CONTINUE
     17
     18                                         ;       FATAL EXIT; DROP UUT
     19 042104                                  1000$:
     20 042104  012737  177777  002442                MOV     @-1,STATUS              ; SET FATAL STATUS
     21 042112  013702  002300                        MOV     TBLNDX,R2               ; LOAD UNIT INDEX
     22 042116  012762  000000  002230                MOV     @0,CTLRLST(R2)          ; ZERO CONTROLLER TABLE ADDRESS
     23 042124  013700  002074                        MOV     L$LUN,R0
        042130  104451                                TRAP    C$DODU
     24 042132  000137  040710                        JMP     100$                    ; AND CONTINUE
     25
     26                                         ;       TEST EXIT
     27 042136                                  1200$:
     28 042136  104432                                TRAP    C$EXIT
        042140  000002                                .WORD   L10027-.
     29
     30                                                 .EVEN
     31
     32 042142                                  L10027:
        042142  104401                                TRAP    C$ETST
     33
     35
```

```
                                .SBTTL  HARDWARE PARAMETER CODING SECTION
                                ;**
                                ; 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.
                                ;--

042144  000027                          .WORD L10030-L$HARD/2
042146                          L$HARD::
                000000          H.UBA   = 0                             ;UNIBUS ADDRESS
                000002          H.VEC   = 2                             ;XDA VECTOR
                000004          H.BRL   = 4                             ;BR LEVEL
                000006          H.BST   = 6                             ;BURST RATE
                000010          H.DRV   = 10                            ;DRIVE NUMBER
                                                                        ;PRINT 'UNIBUS ADDRESS OF XDA?'
042146  000031                          .WORD   T$CODE
042150  042224                          .WORD   MSGUBA
042152  160000                          .WORD   T$LOLIM
042154  177774                          .WORD   T$HILIM
                                                                        ;PRINT 'VECTOR?'
042156  001031                          .WORD   T$CODE
042160  042252                          .WORD   MSGVEC
042162  000004                          .WORD   T$LOLIM
042164  000774                          .WORD   T$HILIM
                                                                        ;PRINT  BR LEVEL?'
042166  002052                          .WORD   T$CODE
042170  042261                          .WORD   MSGBRL
042172  177777                          .WORD   -1
042174  000004                          .WORD   T$LOLIM
042176  000007                          .WORD   T$HILIM
                                                                        ;PRINT 'UNIBUS BURST RATE?'
042200  003052                          .WORD   T$CODE
042202  042272                          .WORD   MSGBST
042204  177777                          .WORD   -1
042206  000000                          .WORD   T$LOLIM
042210  000077                          .WORD   T$HILIM
                                                                        ;PRINT 'DRIVE #?'
042212  004052                          .WORD   T$CODE
042214  042314                          .WORD   MSGLDR
042216  177777                          .WORD    1
042220  000000                          .WORD   T$LOLIM
042222  000377                          .WORD   T$HILIM
                                        .EVEN
042224                          L10030:

042224      125     116     111 MSGUBA: .ASCIZ  \UNIBUS ADDRESS OF XDA\
042252      126     105     103 MSGVEC: .ASCIZ  \VECTOR\
042261      102     122     040 MSGBRL: .ASCIZ  \BR LEVEL\
042272      125     116     111 MSGBST: .ASCIZ  \UNIBUS BURST RATE\
042314      104     122     111 MSGLDR: .ASCIZ  \DRIVE #\
                                        .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.
                                ;--

042324  000000                          .WORD L10031-L$SOFT/2
042326                          L$SOFT::

                                        .EVEN
042326                          L10031:


042326                          $PATCH::.BLKW   50.                     ;PATCH AREA (50. WORDS)

042472                          DBUFF:: .BLKB   512.    ;BYTES         ;DATA BUFFER
043472                          TBUFF:: .BLKB   512.    ;BYTES         ;TEMPORARY BUFFER FOR RCT BLOCK 0
044472                          IBUFF:: .BLKB   512.    ;BYTES         ;IMAGE BUFFER FOR LBN BEING REPLACED
045472                          BUFF1:: .BLKB   512.    ;BYTES         ;BUFFER 1
046472                          BUFF2:: .BLKB   512.    ;BYTES         ;BUFFER 2

                                        .EVEN
047472  047514                        .WORD T$FREE
047474  000007                        .WORD T$SIZE
047476                          L$LAST::
```

SOFTWARE PARAMETER CODING SECTION

```
      1
      3 047476  000000                        .WORD   0
        047500  000005                        .WORD   L10034-./2-1
        047502                        L10032:
      4 047502  172150                        .WORD   172150                  ; UNIBUS ADDRESS
      5 047504  000154                        .WORD   154                     ; VECTOR ADDRESS
      6 047506  000005                        .WORD   5.                      ; BR LEVEL
      7 047510  000077                        .WORD   63.                     ; UNIBUS BURST RATE
      8 047512  000000                        .WORD   0.                      ; DRIVE NUMBER
      9 047514                        L10034:
     11         000001                .END
```

Symbol table

```
ACCESS  002574 G    B.ESTA= 000100      COPY    034276      C$PNTF= 000017      DU.QUE= 010000
ADR   = 000020 G    B.EVNT= 000001      CR    = 000015 G    C$PNTS= 000016      DU.SPC= 060000
ALOCM   040054      B.FLAG= 000040      CRLF    014231      C$PNTX= 000015      DU.TER= 040000
ARG.CT= 000006      B.HADD= 000002      CTLRLS  002230 G    C$PUTB= 000072      D.BB  = 000002
ASSEMB= 000010      B.MOD = 000004      CTLRTB  002304 G    C$PUTW= 000073      D.BB01= 000004
AUTORC  002152 G    B.MSCP= 000140      CT.AVL= 100000      C$QIO = 000377      D.BB02= 000010
BACKMS  022464      B.PHAS= 000034      CT.BRL= 007000      C$RDBU= 000007      D.BB03= 000014
BACKUP  002652 G    B.RCT = 000003      CT.CMD= 000004      C$REFG= 000047      D.BB04= 000020
BADRBN= 000024 G    B.SADD= 000001      CT.MSG= 000010      C$REL = 000077      D.BB05= 000024
BASEMS  002552 G    B.SAEX= 000004      CT.REQ= 000020      C$RESE= 000033      D.BB06= 000030
BBRCNT  002540 G    B.SAVA= 000002      CT.UNT= 000077      C$REVI= 000003      D.BB07= 000034
BCNT    002334 G    CACHES= 000620 G    CT.USO= 000040      C$RFLA= 000021      D.BB08= 000040
BELL  = 000007 G    CACHID= 000030 G    CT.VEC= 000777      C$RPT = 000025      D.BB09= 000044
BITTBL  020612      CACHLS  002254 G    C$AU  = 000052      C$SEFG= 000046      D.BB10= 000050
BIT0  = 000001 G    CACHTB  002310 G    C$AUTO= 000061      C$SPRI= 000041      D.BB11= 000054
BIT00 = 000001 G    CACHTS  017562      C$BRK = 000022      C$SVEC= 000037      D.BB12= 000060
BIT01 = 000002 G    CALBLK  031332      C$BSEG= 000004      C$TOME= 000076      D.BB13= 000064
BIT02 = 000004 G    CALRBN  031256      C$BSUB= 000002      C.BST = 000004      D.BB14= 000070
BIT03 = 000010 G    CALR1   016042      C$CLCK= 000062      C.DRVN= 000006      D.BB15= 000074
BIT04 = 000020 G    CALR2   016122      C$CLEA= 000012      C.DRVT= 000020      D.BB16= 000100
BIT05 = 000040 G    CALR3   016124      C$CLOS= 000035      C.FLG = 000014      D.BCYL= 000146
BIT06 = 000100 G    CALR4   016126      C$CLP1= 000006      C.HCOM= 000016      D.BE  = 000040
BIT07 = 000200 G    CALR5   016130      C$CPBF= 000074      C.JAD = 000012      D.BEC   000104
BIT08 = 000400 G    CALR6   016132      C$CPME= 000075      C.JSR = 000010      D.BGN1= 000106
BIT09 = 001000 G    CF.ATN= 000200      C$CVEC= 000036      C.REF = 000026      D.BGN2= 000116
BIT1  = 000002 G    CF.MSC= 000100      C$DCLN= 000044      C.SIZE= 000030      D.BGN3= 000126
BIT10 = 002000 G    CF.OTH= 000040      C$DODU= 000051      C.TO  = 000022      D.BGN4= 000136
BIT11 = 004000 G    CF.SHD= 000002      C$DRPT= 000024      C.TOH = 000024      D.CYL = 000400
BIT12 = 010000 G    CF.THS= 000020      C$DU  = 000053      C.UADR= 000000      D.DC  = 000002
BIT13 = 020000 G    CF.576= 000001      C$EDIT= 000003      C.VEC = 000002      D.DCA = 000001
BIT14 = 040000 G    CHRMSG= 023110      C$ERDF= 000055      DBM01   035470      D.DCY = 020000
BIT15 = 100000 G    CHRRPL= 023104      C$ERHR= 000056      DBM02   035556      D.ECC = 010000
BIT2  = 000004 G    CLKFLG  002206 G    C$ERRO= 000060      DBM03   035601      D.ECYL= 000152
BIT3  = 000010 G    CLOG    034416      C$ERSF= 000054      DBM04   035667      D.END1= 000112
BIT4  = 000020 G    CLRBUF  034240      C$ERSO= 000057      DBUFF   042472 G    D.END2= 000122
BIT5  = 000040 G    CMDIN   002712 G    C$ESCA= 000010      DCODE   002404 G    D.END3= 000132
BIT6  = 000100 G    CMDMOD  002346 G    C$ESEG= 000005      DEBUG   002650 G    D.END4= 000142
BIT7  = 000200 G    CMDPCK  002326 G    C$ESUB= 000003      DELTA   002510 G    D.IW  = 040000
BIT8  = 000400 G    CMDREF  002342 G    C$ETST= 000001      DEVNAM  014225      D.PAT = 000000
BIT9  = 001000 G    CMPUUT  040216      C$EXIT= 000032      DFPTBL  002132 G    D.RET = 001000
BLDCMD  030632      CNTTBL  020636      C$FREQ= 000101      DIAG  = 177777      D.RO  = 004000
BLD28   034654      CNV28   034756      C$FRME= 000100      DIAGMC= 000000      D.SEQ = 000100
BLKCNT  002572 G    CON.A   033444      C$GETB= 000026      DIVIDE  034436      D.SERN= 000156
BLKSIZ= 001000 G    CON.A1  033452      C$GETW= 000027      DIV10   034474      D.SIZE= 000164
BOE   = 000400 G    CON.A2  033466      C$GMAN= 000043      DRIVTB  002306 G    D.TR  = 000020
BRF   = 020000 G    CON.D   033470      C$GPHR= 000042      DRPUUT  040254      D.WC  = 000010
BUFF1   045472 G    CON.H   033502      C$GPRI= 000040      DSPDSC  032364      D.WCA = 000004
BUFF2   046472 G    CON.N   033526      C$INIT= 000011      DSPHEL  032150      D.WO  = 002000
BUSFLA  002614 G    CON.N1  033532      C$INLP= 000020      DSPRCT  002156 G    ECCCNT  002536 G
B.BLOC= 000001      CON.O   033514      C$MANI= 000050      DSPRPL  002154 G    ECODE   002352 G
B.CMDR= 000001      CON.QU  033424      C$MAP = 000102      DSTCNT  002534 G    EF.BBR= 000200
B.CODE= 000002      CON.QX  033442      C$MEM = 000031      DT.AVL= 100000      EF.BBU= 000100
B.COPY= 000002      CON.R   033550      C$MMU = 000103      DT.UNT= 000077      EF.CON= 000036 G
B.DCOD= 000004      CON.R1  033572      C$MSG = 000023      DUP   = 001000      EF.LOG= 000040
B.DERR= 000010      CON.S   033610      C$OPNR= 000034      DU.DFL= 020000      EF.NEW= 000035 G
B.ECCO= 000020      CON.S1  033614      C$OPNW= 000104      DU.FTL= 050000      EF.PWR= 000034 G
B.EMRE= 000010      COPIES  002423 G    C$PNTB= 000014      DU.INF= 030000      EF.RES= 000037 G
```

Symbol table

```
EF.SEX= 000020          ERRLOG  016634          F$MOD = 000000          HC.MPK= 000020          INF602  010320
EF.STA= 000040 G        ERRLO   016734          F$MSG = 000011          HC.MSG= 000004          INF603  010405
EMPTY   002512 G        ERRL1   016772          F$PROT= 000021          HC.PSZ= 000060          INIPAR  023160
EMSTAT  002354 G        ERRL2   017066          F$PWR = 000017          HC.RSZ= 000004          INISWP  022206
ENBERR  002162 G        ERRL3   017224          F$RPT = 000012          HC.SIZ= 000164          INITAC  030140
ENBRPL  002160 G        ERRL4   017462          F$SEG = 000003          HDR001  010472          INITBL  037422
ENBWFE  002164 G        ERRME1  014427          F$SOFT= 000005          HDR101  010667          INITRW  030074
ENDREF  002350 G        ERRMSG  002172 G        F$SRV = 000010          HDR201  011314          INTCPK  030626
ENTRYS= 000200 G        ERRNBR  002170 G        F$SUB = 000002          HDR301  012043          INTRCV  002332 G
ERFLAG  002364 G        ERRREF  002360 G        F$SW  = 000014          HDR401  012663          INTSRV  016216 G
ERLAST  016630           ERRSTE  002550 G        F$TEST= 000001          HDR501  013107          INVCHR  014340
ERLDS   002406 G        ERRTYP  002166 G        F.CRLF  014215          HDR601  013173          IPVAL   002322 G
ERLEXI  017514           ERR.SZ= 000010          F.TEXT  014220          HDR701  013731          ISR   = 000100 G
ERLFMT  002372 G        ERR.TB  016134          GBCNT   002566 G        HELP  = 000000          ISSUE   030204
ERLLBN  002374 G        ERR001  015220 G        GETCDN  033730          HLPFIL  014672          IXE   = 004000 G
ERLMSG  004020 G        ERR101  015266 G        GETCHR  023070          HOE   = 100000 G        I$AU  = 000041
ERLPSI= 000005          ERR201  015336 G        GETCNT  033664          H.BRL = 000004          I$AUTO= 000041
ERLPTB  016616          ERR300  015406 G        GETCNX  033670          H.BST = 000006          I$CLN = 000041
ERLVAL  004026 G        ERR301  015504 G        GETCXX  033736          H.DRV = 000010          I$DU  = 000041
ERM001  010527          ERR302  015570 G        GETLBN  023410          H.UBA = 000000          I$HRD = 000041
ERM101  010727          ERR401  015650 G        GETLOG  023126          H.VEC = 000002          I$INIT= 000041
ERM102  011061          ERR601  015720 G        GETVSN  032022          IBE   = 010000 G        I$MOD = 000041
ERM103  011145          ERR701  015770 G        GLBN    002562 G        IBUFF   044472 G        I$MSG = 000041
ERM104  011240          EVENT   002362 G        GRPSIZ= 000200 G        IDU   = 000040 G        I$PROT= 000040
ERM201  011346          EVL   = 000004 G        GTDRVT  032136          IER   = 020000 G        I$PTAB= 000041
ERM202  011453          EXIT10  025600          G$CNTO= 000200          INCARN= 000040 G        I$PWR = 000041
ERM203  011711          EXIT11  026122          G$DELM= 000372          INCRLB  002554 G        I$RPT = 000041
ERM204  011743          EXIT12  026520          G$DISP= 000003          INF100  004362          I$SECT= 000000
ERM300  012076          EXIT13  026612          G$EXCP= 000400          INF101  004546          I$SEG = 000041
ERM301  012137          EXIT15  026750          G$HILI= 000002          INF102  004603          I$SETU= 000041
ERM302  012202          EXIT16  027122          G$LOLI= 000001          INF103  004731          I$SFT = 000041
ERM303  012246          EXIT17  027214          G$NO  = 000000          INF110  005016          I$SRV = 000041
ERM304  012313          EXIT3   024770          G$OFFS= 000400          INF111  005165          I$SUB = 000041
ERM305  012361          EXIT4   025126          G$OFSI= 000376          INF200  005271          I$TST = 000041
ERM306  012526          EXIT5   025174          G$PRMA= 000001          INF201  005343          J$JMP = 000167
ERM307  012617          EXIT6   025340          G$PRMD= 000002          INF202  005725          KTMEM   002226
ERM401  012727          EXIT9   025450          G$PRML= 000000          INF210  006170          KW.BRL  002212
ERM402  013000          EXTMSK  002370 G        G$RADA= 000140          INF211  006244          KW.CSR  002210
ERM403  013050          E$END = 002100          G$RADB= 000000          INF212  006332          KW.EL   002220
ERM501  013125          E$LOAD= 000035          G$RADD= 000040          INF213  006420          KW.HZ   002216
ERM601  013216          FEF   = 000200 G        G$RADL= 000120          INF220  006452          KW.OUT= 000105 G
ERM602  013242          FERCNT  002530 G        G$RADO= 000020          INF221  006523          KW.VEC  002214
ERM603  013267          FFREE   002176 G        G$XFER= 000004          INF301  007002          KW11I   016174 G
ERM604  013334          FLAGS   002356 G        G$YES = 000010          INF302  007027          LBN     002446 G
ERM605  013402          FMERR   040100          HADDR   002400 G        INF310  007061          LBNDX   002522 G
ERM606  013472          FMT.AS  014223          HCECNT  002532 G        INF311  007135          LBNLO = 000014 G
ERM607  013621          FSIZE   002200 G        HCOM    002324 G        INF320  007164          LBNSTA  002516 G
ERM700  013763          F$AU  = 000015          HCOMM   040004          INF321  007242          LF    = 000012 G
ERM701  014024          F$AUTO= 000020          HC.CCT= 000012          INF322  007630          LINBUF  002716
ERM702  014062          F$BGN = 000040          HC.CEV= 000100          INF323  010043          LMT28   014277
ERM703  014130          F$CLEA= 000007          HC.CMD= 000010          INF324  010065          LOADFL  002202 G
ERM704  014157          F$DU  = 000016          HC.CPK= 000104          INF401  010114          LOE   = 040000 G
ERRBLK  002174 G        F$END = 000041          HC.ESZ= 000004          INF405  010166          LOG   = 000001
ERRC    033632          F$HARD= 000004          HC.INT= 000000          INF406  010206          LOGMSG= 023146
ERRCNT  002475 G        F$HW  = 000013          HC.ISZ= 000004          INF407  010224          LOGRPL= 023142
ERRD    033644          F$INIT= 000006          HC.MCT= 000006          INF408  010243          LOT   = 000010 G
ERRFMT  002366 G        F$JMP = 000007          HC.MEV= 000014          INF601  010264          LPNT    033302
```

Symbol table

```
LPNTB   033254          L$UNIT  002012 G        MD.SCL= 002000          OP.ESP= 000002          P.CPSP= 000042
LPNTF   033244          L.BADR= 000030 G        MD.SEC= 000100          OP.FLU= 000023          P.CRF = 000000
LPNTS   033274          L.CRF = 000000 G        MD.SEQ= 000020          OP.GCS= 000002          P.CTMO= 000020
LPNTX   033264          L.DS  = 000060 G        MD.SER= 000400          OP.GSS= 000001          P.CYLS= 000050
L$ACP   002110 G        L.EVNT= 000012 G        MD.SPD= 000001          OP.GUS= 000003          P.DEXT= 000014
L$APT   002036 G        L.FLGS= 000011 G        MD.SSH= 000200          OP.MRD= 000030          P.DFLG= 000017
L$AU    040306 G        L.FMT = 000010 G        MD.SWP= 000004          OP.MWR= 000031          P.DMDT= 000024
L$AUT   002070 G        L.HDCD= 000050 G        MD.VOL= 000002          OP.ONL= 000011          P.DPRG= 000020
L$AUTO  040122 G        L.SDI = 000054 G        MD.WBN= 000100          OP.RD = 000041          P.DTMO= 000024
L$CCP   002106 G        L10000  002144          MD.WBV= 000400          OP.RLC= 000103          P.ELGF= 000034
L$CLEA  040124 G        L10001  002166          MINLBN  002600 G        OP.RPL= 000024          P.FBBK= 000034
L$CO    002032 G        L10002  015264          MODEL   003244          OP.RSD= 000005          P.FLGS= 000011
L$DEPO  002011 G        L10003  015334          MSCP  = 000000          OP.SCC= 000004          P.GRPS= 000046
L$DESC  004324 G        L10004  015404          MSCPMS  003330 G        OP.SEX= 000007          P.HSTI= 000020
L$DESP  002076 G        L10005  015502          MSCPND  004226          OP.SHC= 000102          P.HTMO= 000020
L$DEVP  002060 G        L10006  015566          MSCPTB  004230          OP.SSD= 000004          P.LBN = 000034
L$DISP  002124 G        L10007  015646          MSCPVA  003350 G        OP.SUC= 000012          P.MEDI= 000034
L$DLY   002116 G        L10010  015716          MSGADR= 023456          OP.WR = 000042          P.MLUN= 000014
L$DTP   002040 G        L10011  015766          MSGBRL  042261          OSTRE   033422          P.MOD = 000012
L$DTYP  002034 G        L10012  016040          MSGBST  042272          OSTRNG  033352          P.MODE= 000032
L$DU    040146 G        L10013  016162          MSGLDR  042314          O$APTS= 000000          P.OPCD= 000010
L$DUT   002072 G        L10014  016172          MSGPCK  002330 G        O$AU  = 000000          P.OTRF= 000014
L$DVTY  004300 G        L10015  016214          MSGUBA  042224          O$BGNR= 000001          P.OVRL= 000034
L$EF    002052 G        L10016  016222          MSGVEC  042252          O$BGNS= 000000          P.RBN = 000014
L$ENVI  002044 G        L10017  035716          MULT    034542          O$DU  = 000001          P.RBNS= 000056
L$ERRT  002166 G        L10021  040120          MULTRD  027224          O$ERRT= 000001          P.RCTC= 000057
L$ETP   002102 G        L10022  040122          MULTWR  027514          O$GNSW= 000001          P.RCTS= 000054
L$EXP1  002046 G        L10023  040144          M.RA60= 000004          O$POIN= 000001          P.RGID= 000034
L$EXP4  002064 G        L10024  040304          M.RA80= 000001          O$SETU= 000001          P.RGOF= 000040
L$EXP5  002066 G        L10025  040312          M.RA81= 000005          PB      033146          P.SHST= 000042
L$HARD  042146 G        L10026  040622          M.RA82= 000013          PF      033122          P.SHUN= 000040
L$HIME  002120 G        L10027  042142          M.UNKN= 000000          PHASE   002560 G        P.STS = 000012
L$HPCP  002016 G        L10030  042224          NCONF   033406          PNT   = 001000 G        P.TIME= 000024
L$HPTP  002022 G        L10031  042326          NCONS   033362          PNTNUM  033742          P.TRKS= 000044
L$HW    002132 G        L10032  047502          NDX.AC= 000002          PNTNUS  033750          P.UADR= 000020
L$ICP   002104 G        L10034  047514          NDX.RD= 000000          PRI   = 002000 G        P.UNFL= 000016
L$INIT  035726 G        MANDIS  014473          NDX.RP= 000003          PRIMRY  002434 G        P.UNIT= 000004
L$LADP  002026 G        MANRPL  002150 G        NDX.WR= 000001          PRINTC  033066          P.UNSZ= 000044
L$LAST  047476 G        MATBLK  002500 G        NXMAD   002224          PRI00 = 000000 G        P.UNTI= 000024
L$LOAD  002100 G        MATFLG  002514 G        NXMI    016154 G        PRI01 = 000040 G        P.USEF= 000022
L$LUN   002074 G        MATOFF  002504 G        NXTSTE  002546 G        PRI02 = 000100 G        P.VRSN= 000014
L$MREV  002050 G        MATRBN  002462 G        OLIMIT  014367          PRI03 = 000140 G        P.VSER= 000050
L$NAME  002000 G        MAXLBN  002604 G        ONEFIL= 000001          PRI04 = 000200 G        P1    = 100000 G
L$PRIO  002042 G        MDLNDX  003246          ONLINE  002612 G        PRI05 = 000240 G        P2    = 040000 G
L$PROT  035720 G        MDLSIZ= 000012          OPCODE  002344 G        PRI06 = 000300 G        RA60    003311
L$PRT   002112 G        MDLTBL  003250          OPHELP  002146 G        PRI07 = 000340 G        RA80    003304
L$REPP  002062 G        MDLTEX  003262          OPTIN   002714 G        PS      033216          RA81    003316
L$REV   002010 G        MD.CMP= 040000          OP.ABO= 000001          PTABLE  002302 G        RA82    003323
L$RPT   035132 G        MD.CWB= 000010          OP.ACC= 000020          PTYPE   033350          RBN     002452 G
L$SOFT  042326 G        MD.ERR= 010000          OP.AVA= 000100          PX      033172          RBNLO = 000020 G
L$SPC   002056 G        MD.EXP= 100000          OP.AVL= 000010          P.BCNT= 000014          RBNS    002422 G
L$SPCP  002020 G        MD.FEU= 000001          OP.CCD= 000021          P.BUFF= 000020          RCTBLK  002476 G
L$SPTP  002024 G        MD.IMF= 000002          OP.CMP= 000040          P.CLAS= 000033          RCTCOP  002424 G
L$STA   002030 G        MD.NXU= 000001          OP.DUP= 000101          P.CMST= 000020          RCTERR  016370
L$SW    002146 G        MD.PRI= 000001          OP.ELP= 000003          P.CNCL= 000022          RCTLBN  002456 G
L$TEST  002114 G        MD.RIP= 000001          OP.END= 000200          P.CNTF= 000016          RCTMAS  002426 G
L$TIML  002014 G        MD.SCH= 004000          OP.ERS= 000022          P.CNTI= 000024          RCTMSG  003660 G
```

Symbol table

```
RCTOFF  002502 G    SA.STP= 100000      SVCGBL= 000000      T$FLAG= 000040      UNKNOW  003274
RCTSIZ  002416 G    SA.S1 = 004000      SVCINS= 000000      T$FREE= 047514      UNSIZ   002430 G
RCTTBL  002312 G    SA.S2 = 010000      SVCSUB= 000000      T$GMAN= 000000      UNUSE   002440 G
RCTVAL  003670 G    SA.S3 = 020000      SVCTAG= 000000      T$HILI= 000377      VBUFF1  002473 G
RDCNT   002556 G    SA.S4 = 040000      SVCTST= 000000      T$LAST= 000001      VBUFF2  002474 G
RDSTAT  002524 G    SA.TST= 100000      SWMSG0  022525      T$LOLI= 000000      VIBUFF  002472 G
RDVALD  002470 G    SA.VCE= 000177      SWMSG1  022553      T$LSYM= 010000      VOLSN = 000000 G
READLB  023604      SA.VEC= 000177      SWMSG2  022613      T$LTNO= 000002      VSNBUF  002620 G
RECOVR  002466 G    SA.WRP= 040000      SWMSG3  022644      T$NEST= 177777      VSNPTR  002616 G
REPEAT  002610 G    SB.DST= 000150      SWMSG4  022707      T$NS0 = 000000      VWP   = 000002 G
REPLAC  024156      SB.ECC= 000350      SWMSG5  022753      T$NS1 = 000005      W     = 000000
REPLY   002654 G    SB.HCE= 000110      SWMSG6  022777      T$PCNT= 000000      WAIT    031072
RESCAN  002513 G    SCNDRY  002436 G    SWMSG7  023024      T$PTAB= 010033      WBC   = 000001 G
RESET   016224      SEARCH  031400      S$LSYM= 010000      T$PTHV= 000001      WFECNT  002542 G
RFLAGS= 000010 G    SETTO   034334      TBLNDX  002300 G    T$PTNU= 000001      WRSTAT  002526 G
RG.FLG= 040000      SFLAG   002515 G    TBUFF   043472 G    T$SAVL= 177777      XACCES  004257
RG.OWN= 100000      SFPTBL  002146 G    TF.BAD= 100000 G    T$SEGL= 177777      XBLOCK  003700
RNTIM   014233      SNDCMD  030744      TF.BBR= 000200 G    T$SIZE= 000007      XCMDRF  003370
RNTIME  020650      SND.S1  037424      TF.BBU= 000100 G    T$SUBN= 000000      XCODE   003421
RNTIMX  021036      SND.S2  037430      TF.DST= 000004 G    T$TAGL= 177777      XCOPY   003732
RNTIM1  014266      SND.S3  037434      TF.ECC= 000010 G    T$TAGN= 010035      XDAINT  036670
RNTIM2  014274      STATBL  020624      TF.FER= 000001 G    T$TEMP= 000000      XDAIST  037200
RPLSTA  002520 G    STATUS  002442 G    TF.HCE= 000002 G    T$TEST= 000002      XDARSD  040002
RSP.CK  037542      STEP    002544 G    TF.LOG= 000040 G    T$TSTM= 177777      XDARSP  037606
RSP.S1  037440      STEPER  024226      TF.SEX= 000020 G    T$TSTS= 000001      XDASRV  016164 G
RSP.S2  037452      STEPFT  024250      TF.WFE= 000400 G    T$$AU = 010025      XDCODE  004112
RSP.S3  037472      STEPSI= 000044      TIMDAT= 000044 G    T$$AUT= 010022      XDHEX   004217
RSP.S4  037510      STEPTB  024112      TINDEX= 000012      T$$CLE= 010023      XDINFO  004152
RTFLAG  002204 G    STEP10  025460      TMPSTA  002444 G    T$$DAT= 010034      XECODE  003537
SADDR   002314 G    STEP11  025610      TRKSIZ  002420 G    T$$DU = 010024      XENDRF  003506
SAEXP   002320 G    STEP12  026132      TTYIN   002666 G    T$$HAR= 010030      XESTAT  003625
SARMSG  003116 G    STEP13  026530      TTYOUT  033242      T$$HW = 010000      XEVENT  004034
SARVAL  003126 G    STEP15  026640      TXT000  014705      T$$INI= 010021      XEVNT   004035
SAVAL   002316 G    STEP16  026760      TXT001  014762      T$$MSG= 010012      XFLAGS  003572
SA.BST= 000374      STEP17  027132      TXT002  014767      T$$PC = 000001      XHADDR  004063
SA.CMD= 034000      STEP3   024260      TXT005  014774      T$$PRO= 010020      XLBN    014575
SA.CME= 000070      STEP4   024772      TXT006  015031      T$$PTA= 010033      XMOD    003454
SA.CM1= 004000      STEP5   025136      TX.BBR  015150      T$$RPT= 010017      XOFF  = 000023 G
SA.CNT= 000360      STEP6   025204      TX.BBU  015155      T$$SOF= 010031      XON   = 000021 G
SA.CTP= 003400      STEP9   025350      TX.BLK  015174      T$$SRV= 010016      XPHASE  003764
SA.DI = 000400      STROFF  002506 G    TX.DST  015213      T$$SW = 010001      XRBN    014615
SA.ERC= 003777      ST.ABO= 000002      TX.ECH  015143      T$$TES= 010027      XRCT    014537
SA.ERR= 100000      ST.AOL= 000400      TX.FER  015136      T1      040314 G    XREAD   004242
SA.GO = 000001      ST.AVL= 000004      TX.HCE  015206      T2      040624 G    XREPLA  004267
SA.INE= 000200      ST.CMD= 000001      TX.LB1  015060      UADR    002340 G    XSADDR  003165
SA.INT= 000200      ST.CMP= 000007      TX.LB2  015100      UAM   = 000200 G    XSAEXP  003214
SA.LFC= 000002      ST.CNT= 000012      TX.LOG  015167      UF.CMR= 000001      XSAVAL  003136
SA.MCV= 000017      ST.DAT= 000010      TX.PRI  015117      UF.CMW= 000002      XSTAT   003626
SA.MP = 000100      ST.DIA= 000037      TX.SEC  015124      UF.INA= 040000      XSTEP   014635
SA.MSE= 000007      ST.DRV= 000013      TX.SEX  015162      UF.RPL= 100000      XWRITE  004250
SA.MSG= 003400      ST.HST= 000011      TX.UNS  015131      UF.SCH= 004000      X$ALWA= 000000
SA.MS1= 000400      ST.MFE= 000005      TX.WFE  015201      UF.SCL= 002000      X$FALS= 000040
SA.NV = 002000      ST.MSK= 000037      TYPSTA  020002      UF.WBN= 000100      X$OFFS= 000400
SA.NVE= 000400      ST.OFL= 000003      T$ARGC= 000002      UF.WPH= 020000      X$TRUE= 000020
SA.PRG= 000001      ST.SUB= 000040      T$CODE= 004052      UF.WPS= 001000      $MUL  = 000037
SA.QB = 001000      ST.SUC= 000000      T$ERRN= 000457      JF.576= 000004      $PATCH  042326 G
SA.STE= 000200      ST.WPR= 000006      T$EXCP= 000000      UNITIN  021050
```

Symbol table

. ABS. 047514   000   (RW,I,GBL,ABS,OVR)
Errors detected: 0

*** Assembler statistics

Work file reads: 986
Work file writes: 860
Size of work file: 38688 Words (152 Pages)
Size of core pool. 14080 Words (55 Pages)
Operating system: RT-11 (Under RTEM-11)

Elapsed time: 00:05:30.00
ZUDLA0.BIN/DS:GBL/EN:ABS:AMA,ZUDLA0/CR=SVC35R/ML,ZUDLA0.MAC

CZUDLA0 BBR Replacement Utility MACRO Y05.03c Friday 19-Apr-85 10:42 Page S-1
Cross reference table (CREF V05.03)

```
$MUL     92-22    92-22#
$PATCH  145-17#
ACCESS   21-89#   65-16*   65-17*  142-32*  142-33
ADR       5-9#
ALOCM    59-34   123-32   125-10   126-8    127-9    131-16   132-17#
ARG.CT   36-12    36-12    36-12    36-12#   36-12#   36-12#   36-13    36-13    36-13    36-13#   36-13#   36-13#   36-27    36-27
         36-27#   36-27#   37-11    37-11    37-11#   37-11#   37-36    37-36    37-36    37-36    37-36#   37-36#   37-36#   37-36#
         37-36#   37-36#   37-59    37-59    37-59    37-59    37-59#   37-59#   37-59#   37-59#   37-80    37-80    37-80    37-80
         37-80#   37-80#   37-80#   37-80#   38-11    38-11    38-11#   38-11#   38-32    38-32    38-32#   38-32#   39-11    39-11
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         46-44#   46-44#   46-45    46-45    46-45    46-45#   46-45#   46-45#   48-20    48-20    48-20    48-20    48-20#   48-20#
         48-20#   48-20#   49-17    49-17    49-17    49-17    49-17#   49-17#   49-17#   49-17#   49-18    49-18    49-18    49-18#
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         53-57    53-57    53-57#   53-57#   53-57#   53-57#   53-58    53-58    53-58    53-58#   53-58#   53-58#   54-7     54-7
         54-7     54-7     54-7#    54-7#    54-7#    54-7#    54-8     54-8     54-8     54-8#    54-8#    54-8#    54-17    54-17
         54-17    54-17    54-17#   54-17#   54-17#   54-17#   54-18    54-18    54-18    54-18#   54-18#   54-18#   55-12    55-12
         55-12    55-12    55-12#   55-12#   55-12#   55-12#   55-13    55-13    55-13    55-13#   55-13#   55-13#   55-22    55-22
         55-22    55-22    55-22#   55-22#   55-22#   55-22#   55-23    55-23    55-23    55-23#   55-23#   55-23#   56-25    56-25
         56-25    56-25#   56-25#   56-25#   56-29    56-29    56-29    56-29#   56-29#   56-29#   56-34    56-34    56-34    56-34#
         56-34#   56-34#   59-58    59-58    59-58    59-58    59-58    59-58    59-58#   59-58#   59-58#   59-58#   59-58#   59-58#
         59-62    59-62    59-62    59-62    59-62    59-62    59-62#   59-62#   59-62#   59-62#   59-62#   59-62#   60-8     60-8
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         66-49    66-49    66-49    66-49    66-49#   66-49#   66-49#   66-49#   98-21    98-21    98-21    98-21#   98-21#   98-21#
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        117-68   117-68   117-68   117-68   117-68   117-68   117-68   117-68   117-68#  117-68#  117-68#  117-68#  117-68#  117-68#
        117-68#  117-68#  117-73   117-73   117-73   117-73   117-73   117-73   117-73#  117-73#  117-73#  117-73#  117-73#  117-73#
        117-78   117-78   117-78#  117-78#  118-7    118-7    118-7    118-7#   118-7#   118-7#   118-15   118-15   118-15   118-15
        118-15   118-15#  118-15#  118-15#  118-15#  118-15#  118-24   118-24   118-24   118-24#  118-24#  118-24#  118-33   118-33
        118-33   118-33   118-33   118-33   118-33#  118-33#  118-33#  118-33#  118-33#  118-33#  121-12   121-12   121-12#  121-12#
        123-8    123-8    123-8#   123-8#   135-13   135-13   135-13   135-13#  135-13#  135-13#  135-16   135-16   135-16   135-16#
        135-16#  135-16#  137-13   137-13   137-13#  137-13#  137-56   137-56   137-56#  137-56#  138-9    138-9    138-9#   138-9#
        138-10   138-10   138-10#  138-10#  138-11   138-11   138-11#  138-11#  138-32   138-32   138-32#  138-32#  142-36   142-36
        142-36   142-36   142-36#  142-36#  142-36#  142-36#  143-3    143-3    143-3    143-3    143-3#   143-3#   143-3#   143-3#
ASSEMB    1-I02    1-I02
AUTORC    4-14#   61-15    62-38
B.BLOC   26-5#    26-9
B.CMDR   25-5#    88-103
B.CODE   25-6#
B.COPY   26-6#    26 9
B.DCOD   27-7#
B.DERR   27-8#
B.ECOD   25-9#
B.EMRE   25-8#    88-103
B.ESTA   25-11#   25-13    58-12    58-41    59-12
B.EVNT   27-5#    47-44    48-5     48-17    50-17    51-5
B.FLAG   25-10#   25-13
B.HADD   27-6#
```

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```
B.MOD   25-7#
B.MSCP  25-13#  73-39   79-41   79-75   79-85   82-46   84-40   85-39   85-58   88-79   88-103  88-110  139-39
B.PHAS  26-7#   70-30
B.RCT   26-9#
B.SADD  23-5#   45-33   88 87   88-95   128-69  129-35  129-118 130-43  130-53
B.SAEX  23-7#   129-118 130-43
B.SAVA  23-6#   88-87   88-95   128 69  129-118 130-43  130-53
BACKMS  62-71#  123-9
BACKUP  22-4#   123-10  123-13  127-25
BADRBN  18-7#   71-8    71-9    77-42*  77-43*
BASEMS  21-81#  36-12   36-27   37-11   37-59   37-80   38-11   38-32   39-11   45-32*  47-45*  48-6*   48-18*  50-18*
        51-6*   52-40*  58-11*  58-21*  58-40*  59-11*  70-31*  73-38*  76-36*  79-40*  79-74*  79-84*  82-45*  84-39*
        84-66*  85-38*  85-57*  85-79*  88-78*  88-86*  88-94*  88-102* 88-109* 98-35*  128-68* 128-94* 129-34* 129-117*
       130-42* 130-52* 132-33* 139-38*
BBRCNT  21-74#  54-19*  65-39*  117-68
BCNT    20-9#   86-27   86-28   109-15  110-15
BELL    29-17
BIT0     5-9#   15-24   18-15   21-53   23-5    25-5    26-5    27-5
BIT00    5-9    5-9#
BIT01    5-9    5-9#
BIT02    5-9    5-9#
BIT03    5-9    5-9#
BIT04    5-9    5-9#
BIT05    5-9    5-9#
BIT06    5-9    5-9#
BIT07    5-9    5-9#
BIT08    5-9    5-9#
BIT09    5-9    5-9#
BIT1     5-9#   15-23   18-16   21-54   23-6    25-6    26-6    27-6
BIT10    5-9#   15-15
BIT11    5-9#   15-14
BIT12    5-9#   15-13   78-57   98-70
BIT13    5-9#   15-12   18-18   78-54   94-72   98-63   98-70
BIT14    5-9#   15-11   18-19   78-89   98-78
BIT15    5-9#   14-14   15-10   18-20   21-62   107-30
BIT2     5-9#   14-20   15-22   21-55   23-7    25-7    26-7    27-7
BIT3     5-9#   14-18   15-21   21-56   25-8    27-8
BIT4     5-9#   14-16   15-20   21-57   25-9
BIT5     5-9#   14-15   15-19   21-58   25-10
BIT6     5-9#   15-18   21-59   25-11
BIT7     5-9#   18-17   21-60
BIT8     5-9#   15-17   21-61
BIT9     5-9#   15-16
BITTBL  53-54   53-60   55-30#
BLD28  116-11#
BLDCMD  88-28   89-32#
BLKCNT  21-88#  141-6   142-19* 142-30*
BLKSIZ  17-4#   20-9    138-58* 142-21
BOE      5-9#
BRF     18-18#  71-5    77-41
BUFF1   78-50   81-28   145-22#
BUFF2   78-86   81-36   145-23#
BUSFLA  21-94#  120-40*
C$AU     1-I02# 136-15
C$AUTO   1-I02# 133-12
C$BRK    1-I02# 45-20   91-35   129-15  130-33  139-4
```

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```
C$BSEG   1-I02#
C$BSUB   1-I02#
C$CLCK   1-I02# 121-7    121-9
C$CLEA   1-I02# 134-17
C$CLOS   1-I02#  97-58
C$CLP1   1-I02#
C$CPBF   1-I02#
C$CPME   1-I02#
C$CVEC   1-I02#  45-37   129-30
C$DCLN   1-I02# 123-16   127-28   132-35
C$DODU   1-I02# 137-71   137-77   143-23
C$DRPT   1-I02# 137-57   143-6
C$DU     1-I02# 135-26
C$EDIT   1-I02#   1-I25
C$ERDF   1-I02#  45-34    47-46    48-7     48-19    50-19    51-7     52-42    58-13    58-23    59-13    84-68    85-81    88-80
        88-88    88-96    88-104   88-111   128-70   128-95   129-36   129-119  130-44   130-54   139-40
C$ERHR   1-I02#  58-42    73-40    76-38    79-42    79-76    79-86    82-47    84-41    85-40    85-59
C$ERRO   1-I02#
C$ERSF   1-I02# 13#
C$ERSO   1-I02#  70-82    98-36
C$ESCA   1-I02#
C$ESEG   1-I02#
C$ESUB   1-I02#
C$ETST   1-I02# 137-82   143-32
C$EXIT   1-I02# 127-34   134-13   137-7    137-11   137-72   137-78   138-7    143-28
C$FREQ   1-I02#
C$FRME   1-I02#
C$GETB   1-I02#  97-37
C$GETW   1-I02#
C$GMAN   1-I02#  61-20    63-28    64-27    66-33
C$GPHR   1-I02# 124-24
C$GPRI   1-I02#
C$INIT   1-I02# 132-39
C$INLP   1-I02#
C$MANI   1-I02# 124-7    137-9    138-34
C$MAP    1-I02#
C$MEM    1-I02# 120-34   123-18
C$MMU    1-I02#
C$MSG    1-I02#  36-16    36-37    37-21    37-46    37-69    37-90    38-21    38-42    39-18
C$OPNR   1-I02#  97-28
C$OPNW   1-I02#
C$PNTB   1-I02#  97-85    99-20
C$PNTF   1-I02#  99-18
C$PNTS   1-I02#  99-24
C$PNTX   1-I02#  99-22
C$PUTB   1-I02#
C$PUTW   1-I02#
C$QIO    1-I02#
C$RDBU   1-I02# 120-37
C$REFG   1-I02# 122-5    122-10   122-15
C$REL    1-I02#
C$RESE   1-I02#   1-I02# 120-28
C$REVI   1-I02#   1-I25
C$RFLA   1-I02#
C$RPT    1-I02# 118-52
C$SEFG   1-I02#
```

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```
C$SPRI    1-102# 127-30
C$SVEC    1-102# 45-18    57-44    121-19   129-27
C$TOME    1-102#
C.BST    14-25#  128-100
C.DRVN   14-26#   36-12    59-58    89-51
C.DRVT   14-31#   96-14   125-13*  126-4    126-9*
C.FLG    14-29#   88-39*   90-44*   91-28    91-54*  125-31*  129-104* 129-107*
C.HCOM   14-30#  125-12*
C.JAD    14-28#
C.JSR    14-27#   57-41
C.REF    14-34#  125-34*
C.SIZE   14-36#  125-9
C.TO     14-32#   91-23    91-42   125-32*  130-24   130-39
C.TOH    14-33#   91-39   125-33*  130-36
C.UADR   14-23#  129-25
C.VEC    14-24#   57-34
CACHES   17-3#    52-37   118-37   127-8    127-15
CACHID   18-8#    80-30    83-28
CACHLS   19-28#  123-23   127-5    127-10*
CACHTB   19-33#   52-22   118-24   118-27   127-14*
CACHTS   52-20#  137-41   140-8    141-24
CALBLK   78-30    78-66    93-23#   94-40
CALR1    36-31    37-15    37-40    37-63    37-84    38-15    38-36    40-11#   41-27
CALR2    40-32#   41-28
CALR3    40-39#   41-29
CALR4    41-5#    41-30
CALR5    41-12#   41-31
CALR6    41-19#   41-32    41-33    41-34
CALRBN   92-20#   94-67    94-80    98-46
CF.576   10-42#
CF.ATN   10-37#
CF.MSC   10-38#
CF.OTH   10-39#
CF.SHD   10-41#
CF.THS   10-40#   58-35
CHRMSG   63-21*   63-24#   63-28
CHRRPL   63-22*   63-25#   63-28    63-30
CLKFLG   19-11#
CLOG    112-11#  128-32   128-40
CLRBUF   73-29    84-31   109-12#
CMDIN    22-9#
CMDMOD   20-16#   25-32    67-36*   67-72*   79-36*   79-46*   79-5?*   82-33*   84-30*   84-59*   85-30*   85-49*   85-72*   89 43
        139-14*
CMDPCK   20-5#   131-24*
CMDREF   20-14#   25-30    65-44*   88-60    90-24*   90-25
CMPUUT  135-13   135-21#
CNTTBL   53-59*   55-44#
CNV28    66-36   117-17#
CON.A   102-15#  105-51
CON.A1  102-17#  102-20
CON.A2  102 18   102-21#
CON.D   102-25#  105-51
CON.H   102-31#  105-51
CON.N   103-10#  105-51
CON.N1  103-11#  103-13
CON.O   103-4#   105-51
```

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```
D.PAT    15-27#
D.RET    15-16#
D.RO     15-14#
D.SEQ    15-18#
D.SERN   16-13#
D.SIZE   16-15#  126-7    126-13
D.TR     15-20#
D.WC     15-21#
D.WCA    15-22#
D.WO     15-15#
DBM01   118-7    118-43#
DBM02   118-15   118-45#
DBM03   118-24   118-47#
DBM04   118-33   118-49#
DBUFF    20-10    59-49    60-6     69-28    69-34    75-25    75-31    75-47    76-27    77-32    78-49    78-85    98-27   145-19#
DCODE    20-36#   50-31*   50-32
DEBUG    22-3#    51-11   117-75   138-37   143-7
DELTA    21-37#   94-51*   94-55    94-96*   94-98*   94-100
DEVNAM   34-10#   59-58   120-41*
DFPTBL    3-10#
DIAG      7-13#
DIAGMC    1-I02    1-I02
DIV10    95-37   114-20#
DIVIDE   56-20    56-22    56-24    71-16    93-27    94-35   107-40   108-8   113-17#  116-16   139-23
DRIVTB   19-32#
DRPUUT  135-16   135-22#
DSPDSC   98-17#  137-28   137-65   143-13
DSPHEL   62-25    97-22#
DSPRCT    4-16#   62-48   143-11
DSPRPL    4-15#   62-43
DSTCNT   21-72#   55-47    65-37*   117-68
DT.AVL   15-10#
DT.UNT   15-8#
DU.DFL   13-23#
DU.FTL   13-26#
DU.INF   13-24#
DU.QUE   13-22#
DU.SPC   13-27#
DU.TER   13-25#
DUP       7-14#
E$END     1-I02#
E$LOAD    1-I02#   1-I25
ECCCNT   21-73#   55-48    65-38*   117-68
ECODE    20-21#   25-34    88-43*   88-47    88-55    88-65
EF.BBR   10-29#   79 63   141-4
EF.BBU   10-30#
EF.CON    5-9#
EF.LOG   10-31#
EF.NEW    5-9#   122-15
EF.PWR    5-9#
EF.RES    5-9#   122-10
EF.SEX   10-32#
EF.STA    5-9#   122-5
EMPTY    21-38#   94-29*   94-66    94-71*
EMSTAT   20-22#   25-36    36-13    46-45    58-6     59-6     67-42    67-45    73-33    79-69    79-81    82-40    84 34    85 33
         85-52    88-41*   88-71   139-31
```

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```
ENBERR   4-18#   58-33    62-59
ENBRPL   4-17#   62-53    67-76    67 82    137-46   140-15   141-28
ENBWFE   4-19#   62-64    79-50    82-30
ENDREF  20-20#   25-33    88-40*   88-60
ENTRYS  17-6#    92-22    93-26    94-58    94-100   98-86
ERFLAG  20-29#
ERLAST  47-29#   49-9     49-11    49-14*   49-15*
ERLDS   20-37#   50-7     50-31    50-36
ERLEXI  47-47    48-8     48-21    50-42    51-9#
ERLFMT  20-33#   47-35*   47-37
ERLLBN  20-34#   49-4*    49-5*    49-9     49-11    49-14    49-15    49-17    49-17    50-4*    50-5*    50-21    50-21
ERLMSG  27-12#
ERLPSI  47-27#   47-38
ERLPTB  47-20#   47-27    47-52
ERLVAL  27-19#
ERM001  32-7#    132-33
ERM101  32-13#   129-34
ERM102  32-15#   45-32    128-68   129-117  130-42   130-52
ERM103  32-16#   128-94
ERM104  32-17#
ERM201  32-22#   58-11
ERM202  32-24#   58-40
ERM203  32-28#   59-11
ERM204  32-29#   58-21
ERM300  32-35#   37-36
ERM301  32-36#   73-38
ERM302  32-37#   79-74    82-45
ERM303  32-38#   139-38
ERM304  32-39#   79-40
ERM305  32-40#   79-84
ERM306  32-42#   88-102
ERM307  32-43#   88-78
ERM401  33-5#    88-86
ERM402  33-6#    88-94
ERM403  33-7#    88-109
ERM501  33-12#
ERM601  33-17#   84-39
ERM602  33-18#   85-38    85-57    98-35
ERM603  33-19#   84-66
ERM604  33-20#   85-79
ERM605  33-21#   70-31
ERM606  33-22#   76-36
ERM607  33-24#   52-40
ERM700  33-30#   47-45
ERM701  33-31#   48-6
ERM702  33-32#   48-18
ERM703  33-33#   50-18
ERM704  33-34#   51-6
ERR.SZ  41-36#   103-20
ERR.TB  41-27#   41-36    103-23
ERR001  36-7#    58-13    58-23    58-42    59-13    98-36    132-34
ERR101  36-23#   45-34    128-70   128-95   129-36   129-119  130-44   130-54
ERR201  37-7#
ERR300  37-28#
ERR3C1  37-53#   73-40    79-42    79-76    79-86    82-47    84-41    85-40    85-59    88-80    88 104
ERR3C2  37-76#   139-40
```

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```
ERR401  39-7#    88-88    88-96    88-111
ERR601  38-28#   52-42    70-32    76-38    84-68    85-81
ERR701  39-7#    47-46    48-7     48-19    50-19    51-7
ERRBLK  19-5#
ERRC    101-39   101-46   105-35#
ERRCNT  21-28#   84-26*   84-46*   85-25*   85-45*
ERRD    101 48   105-51#
ERRFMT  20-30#
ERRL0   47-21    48-3#
ERRL1   47-22    48-11#
ERRL2   47-23    49-3#
ERRL3   47-24    50-3#
ERRL4   47-25    51-3#
ERRLOG  47-31#   88-49
ERRME1  34-18#   101-44   103-26
ERRMSG  19-5#
ERRNBR  19-5#
ERRREF  20-27#
ERRSTE  21-80#
ERRTYP  19-5#
EVENT   20-28#   27-20    39-12    47-36*   49-18
EVL      5-9#
EXIT10  77-49#
EXIT11  78-63    78-93#
EXIT12  79-64    79-82    79-94#
EXIT13  80-39#
EXIT15  81-35    81-41#
EXIT16  82-38    82-43    82-50#
EXIT17  83-36#
EXIT3   70-16    72-16    72-19#
EXIT4   73-30    73-36    73-42#
EXIT5   74-28#
EXIT6   75-49#
EXIT9   76-34    76-41#
EXTMSK  20-31#   40-14    40-19*   45-33*   47-44*   48-5*    48-17*   50-17*   51-5*    52-41*   58-12*   58-22*   58-41*   59-12*
        70-30*   73-39*   76-37*   79-41*   79-75*   79-85*   82-46*   84-40*   84-67*   85-39*   85-58*   85 80*   88-79*   88-87*
        88-95*   88-103*  88-110*  128-69*  129-35*  129-118* 130-43*  130-53*  139-39*
F$AU     1-I02#  136-9    136-15
F$AUTO   1-I02#  133-10   133-12
F$BGN    1-I02#   1-I17    4-22     5-3      36-7     36-23    37-7     37-28    37-53    37-76    38-7     38-28    39-7     42-11
        43-20    44-6     44-11    67-102   117-56   117-62   119-9    120-26   127-34   133-10   134-8    134-13   135-8    136-9
       136-16   136-17   137-3    137-7    137-11   137-72   137-78   137-82   138-3    138-7    143-28   143-32   143-34   144-2
       144-12   145-12   145-26   146-2    146-3    146-3    146-9    146-10
F$CLEA   1-I02#  134-8    134-17
F$DU     1-I02#  135-8    135-26
F$END    1-I02    1-I02    1-I02    1-I02    1-I02    1-I02    1-I02    1-I02    1-I02    1-I02    1-I02    1 I02    1-I02
         1-I02    1-I02    1-I02#   1-I17    4-22     5-3      36-16    36-35    36-37    37-19    37-21    37-44    37-46    37-67
        37-69    37-88    37-90    38-19    38-21    38-40    38-42    39-16    39-18    42-13    43-23    44-10    44-13    67-102
       117-56   117-79   118-40   118-52   127-34   132-39   133-12   134-13   134-17   135-18   135-26   136-11   136-15   136-16
       136-17   137-3    137-3    137-3    137-7    137-11   137-72   137-78   137-82   137-82   138-3    138-3    138-3    138-7
       143 28   143-32   143-32   143-34   144-2    144-30   145-14   145-26   146-2    146-3    146-9    146-10
F$HARD   1-I02#  144-12   144-30
F$HW     1-I02#   3-10     3-17
F$INIT   1-I02#  120-26   132-39
F$JMP    1-I02#  36-35    36-35    37-19    37-19    37-44    37-44    37-67    37-67    37-88    37-88    38-19    38-19    38-40
        38-40    39-16    39-16    117-79   117-79   118-40   118-40   127-34   134-13   135-18   135-18   136-11   136-11   137-7
```

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```
        137-11   137-72   137-78   138-7    143-28
F$MOD     1-I02#   1-I17    4-22     5-3     67-102  117-56  136-16  136-17  143-34  144-2   145-26
F$MSG     1-I02#  36-7     36-16    36-23    36-37   37-7    37-21   37-28   37-46   37-53   37-69   37-76   37-90   38-7
         38-21    38-28    38-42    39-7     39-18
F$PROT    1-I02# 119-9    119-15
F$PWR     1-I02#
F$RPT     1-I02# 117-62   118-52
F$SEG     1-I02#
F$SOFT    1-I02# 145-12   145-14
F$SRV     1-I02#  42-11    42-13    43-20    43-23   44-6    44-10   44-11   44-13
F$SUB     1-I02#
F$SW      1-I02#   4-10     4-21
F$TEST    1-I02# 137-3    137-82   138-3    143-32
F.CRLF   34-5#    99-13
F.TEXT   34-6#    97-85    99-10
FEF      18-17#   70-22    75-40
FERCNT   21-70#   55-45    65-35*  117-68
FFREE    19-7#    59-32    59-36*  120-34*  120-35  123-18*  123-19  132-18  132-22*
FLAGS    20-23#   25-35    67-41    79-63    88-42*  141-4
FMERR   128-46   132-20   132-32#
FMT.AS   34-8#
FSIZE    19-8#    59-32    59-36*  120-35*  123-19*  128-44  132-19*
G$CNTO    1-I02#
G$DELM    1-I02#
G$DISP    1-I02#
G$EXCP    1-I02#
G$HILI    1-I02#
G$LOLI    1-I02#
G$NO      1-I02#
G$OFFS    1-I02#  61-20    63-28    64-27    66-33   144-21  144-23  144-25  144-27  144-29
G$OFSI    1-I02#  61-20    63-28    64-27    66-33   144-21  144-23  144-25  144-27  144-29
G$PRMA    1-I02# 144-21   144-23
G$PRMD    1-I02#  63-28    66-33   144-25   144-27   144-29
G$PRML    1-I02#  61-20    64-27
G$RADA    1-I02#  63-28    66-33
G$RADB    1-I02#
G$RADD    1-I02# 144-25   144-27   144-29
G$RADL    1-I02#  61-20    64-27
G$RADO    1-I02# 144-21   144-23
G$XFER    1-I02#
G$YES     1-I02#  61-20    63-28    64-27    66-33   144-21  144-23  144-25  144-27  144-29
GBCNT    21-87#   65-25*   65-26*   87-26    87-27   142-17*  142-18*  142-21*  142-22*  142-28*  142-29*
GETCDN  106-17   106-19   106-29#
GETCHR   62-31    63-20#
GETCNT  102-15   103-10   103-19   103-32   106-14#  107-16
GETCNX  106-16#  106-28
GETCXX  106-30   106-32#
GETLBN   66-20#  137-36   138-46   138-52
GETLOG   62-21    62-40    62-45    62-50    62-55   62-61   62-66   64-19#  123-12  137-24  137-62
GETVSN   59-56    95-21#
GLBN     21-86#   65-18*   65-19*   87-28    87-29   138-56*  138-57*  139-24*  139-25*  139-26  139-27  140-19*  140-20*  140-30*
        140-31*  141-6*   141-7*   141-15*  141-16*  141-32*  141-33*  141-43*  141-44*  142-7   142-11  142-36  142-36  143-3
        143-3
GRPSIZ   17-5#    21-88    138-58   142-15   142-30
GTDRVT   96-13#
H.BRL   125-20   144-16#  144-25   144-25   144-25
```

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```
IXE       5-9#
J$JMP     1-I02#  36-35    37-19    37-44    37 67    37-88    38-19    38-40    39-16    117-79   118-40   135-18   136-11
KTMEM    19-22#
KW.BRL   19-16#  121-16*
KW.CSR   19-15#   44-9*    56-14    91-37   121-11*  121-15*  121-20*  130-34
KW.EL    19-19#   44-7*    44-8*    56-17    56-18    65-28*   65-29*   91-39    91-42    111-26   111-27   111-28   121-5*   121-6*
        130-36   130-39
KW.HZ    19-18#   56-19   111-16   121-18*
KW.OUT   44-9    121-4    121-20
KW.VEC   19-17#  121-17*  121-19
KW11I    44-6#   121-19
L$ACP     1-I25#
L$APT     1-I25#
L$AU    136-9#
L$AUT     1-I25#
L$AUTO    1-I25  133-10#
L$CCP     1-I25#
L$CLEA    1-I25  134-8#
L$CO      1-I25#
L$DEPO    1-I25#
L$DESC    1-I25   29-25#
L$DESP    1-I25#
L$DEVP    1-I25#
L$DISP    1-I25    2-8#
L$DLY     1-I25#
L$DTP     1-I25#
L$DTYP    1-I25#
L$DU      1-I25  135-8#
L$DUT     1-I25#
L$DVTY    1-I25   29-20#
L$EF      1-I25#
L$ENVI    1-I25#
L$ERRT    1-I25   19-5#
L$ETP     1-I25#
L$EXP1    1-I25#
L$EXP4    1-I25#
L$EXP5    1-I25#
L$HARD    1-I25  144-12   144-12#
L$HIME    1-I25#
L$HPCP    1-I25#
L$HPTP    1-I25#
L$HW      1-I25    3-10     3-10#
L$ICP     1-I25#
L$INIT    1-I25  120-26#
L$LADP    1-I25#
L$LAST    1-I25  145-25#  146-10
L$LOAD    1-I25#
L$LUN     1-I25#   59-58    98-21   124-15*  124-18*  124-21   124-24   135-13   135-16   137-15*  137-71   137-77   138-13*  138-16*
        138-17   143-23
L$MREV    1-I25#
L$NAME    1-I25#
L$PRIO    1-I25#
L$PROT    1-I25  119-9#
L$PRT     1-I25#
L$REPP    1-I25#
L$REV     1-I25#
```

Cross reference table (CREF V05.03)

```
L$RPT     1-I25  117 62#
L$SOFT  145-12   145-12#
L$SPC     1-I25#
L$SPCP    1-I25#
L$SPTP    1-I25#
L$STA     1-I25#
L$SW      1-I25    4-10     4-10#
L$TEST    1-I25#
L$TIML    1-I25#
L$UNIT    1-I25# 124-13*  124-21   138 17
L.BADR   12-20#   48-12    48-13
L.CRF    12-16#
L.DS     12-23#   50-6
L.EVNT   12-19#   47-36
L.FLGS   12-18#
L.FMT    12-17#   47-35
L.HDCD   12-21#   49-4     49-5     50-4     50-5
L.SDI    12-22#   12-23
L10000    3-10     3-17#
L10001    4-10     4-21#
L10002   36-16#
L10003   36-35    36-37#
L10004   37-19    37-21#
L10005   37-44    37-46#
L10006   37-67    37-69#
L10007   37-88    37-90#
L10010   38-19    38-21#
L10011   38-40    38-42#
L10012   39-16    39-18#
L10013   42-13#
L10014   43-23#
L10015   44-10#
L10016   44-13#
L10017  117-79   118-40   118-52#
L10021  127-34   132-39#
L10022  133-12#
L10023  134-13   134-17#
L10024  135-18   135-26#
L10025  136-11   136-15#
L10026  137-7    137-11   137-72   137-78   137-82#
L10027  138-7    143-28   143-32#
L10030  144-12   144-30#
L10031  145-12   145-14#
L10032  146-3#
L10034  146-3    146-9#
LBN      21-18#   37-36    37-36    37-80    37-80    52-28    52-32    52-56    52-57    53-32    53-32    53 45    53-45    53-57
         53-57    54-7     54-7     54-17    54-17    70-20*   70-21*   71-13    71-14    73-27    7?-28    75-35    75-36    78-52
         78-53    79-32    79-33    79-57    79-58    82-36    82-37    94-32    94-33    94-75    94-77   137-35   139-5*   139-6*
        139-26*  139-27*  141-13*  141-14*  141-15   141-16
LBNDX    21-66#
LBNLO    18-5#    70-20    70-21    75-35*   75-36*   80-30    83-28
LBNSTA   21-64#   53-39    53-60*   54-4     54-14    65-42*   67-37*   67-41*   67-46*   67 50*   67-55*   67-60*   67-65*   67-70
         67-87    67-94    70-18*   70-25*   72-11*   75-38    79-48    79-54*   79-79    82-28   139-7*   140-12   140-28   141-41
LF       29-16    97-31    97-52
LINBUF   22-12#   97-29    97-84    97-86
LMT28    34-15#  117-42
```

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```
MSCPVA   25-29@   37-14    37-39    37 62    37-83
MSGADR   66-22*   66-28@   66-33
MSGBRL  144-25   144-37@
MSGBST  144-27   144-38@
MSGLDR  144-29   144-39@
MSGPCK   20-6@   131-21*
MSGUBA  144-21   144-35@
MSGVEC  144-23   144-36@
MULT     71-22    92-22    94-39   115-15@
MULTRD   59-52    60-13    69-31    72-8     75-28    78-45    78-81    84-23@   94-49    98-42
MULTWR   74-27    75-44    77-48    78-59    78-91    80-37    81-32    81-40    83-35    85-23@
NCONF   101-41   101-46@
NCONS   101-40@  101-43
NDX.AC   28-4@
NDX.RD   28-2@
NDX.RP   28-5@
NDX.WR   28-3@
NODOCU    1-21
NXMAD    19-21@   42-12*   45 15*   45-29   129-26*  129-31
NXMI     42-11@   45-18   129-27
NXTSTE   21-79@   61-9     68-63    68-71    68-78    68-83*   68-85    68-90*   70-15*   72-15*   72-18*   73-43*   74-29*   75-50*
         76-30*   76-39*   76-42*   77-50*   78-94*   79-89*   79-92*   79-95*   80-40*   81-42*   82-51*   83-37*   137-51*  140-25*
        141-38*
O$APTS    1-I02@    1-I25
O$AU      1-I02@    1-I25
O$BGNR    1-I02@    1-I23@    1-I25
O$BGNS    1-I02@    1-I25
O$DU      1-I02@    1-I23@    1-I25
O$ERRT    1-I02@    1-I23@    1-I25
O$GNSW    1-I02@    1-I23@    1-I25
O$POIN    1-I02@    1-I23     1-I23@    1-I23@   1-I23@   1-I23@   1-I23@   1-I25
O$SETU    1-I02@    1-I23@    1-I25   145-25
OLIMIT   34-17@   66-49
ONEFIL    1-H92@
ONLINE   21 93@
OP.ABO    9-3@
OP.ACC    9-4@   139-15
OP.AVA    9-22@
OP.AVL    9-5@
OP.CCD    9-6@
OP.CMP    9-7@
OP.DUP    9-23@
OP.ELP    9-29@
OP END    9-20@   88 47    88-55    88-64
OP.ERS    9-8@
OP.ESP    9-28@
OP.FLU    9-9@
OP.GCS    9-10@
OP.GSS    9-27@
OP.GUS    9-11@   58-4
OP.MRD    9-18@
OP.MWR    9-19@
OP.ONL    9-12@   59-4
OP.RD     9-13@   73-30    84-32
OP.RLC    9-25@
OP.RPL    9 14@   79-38
```

```
OP.RSD    9 31#
OP.SCC    9-15#    58 38
OP.SEX    9-21#    88-55
OP.SHC    9-24#
OP.SSD    9-30#
OP.SUC    9-16#
OP.WR     9-17#    79-59     82-38     85-31     85-50
OPCODE   20 15#    25-31     88-25*    88-63     89-42
OPHELP    4-12#    62-19     62-22
OPTIN    22-10#
OSTRE   101-38    101-45    101-50#
OSTRNG  100-23    101-37#   101-49
P.BCNT   11-9#     12-10#    86-27*    86-28*    87-26*    87-27*    139-20    139-21
P.BUFF   11-10#
P.CLAS   12-56#
P.CMST   12-28#
P.CNCL   12-69#
P.CNTF   11-37#    12-67#    58-37*
P.CNTI   12-70#
P.CPSP   11-26#
P.CRF    11-5#     12-5#     88-40     90-25*
P.CTMO   12-68#
P.CYLS   12-42#
P.DEXT   12-75#
P.DFLG   12-76#
P.DMDT   11-51#
P.DPRG   12-77#
P.DTMO   12-78#
P.ELGF   11-24#
P.FBBK   12-11#   141-13    141-14
P.FLGS   12-8#     88-42
P.GRPS   12-41#
P.HSTI   11-23#    12-35#    12-53#
P.HTMO   11-38#    58-31*
P.LBN    11-12#    37-57     37-58     46-44     46-44     60-11*    60-12*    72-6*     72-7*     73-27*    73-28*    74-25*    74-26*    78-43*
         78-44*    78-79*    78-80*    79-32*    79-33*    79-57*    79-58*    81-30*    81-31*    81-38*    81-39*    82-36*    82-37*    84-53*
         84-54*    85-66*    85-67*    86-29*    86-30*    87-28*    87-29*    94-47*    94-48*    98-40*    98-41*
P.MEDI   12-37#    12-57#
P.MLUN   12-33#    12-51#
P.MOD    11-8#     89-43*
P.MODE   12-55#    59-19
P.OPCD   11-7#     12-7#     88-43     89-42*
P.OTRF   11-17#    12-27#
P.OVRL   11-52#
P.RBN    11-31#    79-30*    79-31*
P.RBNS   12-44#    58-26
P.RCTC   12-45#    58-27
P.RCTS   12-43#    58-18
P.RGID   11-45#
P.RGOF   11-46#
P.SHST   12-39#    12-59#
P.SHUN   11-25#    12-38#    12-58#
P.STS    12-9#     88-41
P.TIME   11-40#
P.TRKS   12-40#    58-17
P.UADR   11-11#    86-26*    87-25*    109-14
```

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Cross reference table (CREF V05.03)

```
REPEAT  21-92#
REPLAC  61-25    68-60#  137-52   140-26   141-39
REPLY   22-6#    61-19*  61-20    61-21    62-29    62-32    137-22   137-25   137-60
RESCAN  21-39#   94-30*  94-86    94-91*
RESET   45-13#  134-11
RFLAGS  18-4#    70-5    70-10    70-22    71-5     72-13    75-37*   75-40*   77-38*   77-41*   77-45*   80-27    83-25
RG.FLG   7-6#    47-43    48-4     48 15    49-6     50-15    51-4     90-37
RG.OWN   7-5#    47-43    48-4     48-15    49-6     50-15    51-4     90-37    90-41
RNTIM   34-12#   56-25
RNTIM1  34-13#   56-29
RNTIM2  34-14#   56-34
RNTIME  56-14#  142-37   143-4
RNTIMX  56-15    56-36#
RPLSTA  21-65#   55-3     55-25*   65-43*   71-3*    80-41*   139-8*
RSP.CK 129-78   129-87   129 95   129-111#
RSP.S1 129-64   129-74#
RSP.S2 129-66   129-82#
RSP.S3 129-68   129-91#
RSP.S4 129-70   129-99#
RTFLAG  19-10#
S$LSYM   1-I02#   3-17#    4-21#    36-16#   36-37#   37-21#   37-46#   37-69#   37-90#   38-21#   38-42#   39-18#   42-13#   43-23#
        44-10#   44-13#   61-20    61-20    61-20    61-20#   63-28    63-28    63-28    63-28#   64-27    64-27    64-27    64-27#
        66-33    66-33    66-33    66-33#  118-52#  132-39#  133-12#  134-17#  135-26#  136-15#  137-82#  143-32#  144-30#  145-14#
SA.BST   6-73#
SA.CM1   6-28#
SA.CMD   6-23#
SA.CME   6-49#
SA.CNT   6-79#  129-101  129-102
SA.CTP   6-52#
SA.DI    6-35#  129-75
SA.ERC   6-15#
SA.ERR   6-6#   130-21
SA.GO    6-71#  128-103
SA.INE   6-64#
SA.INT   6-21#
SA.LFC   6-72#
SA.MCV   6-78#  129-101
SA.MP    6-36#  129-76
SA.MS1   6-27#
SA.MSE   6-48#
SA.MSG   6-22#
SA.NV    6-33#
SA.NVE   6-65#
SA PRG   6-42#
SA.QB    6-34#  129-76
SA.S1    6-10#  129-42   129-75
SA.S2    6-9#   129-86
SA.S3    6-8#   129-94
SA.S4    6-7#   129-53   129-101
SA.STE   6-51#
SA.STP   6-25#  129-17
SA.TST   6-58#  129-21
SA.VCE   6-63#
SA.VEC   6-20#
SA.WRP   6-24#
SADDR   19 38#   23-20    57-33*
```

```
SAEXP    19-40#   23-22    129-115*  130-20*
SARMSG   23-11#   36-29     38-13
SARVAL   23-19#   36-30     38-14
SAVAL    19-39#   23-21     91-30*   128-67*   129-116*  130-29*
SB.DST   13-32#   67-58
SB.ECC   13-33#   67-63
SB.HCE   13-31#   67-53
SCNDRY   21-13#   55-21*    65-32*   98-25*    98-54     98-57     98-72*    117-71    117-73
SEARCH   76-28    94-27#
SETTO    91-24    111-14#   130-25
SFLAG    21-44#   55-6      55-16    71-11*    71-31*    76-33     78-55     79-34     80-44*    94-66*    94-88*    139-9*
SFPTBL    4-10#
SND.S1   129-18*  129-65#   129-83   129-92
SND.S2   129-19*  129-20*   129-67#
SND.S3   129-21*  129-69#
SNDCMD   88-29    90-20#
ST.ABO   13-7#
ST.AOL   13-18#   59-8
ST.AVL   13-9#    58-8
ST.CMD   13-6#
ST.CMP   13-12#
ST.CNT   13-15#
ST.DAT   13-13#   67-48     73-35    79-71     79-81     82-42     84-36     85-35     85-54     139-33
ST.DIA   13-17#
ST.DRV   13-16#
ST.HST   13-14#
ST.MFE   13-10#
ST.MSK   13-3#    58 7      59-7     73-34     79-70     82-41     84-35     85-34     85-53     139-32
ST.OFL   13-8#
ST.SUB   13-4#
ST.SUC   13-5#
ST.WPR   13-11#
STATBL   53-58    53-64     55-37#
STATUS   21-16#   49-22*    51-16*   51-21*    52-45*    52-53*    52-60*    61-33*    61-39*    66 56*    67-94*    67-95*    67-99*    68-85*
         84-42*   84-60*    84-63    84-69*    84-75     85-41*    85-60*    85-73*    85-76     85-82*    85 88     88-71*    88-72     88-77*
         88-85*   88-93*    88-101*  88-108*   88-116    135-10    137-70*   137-76*   143-20*
STEP     21-78#   68-64*
STEP10   68-49    77-29#
STEP11   68-50    78-25#
STEP12   68-51    79-27#
STEP13   68-52    80-22#
STEP15   68-54    81-23#
STEP16   68-55    82-23#
STEP17   68-56    83-20#
STEP3    61-6     68-42     69-25#
STEP4    67-39    67-74     68-43    73-22#
STEP5    67-78    67-84     68-44    74-21#
STEP6    68-45    75-23#
STEP9    68-48    76-24#
STEPER   68-66    68-68     68-73    68-82#
STEPFT   68-39    68-40     68-41    68-46     68-47     68-53     68-89#    69-31     72-8      73-30     73-41     74-27     75-28     75-44
         77-48    78-45     78-59    78-81     78-91     79-38     79-43     79-59     79-77     80 37     81 32     81-40     82-38     82-48
         83-35
STEPSI   68-58#   68-67
STEPTB   68-38#   68-58     68-70
STROFF   21-36#   94-42*    94-54    94-92*    94-102*
```

SVCGBL	1-I02#	1-I07#	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25
	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25
	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25
	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25
	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25
	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25
	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25
	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25	1-I25
	1-I25	1-I25	1-I25	1-I25	2-8	2-8	2-8	3-10	3-10	3-10	3-10	3-10	3-10	4-10
	4-10	4-10	4-10	4-10	4-10	19-5	19-5	19-5	29-20	29-20	29-20	29-25	29-25	29-25
	36-7	36-7	36-7	36-23	36-23	36-23	37-7	37-7	37-7	37-28	37-28	37-28	37-53	37-53
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	135-8	136-9	136-9	136-9	144-12	144-12	144-12	145-12	145-12	145-12	145-25	145-25	145-25	145-25#
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	144-30	144-30	145-14	145-14	145-14	146-3	146-3	146-3	146-9	146-9	146-9			
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SWMSG1	62-28	62-73@												
SWMSG2	62-37	62-74@												
SWMSG3	62-42	62-75@												
SWMSG4	62-47	62-76@	137-21	137-59										
SWMSG5	62-52	62-77@												
SWMSG6	62-58	62-78@												
SWMSG7	62-63	62-79@												
T$$AU	136-9@	136-11	136-15											
T$$AUT	133-10@	133-12												
T$$CLE	134-8@	134-13	134-17											
T$$DAT	146-3	146-3@	146-9											
T$$DU	135-8@	135-18	135-26											
T$$HAR	144-12	144-12@	144-30											
T$$HW	3-10	3-10@	3-17											
T$$INI	120-26@	127-34	132-39											
T$$MSG	36-7@	36-16	36-23@	36-35	36-37	37-7@	37-19	37-21	37-28@	37-44	37-46	37-53@	37-67	37-69
	37-76@	37-88	37-90	38-7@	38-19	38-21	38-28@	38-40	38-42	39-7@	39-16	39-18		
T$$PC	146-2@	146-10												
T$$PRO	119-9@													
T$$PTA	146-2@	146-3	146-3@											
T$$RPT	117-62@	117-79	118-40	118-52										
T$$SOF	145-12	145-12@	145-14											
T$$SRV	42-11@	42-13	43-20@	43-23	44-6@	44-10	44-11@	44-13						
T$$SW	4-10	4-10@	4-21											

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         64-27    64-27#   64-27#   64-27#   66-33    66-33    66-33    66-33#   66-33#   66-33#   144-21   144-21   144-21   144-21#
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        137-78   137-78   137-78#  137-78#  138-7    138-7    138-7#   138-7#   143-28   143-28   143-28#  143-28#
T$FREE  145-25   146-10#
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T$LOLI    63-28    63-28#   66-33    66-33#   144-21   144-21#  144-23   144-23#  144-25   144-25#  144-27   144-27#  144-29   144-29#
T$LSYM    1-I02    1-I02#    3-17     4-21    36-16    36-37    37-21    37-46    37-69    37-90    38-21    38-42    39-18    42-13
         43-23    44-10    44-13   118-52   132-39   133-12   134-17   135-26   136-15   137-82   143-32   144-30   145-14
T$LTNO  145-25#
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        134-17   134-17   134-17   134-17#  135-8    135-8    135-8#   135-26   135-26   135-26   135-26#  136-9    136-9    136-9#
        136-15   136-15   136-15   136-15#  136-16   136-16   136-16   136-16#  136-17   136-17   136-17#  137-3    137-3    137-3#
        137-82   137-82   137-82   137-82#  138-3    138-3    138-3#   143-32   143-32   143-32   143-32#  143-34   143-34   143-34
        143-34#  144-2    144-2    144-2#   144-12   144-12   144-12#  144-30   144-30   144-30   144-30#  145-12   145-12   145-12#
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T$NSO     1-I17#    4-22     5-3#    67-102   117-56#  136-16   136-17#  143-34   144-2#   145-26
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T$SEGL    1-I02#
T$SIZE  145-25   146-10#
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XSAVAL   23-13     23-28#
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          1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25
          1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25#   1-I25#   29-20    29-20#   29-25
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        144-30   144-30#  145-14   145-14#  145-26   145-26#  146-3    146-3#
M$DEFA   61-20    61-20#   63-28    63-28#   64-27    64-27#   66-33    66-33#   144-21   144-21#  144-23   144-23#  144-25   144-25#
         144-27   144-27#  144-29   144-29#
M$ENDE    3-17#    4-21#    4-22#   36-16#   36-37#   37-21#   37-46#   37-69#   37-90#   38-21#   38-42#   39-18#   42-13#   43-23#
         44-10#   44-13#   67-102#  118-52#  132-39#  133-12#  134-17#  135-26#  136-15#  136-16#  137-82#  143-32#  143-34#  144-30#
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         85-59    85-59#   85-81    85-81#   88-80    88-80#   88-88    88-88#   88-96    88-96#   88-104   88-104#  88-111   88 111#
         98-36    98-36#   128-70   128-70#  128-95   128-95#  129-36   129-36#  129-119  129-119# 130-44   130-44#  130-54   130-54#
        132-34   132-34#  139-40   139-40#
M$EXCP   63-28    63-28    63-28#   66-33    66-33#   144-21   144-21   144-21#  144-23   144-23   144-23#  144-25   144-25
        144-25#  144-27   144-27#  144-27#  144-29   144-29   144-29#
M$EXIT   36-35#   37-19#   37-44#   37-67#   37-88#   38-19#   38-40#   39-16#   117-79#  118-40#  127-34   127-34#  134-13   134-13#
        135-18#  136-11#  137-7    137-7#   137-11   137-11#  137-72   137-72#  137-78   137-78#  138-7    138-7#   143-28   143-28#
M$EXSE   36-35#   37-19#   37-44#   37-67#   37-88#   38-19#   38-40#   39-16#   117-79#  118-40#  127-34#  134-13#  135-18#  136-11#
        137-7#   137-11#  137-72#  137-78#  138-7#   143-28#
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        39-16    39-16#   117-79   117-79#  118-40   118-40#  127-34#  134-13#  135-18   135-18#  136-11   136-11#  137-7#   137-11#
       137-72#  137-78#  138-7#   143-28#
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         1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25
         1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25    1-I25#   1-I25#   1-I25#   1-I25#
         1-I25#   1-I25#   1-I25#   1-I25#   1-I25#   1-I25#   1-I25#   1-I25#   1-I25#   1-I25#   1-I25#   1-I25#   1-I25#   1-I25#
         1-I25#   1-I25#   1-I25#   1-I25#   1-I25#   1-I25#   1-I25#   1-I25#   1-I25#   1-I25#   1-I25#   1-I25#   1-I25#   1-I25#
         1-I25#   1-I25#   1-I25#   1-I25#   1-I25#   1-I25#   2-8      2-8#     3-10     3-10#    3-10#    3-10     3-17     3-17#
         4-10     4-10     4-10#    4-10#    4-21     4-21#    19-5     19-5#    29-20    29-20#   29-25    29-25#   36-7     36-7#
        36-16    36-16#   36-23    36-23#   36-37    36-37#   37-7     37-7#    37-21    37-21#   37-28    37-28#   37-46    37-46#
        37-53    37-53#   37-69    37-69#   37-76    37-76#   37-90    37-90#   38-7     38-7#    38-21    38-21#   38-28    38-28#
        38-42    38-42#   39-7     39-7#    39-18    39-18#   42-11    42-11#   42-13    42-13#   43-20    43-20#   43-23    43-23#
        44-6     44-6#    44-10    44-10#   44-11    44-11#   44-13    44-13#   61-20    61-20#   63-28    63-28#   64-27    64-27#
        66-33    66-33#   117-62   117-62#  118-52   118-52#  119-9    119-9#   120-26   120-26#  132-39   132-39#  133-10   133-10#
       133-12   133-12#  134-8    134-8#   134-17   134-17#  135-8    135-8#   135-26   135-26#  136-9    136-9#   136-15   136-15#
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M#MCLO  1-I02   1-I02#
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       99-24   99-24#  121-19  121-19  121-19  121-19  121-19#  129-27  129-27  129-27  129-27  129-27#
M#PUT1 45-18   45-18   45-18   45-18   45-18#  45-18#  45-18#  45-18#  57-44   57-44   57-44   57-44   57-44#  57-44#
       57-44#  57-44#  97-85   97-85   97-85   97-85#  97-85#  97-85#  99-18   99-18   99-18   99-18#  99-18#  99-18#
       99-20   99-20   99-20   99-20#  99-20#  99-20#  99-22   99-22   99-22   99-22#  99-22#  99-22#  99-24   99-24
       99-24   99-24#  99-24#  99-24#  121-19  121-19  121-19  121-19  121-19#  121-19#  121-19#  121-19#  129-27  129-27
      129-27  129-27  129-27#  129-27#  129-27#  129-27#
M#RADI 61-20   61-20#  63-28   63-28#  64-27   64-27#  66-33   66-33#  144-21  144-21#  144-23  144-23#  144-25  144-25#
      144-27  144-27#  144-29  144-29#
M#RBRO 97-37#
M#RNRO 97-37   120-34  120-34#  121-7   121-7#  121-9   121-9#  123-18  123-18#  124-24  124-24#
M#SETS  1-I17   1-I17#  3-10    3-10#   4-10    4-10#   5-3     5-3#    36-7    36-7#   36-23   36-23#  37-7    37-7#
       37-28   37-28#  37-53   37-53#  37-76   37-76#  38-7    38-7#   38-28   38-28#  39-7    39-7#   42-11   42-11#
       43-20   43-20#  44-6    44-6#   44-11   44-11#  117-56  117-56#  117-62  117-62#  119-9   119-9#  120-26  120-26#
       133-10  133-10#  134-8   134-8#  135-8   135-8#  136-9   136-9#  136-17  136-17#  137-3   137-3#  138-3   138-3#
       144-2   144-2#  144-12  144-12#  145-12  145-12#
M#SVC  36-16   36-16#  36-35#  36-37   36-37#  37-19#  37-21   37-21#  37-44#  37-46   37-46#  37-67#  37-69   37-69#
       37-88#  37-90   37-90#  38-19#  38-21   38-21#  38-40#  38-42   38-42#  39-16#  39-18   39-18#  45-18   45-18#
       45-20   45-20#  45-34   45-37   45-37#  47-46   48-7    48-19   50-19   51-7    52-42   57-44   57-44#  58-13
       58-23   58-42   59-13   61-20   61-20#  63-28   63-28#  64-27   64-27#  66-33   66-33#  70-32   73-40   76-38
       79-42   79-76   79-86   82-47   84-41   84-68   85-40   85-59   85-81   88-80   88-88   88-96   88-104  88-111
       91-35   91-35#  97-28   97-28#  97-37   97-37#  97-58   97-58#  97-85   97-85#  98-36   99-18   99-18#  99-20
       99-20#  99-22   99-22#  99-24   99-24#  117-79#  118-40#  118-52  118-52#  120-28  120-28#  120-34  120-34#  120-37
      120-37#  121-7   121-7#  121-9   121-9#  121-19  121-19#  122-5   122-5#  122-10  122-10#  122-15  122-15#  123-16
      123-16#  123-18  123-18#  124-7   124-7#  124-24  124-24#  127-28  127-28#  127-30  127-30#  127-34  127-34#  128-70
      128-95   129-15  129-15#  129-27  129-27#  129-30  129-30#  129-36  129-119  130-33  130-33#  130-44  130-54  132-34
```

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        132-35   132-35#  132-39   132-39#  133-12   133-12#  134-13   134-13#  134-17   134-17#  135-18#  135-26   135-26#  136-11#
        136-15   136-15#  137-7    137-7#   137-9    137-9#   137-11   137-11#  137-57   137-57#  137-71   137-71#  137-72   137-72#
        137-77   137-77#  137-78   137-78#  137-82   137-82#  138-7    138-7#   138-34   138-34#  139-4    139-4#   139-40   143-6
        143-6#   143-23   143-23#  143-28   143-28#  143-32   143-32#
MSTLAB   36 16#   36-37#   37-21#   37-46#   37-69#   37-90#   38-21#   38-42#   39-18#   45-18#   45-20#   45-34#   45-37#   47-46#
        48-7#    48-19#   50-19#   51-7#    52-42#   57-44#   58-13#   58-23#   58-42#   59-13#   61-20#   63-28#   64-27#   66-33#
        70-32#   73-40#   76-38#   79-42#   79-76#   79-86#   82-47#   84-41#   84-68#   85-40#   85-59#   85-81#   88-80#   88-88#
        88-96#   88-104#  88-111#  91-35#   97-28#   97-37#   97-58#   97-85#   98-36#   99-18#   99-20#   99-22#   99-24#   118-52#
        120-28#  120-34#  120-37#  121-7#   121-9#   121-19#  122-5#   122-10#  122-15#  123-16#  123-18#  124-7#   124-24#  127-28#
        127-30#  127-34#  128-70#  128-95#  129-15#  129-27#  129-30#  129-36#  129-119  130-33#  130-44#  130-54#  132-34#  132-35#
        132-39#  133-12#  134-13#  134-17#  135-26#  136-15#  137-7#   137-9#   137-11#  137-57#  137-71#  137-72#  137-77#  137-78#
        137-82#  138-7#   138-34#  139-4#   139-40#  143-6#   143-23#  143-28#  143-32#
MSTSTL   36-16    36-16#   36-37    36-37#   37-21    37-21#   37-46    37-46#   37-69    37-69#   37-90    37-90#   38-21    38-21#
        38-42    38-42#   39-18    39-18#   45-18    45-18#   45-20    45-20#   45-34    45-34#   45-34#   45-37    45-37#   47-46
        47-46#   47-46#   48-7     48-7#    48-7#    48-19    48-19#   48-19#   50-19    50-19#   50-19#   51-7     51-7#    51-7#
        52-42    52-42#   52-42#   57-44    57-44#   58-13    58-13#   58-13#   58-23    58-23#   58-23#   58-42    58-42#   58-42#
        59-13    59-13#   59-13#   61-20    61-20#   63-28    63-28#   64-27    64-27#   66-33    66-33#   70-32    70-32#   70-32#
        73-40    73-40#   73-40#   76-38    76-38#   76-38#   79-42    79-42#   79-76    79-76#   79-76#   79-86    79-86#   79-86#
        79-86#   82-47    82-47#   82-47#   84-41    84-41#   84-41#   84-68    84-68#   84-68#   85-40    85-40#   85-40#   85-59
        85-59#   85-59#   85-81    85-81#   85-81#   88-80    88-80#   88-80#   88-88    88-88#   88-88#   88-96    88-96#   88-96#
        88-104   88-104#  88-104#  88-111   88-111#  88-111#  91-35    91-35#   97-28    97-28#   97-37    97-37#   97-58    97-58#
        97-85    97-85#   98-36    98-36#   98-36#   99-18    99-18#   99-20    99-20#   99-22    99-22#   99-24    99-24#   118-52
        118-52#  120-28   120-28#  120-34   120-34#  120-37   120-37#  121-7    121-7#   121-9    121-9#   121-19   121-19#  122-5
        122-5#   122-10   122-10#  122-15   122-15#  123-16   123-16#  123-18   123-18#  124-7    124-7#   124-24   124-24#  127-28
        127-28#  127-30   127-30#  127-34   127-34#  128-70   128-70#  128-70#  128-95   128-95#  128-95#  129-15   129-15#  129-27
        129-27#  129-30   129-30#  129-36   129-36#  129-36#  129-119  129-119#  129-119#  130-33   130-33#  130-44   130-44#  130-44#
        130-54   130-54#  130-54#  132-34   132-34#  132-34#  132-35   132-35#  132-39   132-39#  133-12   133-12#  134-13   134-13#
        134-17   134-17#  135-26   135-26#  136-15   136-15#  137-7    137-7#   137-9    137-9#   137-11   137-11#  137-57   137-57#
        137-71   137-71#  137-72   137-72#  137-77   137-77#  137-78   137-78#  137-82   137-82#  138-7    138-7#   138-34   138-34#
        139-4    139-4#   139-40   139-40#  139-40#  143-6    143-6#   143-23   143-23#  143-28   143-28#  143-32   143-32#
MSWORD    1-I25    1-I25#   2-8      2-8      2-8      2-8#     36-35    36-35#   37-19    37-19#   37-44    37-44#   37-67    37-67#
        37-88    37-88#   38-19    38-19#   38-40    38-40#   39-16    39-16#   45-34    45-34    45-34    45-34#   47-46    47-46
        47-46    47-46#   48-7     48-7     48-7     48-7#    48-19    48-19    48-19    48-19#   50-19    50-19    50-19    50-19#
        51-7     51-7     51-7     51-7#    52-42    52-42    52-42    52-42#   58-13    58-13    58-13    58-13#   58-23    58-23
        58-23    58-23#   58-42    58-42    58-42    58-42#   59-13    59-13    59-13    59-13#   61-20    61-20    61-20#   61-20#
        63-28    63-28    63-28#   63-28#   64-27    64-27    64-27#   64-27#   66-33    66-33    66-33#   66-33#   70-32    70-32
        70-32    70-32#   73-40    73-40    73-40    73-40#   76-38    76-38    76-38    76-38#   79-42    79-42    79-42    79-42#
        79-76    79-76    79-76    79-76#   79-86    79-86    79-86    79-86#   82-47    82-47    82-47    82-47#   84-41    84-41
        84-41    84-41#   84-68    84-68    84-68    84-68#   85-40    85-40    85-40    85-40#   85-59    85-59    85-59    85-59#
        85-81    85-81    85-81    85-81#   88-80    88-80    88-80    88-80#   88-88    88-88    88-88    88-88#   88-96    88-96
        88-96    88-96#   88-104   88-104   88-104   88-104#  88-111   88-111   88-111   88-111#  98-36    98-36    98-36    98-36#
        117-79   117-79#  118-40   118-40#  127-34#  128-70   128-70   128-70   128-70#  128-95   128-95   128-95   128-95#  129-36
        129-36   129-36    129 36#  129-119  129-119  129-119  129-119#  130-44   130-44   130-44   130-44#  130-54   130-54   130-54
        130-54#  132-34   132-34   132-34   132-34#  134-13#  135-18   135-18#  136-11   136-11#  137-7#   137-11#  137-72#  137-78#
        138-7#   139-40   139-40   139-40   139-40#  143-28#  144-21   144-21#  144-23   144-23#  144-25   144-25#  144-27   144-27#
        144-29   144-29#  146-3    146-3#
MANUAL  124-7    137-9    138-34
MEMORY  120-34   123-18
MULT      1-H59#  92-22
MULTCM    1-G34#  59-52    60-13    69-31    72-8     74-27    75-28    75-44    77-48    78-45    78-59    78-81    78-91    80-37
        81-32    81-40    83-35    94-49    98-42
OPEN    97-28
OR        1-D82#
PN"       1-F65#  56-25    56-29    56-34
PNT...    1-E94#  36-12    36-13    36-27    37-11    37-36    37-59    37-80    38-11    38-32    39-11    39 12    40-17    40-25
        46-44    46 45    48-20    49-17    49-18    50-21    50-32    50-34    50-39    53-32    53-33    53-34    53-35    53 45
```

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        53-46   53 57   53-58   54 7    54-8    54-17   54-18   55-12   55-13   55-22   55-23   56-25   56-29   56-34
        59-58   59-62   60-8    61-24   62-17   66-24   66-49   98-21   98-56   98-57   98-67   98-75   98-82   101-44
       103-26  117-42  117-45  117-67  117-68  117-73  117-78  118-7   118-15  118-24  118-33  121-12  123-8   135-13
       135-16  137-13  137-56  138-9   138-10  138-11  138-32  142-36  143-3
PNTB    1-F38#  36-12   36 13   36-27   37-11   37-36   37-59   37-80   38-11   38-32   39-11   39-12   40-25   46-44
        46-45   53-32   53-33   53-34   53-35   53-45   53-46   53-57   53-58   54-7    54-8    54-17   54-18   55-12
        55-13   55-22   55-23   59-58   59-62   60-8    61-24   62-17   66-24   98-21   98-56   98-57   98-67   98-75
        98-82  117-67  117-68  117-73  117-78  118-7   118-15  118-24  118-33  138-10  138-11  138-32  142-36  143-3
PNTF    1-F29#  66-49  101-44  103-26  117-42  117-45  121-12  123-8   135-13  135-16  137-13  137-56  138-9
PNTS    1-F56#
PNTX    1-F47#  40-17   48-20   49-17   49-18   50-21   50-32   50-34   50-39
POINTE  1-I23
POP     1-D52#  36-15   36-33   37-17   37-42   37-65   37-86   38-17   38-38   39-14   43-22   45-38   46-60   46-67
       46-74   49-20   51-14   51-19   52-43   52-51   52-58   55-26   56-30   56-35   57-37   59-36   66-55   71-18
       78-33   78-36   78-69   78-72   84-61   84-73   85-74   85-86   89-53   90-35   90-45   91-47   91-55   91-62
       93-30   94-42   94-43   95-47   97-59   99-16  100-24  103-27  106-32  108-32  108-41  109-20  110-20  111-40
      112-17  113-29  114-34  115-41  116-24  116-29  117-52  128-81  128-105 128-111 129-59  130-26  132-23
PRINT   1-E77#  56-28   56-33   56-36   102-8   102-19  103-11  103-33  108-16  108-38  134-10
PRINTB  97-85   99-20
PRINTF  99-18
PRINTS  99-24
PRINTX  99-22
PUSH    1-D41#  36-9    36-25   37-9    37-30   37-55   37-78   38-9    38-30   39-9    45-14   46-26   47-32   52-21
       53-23   56-16   56-23   57-34   59 32   66-21   71-12   78-29   78-65   84-24   85-24   89-33   90-21   90-28
       91-20   93-23   94 31   95-22   97-24   99-9   100-17  100-22  106-14  107-17  107-23  107-41  109-12  110-12
      111-14  112-11  113-17  114-20  115-15  116-11  116-18  117-17  117-29  128-28  128-79  129-16  130-19  132-18
READBU 120-37
READEF 122-5    122-10  122-15
SETCMD  1-F91#  58-4    58-38   59-4    73-30   79-38   79-59   82-38   84-32   85-31   85-50   139-15
SETPRI 127-30
SETVEC  45-18   57-44   121-19  129-27
STARS   1-C77#  120-8   120-21
SVC     1-I01#   1-I02
TABLE   1-E30#  14-22   15-26   144-13
XFER   36-35#  37-19#  37-44#  37-67#  37-88#  38-19#  38-40#  39-16#  117-79#  118-40#  127-34#  134 13#  135 18#  136-11#
      137-7#  137-11#  137-72#  137-78#  138-7#  143-28#
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