RP07 FCTNL TEST CZRJLA0 AH-F959A-MC FICHE 1 OF 1

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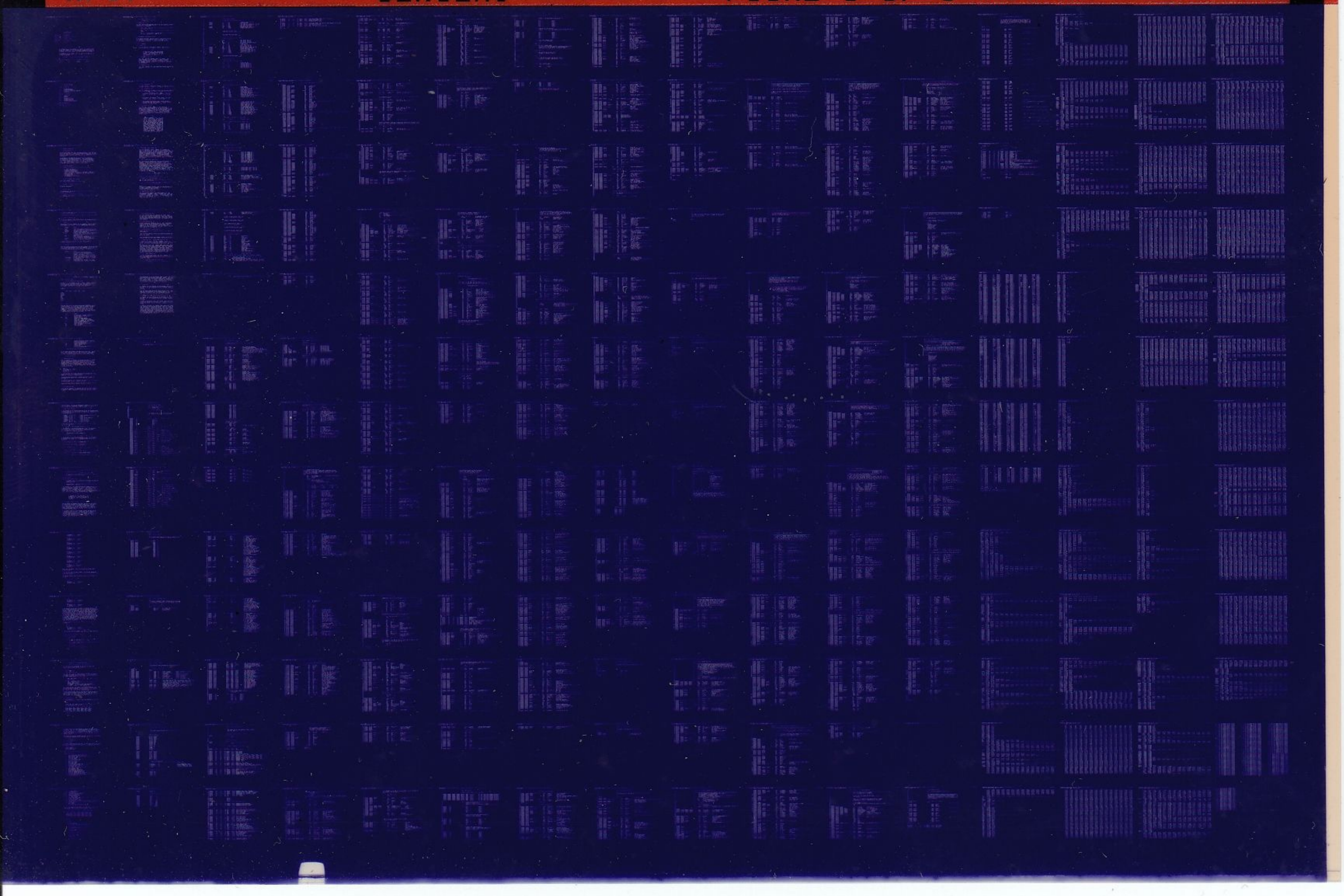

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IDENTIFICATION

PRODUCT CODE: AC-F958A-MC

PRODUCT NAME: CZRJLA0 RP07 FCTNL TEST

PRODUCT DATE: JANUARY 1, 1983

MAINTAINER: CX DIAGNOSTIC ENGINEERING

AUTHOR: MIKE LEAVITT

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1.0 GENERAL INFORMATION

1.1 PROGRAM ABSTRACT

THE RP07 FUNCTIONAL DRIVE TEST CONTAINS A SERIES OF TESTS THAT WILL VERIFY THAT THE DISK IS CAPABLE OF PERFORMING SEEKS, THAT THE SEEKS AND ACCESS TIMES ARE WITHIN TOLERANCE, THAT THE ADDRESSING CIRCUITRY OPERATES PROPERLY, AND THAT WRITE AND READ DATA CAPABILITIES ARE FUNCTIONAL.

THIS DIAGNOSTIC HAS BEEN WRITTEN FOR USE WITH THE DIAGNOSTIC RUNTIME SERVICES SOFTWARE (SUPERVISOR). THESE SERVICES PROVIDE THE INTERFACE TO THE OPERATOR AND TO THE SOFTWARE ENVIRONMENT. THIS PROGRAM CAN BE USED WITH XXDP+, ACT, APT, SLIDE AND PAPER TAPE. FOR A COMPLETE DESCRIPTION OF THE RUNTIME SERVICES, REFER TO THE XXDP+ USER'S MANUAL. THERE IS A BRIEF DESCRIPTION OF THE RUNTIME SERVICES IN SECTION 2 OF THIS DOCUMENT.

1.2 SYSTEM REQUIREMENTS

THIS PROGRAM WILL REQUIRE THE FOLLOWING SYSTEM HARDWARE:

1. AN XXDP+ LOAD MEDIUM
2. A CONSOLE KEYBOARD/PRINTER
3. 28K WORDS OF MAIN MEMORY
4. A PDP-11 PROCESSOR WHICH HAS THE THROUGHPUT CAPABILITY EQUAL TO AT LEAST 2.2 MBYTES/SEC FOR OPERATION IN NON-INTERLEAVED MODE OR 1.3 MBYTES/SECOND FOR OPERATION IN INTERLEAVED MODE.
5. ONE RH70 OR RH11 CONTROLLER
6. A PROGRAMMABLE CLOCK (KW11-P)

1.3 RELATED DOCUMENTS AND STANDARDS

XXDP+ USER'S MANUAL (CHQUS)
RP07 PURCHASE SPECIFICATIONS (A-PS-3015478-0-0)

1.4 DIAGNOSTIC HIERARCY PREREQUISITES

RP07 FRONT END DIAGNOSTIC,
RP07 PDP11 FORMATTER.

1.5 RESTRICTIONS

THIS PROGRAM WILL NOT BE ABLE TO RUN ANY OF THE AVAILABLE RP07 RESIDENT MICRODIAGNOSTICS.

THIS PROGRAM WILL NOT RUN ON LSI-11 CPU'S.

THE COMMANDS: NOP, DIAGNOSTIC, FORMAT TRACK, AND READ/WRITE TRACK DESCRIPTOR ARE NOT USED.

IF A KW11-P SYSTEM CLOCK IS NOT INSTALLED ON THE SYSTEM, THE TIMING TESTS WILL NOT BE EXECUTED.

THE PROGRAM DOES NOT PROVIDE MODULE CALLOUT IN THE ERROR PRINTOUT.

2.0 OPERATING INSTRUCTIONS

THIS SECTION CONTAINS A BRIEF DESCRIPTION OF THE RUNTIME SERVICES. FOR DETAILED INFORMATION, REFER TO THE XXDP+ USER'S MANUAL (CHQUS).

2.1 COMMANDS

THERE ARE ELEVEN LEGAL COMMANDS FOR THE DIAGNOSTIC RUNTIME SERVICES (SUPERVISOR). THIS SECTION LISTS THE COMMANDS AND GIVES A VERY BRIEF DESCRIPTION OF THEM. THE XXDP+ USER'S MANUAL HAS MORE DETAILS.

COMMAND	EFFECT
START	START THE DIAGNOSTIC FROM AN INITIAL STATE
RESTART	START THE DIAGNOSTIC WITHOUT INITIALIZING
CONTINUE	CONTINUE AT TEST THAT WAS INTERRUPTED (AFTER ^C)
PROCEED	CONTINUE FROM AN ERROR HALT
EXIT	RETURN TO XXDP+ MONITOR (XXDP+ OPERATION ONLY!)
ADD	ACTIVATE A UNIT FOR TESTING (ALL UNITS ARE CONSIDERED TO BE ACTIVE AT START TIME
DROP	DEACTIVATE A UNIT
PRINT	PRINT STATISTICAL INFORMATION (IF IMPLEMENTED BY THE DIAGNOSTIC - SECTION 4.0)
DISPLAY	TYPE A LIST OF ALL DEVICE INFORMATION
FLAGS	TYPE THE STATE OF ALL FLAGS (SEE SECTION 2.3)
ZFLAGS	CLEAR ALL FLAGS (SEE SECTION 2.3)

A COMMAND CAN BE RECOGNIZED BY THE FIRST THREE CHARACTERS. SO YOU MAY, FOR EXAMPLE, TYPE "STA" INSTEAD OF "START".

2.2 SWITCHES

THERE ARE SEVERAL SWITCHES WHICH ARE USED TO MODIFY SUPERVISOR OPERATION. THESE SWITCHES ARE APPENDED TO THE LEGAL COMMANDS. ALL OF THE LEGAL SWITCHES ARE TABULATED BELOW WITH A BRIEF DESCRIPTION OF EACH. IN THE DESCRIPTIONS BELOW, A DECIMAL NUMBER IS DESIGNATED BY "DDDDD".

SWITCH	EFFECT
/TESTS:LIST	EXECUTE ONLY THOSE TESTS SPECIFIED IN THE LIST. LIST IS A STRING OF TEST NUMBERS, FOR EXAMPLE - /TESTS:1:5:7-10. THIS LIST WILL CAUSE TESTS 1,5,7,8,9,10 TO BE RUN. ALL OTHER TESTS WILL NOT BE RUN.
/PASS:DDDDD	EXECUTE DDDDD PASSES (DDDDD = 1 TO 64000)
/FLAGS:FLGS	SET SPECIFIED FLAGS. FLAGS ARE DESCRIBED IN SECTION 2.3.
/EOP:DDDDD	REPORT END OF PASS MESSAGE AFTER EVERY DDDDD PASSES ONLY. (DDDDD = 1 TO 64000)
/UNITS:LIST	TEST/ADD/DROP ONLY THOSE UNITS SPECIFIED

IN THE LIST. LIST EXAMPLE - /UNITS:0:5:10-12
USE UNITS 0,5,10,11,12 (UNIT NUMBERS = 0-63)

EXAMPLE OF SWITCH USAGE:

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

THE EFFECT OF THIS COMMAND WILL BE: 1) TESTS 1 THROUGH 5 WILL BE EXECUTED, 2) ALL UNITS WILL TESTED 1000 TIMES AND 3) THE END OF PASS MESSAGES WILL BE PRINTED AFTER EACH 100 PASSES ONLY. A SWITCH CAN BE RECOGNIZED BY THE FIRST THREE CHARACTERS. YOU MAY, FOR EXAMPLE, TYPE "/TES:1-5" INSTEAD OF "/TESTS:1-5".

BELOW IS A TABLE THAT SPECIFIES WHICH SWITCHES CAN BE USED BY EACH COMMAND.

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

2.3 FLAGS

FLAGS ARE USED TO SET UP CERTAIN OPERATIONAL PARAMETERS SUCH AS LOOPING ON ERROR. ALL FLAGS ARE CLEARED AT STARTUP AND REMAIN CLEARED UNTIL EXPLICITLY SET USING THE FLAGS SWITCH. FLAGS ARE ALSO CLEARED AFTER A START COMMAND UNLESS SET USING THE FLAG SWITCH. THE ZFLAGS COMMAND MAY ALSO BE USED TO CLEAR ALL FLAGS. WITH THE EXCEPTION OF THE START AND ZFLAGS COMMANDS, NO COMMANDS AFFECT THE STATE OF THE FLAGS; THEY REMAIN SET OR CLEARED AS SPECIFIED BY THE LAST FLAG SWITCH.

FLAG	EFFECT
HOE	HALT ON ERROR - CONTROL IS RETURNED TO RUNTIME SERVICES COMMAND MODE
LOE	LOOP ON ERROR
IER*	INHIBIT ALL ERROR REPORTS
IBR*	INHIBIT ALL ERROR REPORTS EXCEPT FIRST LEVEL (FIRST LEVEL CONTAINS ERROR TYPE, NUMBER, PC, TEST AND UNIT)
IXR*	INHIBIT EXTENDED ERROR REPORTS (THOSE CALLED BY PRINTX MACRO'S)
PRI	DIRECT MESSAGES TO LINE PRINTER
PNT	PRINT TEST NUMBER AS TEST EXECUTES
BOE	"BELL" ON ERROR
UAM	UNATTENDED MODE (NO MANUAL INTERVENTION)

ISR	INHIBIT STATISTICAL REPORTS (DOES NOT APPLY TO DIAGNOSTICS WHICH DO NOT SUPPORT STATISTICAL REPORTING)
IDR	INHIBIT PROGRAM DROPPING OF UNITS
ADR	EXECUTE AUTODROP CODE
LOT	LOOP ON TEST
EVL	EXECUTE EVALUATION (ON DIAGNOSTICS WHICH HAVE EVALUATION SUPPORT)

* ERROR MESSAGES ARE DESCRIBED IN SECTION 3.1

SEE THE XXDP+ USER'S MANUAL FOR MORE DETAILS ON FLAGS. YOU MAY SPECIFY MORE THAN ONE FLAG WITH THE FLAG SWITCH. FOR EXAMPLE, TO CAUSE THE PROGRAM TO LOOP ON ERROR, INHIBIT ERROR REPORTS AND TYPE A "BELL" ON ERROR, YOU MAY USE THE FOLLOWING STRING:

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

2.4 HARDWARE QUESTIONS

WHEN A DIAGNOSTIC IS STARTED, THE RUNTIME SERVICES WILL PROMPT THE USER FOR HARDWARE INFORMATION BY TYPING "CHANGE HW (L) ?" YOU MUST ANSWER "Y" AFTER A START COMMAND UNLESS THE HARDWARE INFORMATION HAS BEEN "PRELOADED" USING THE SETUP UTILITY (SEE CHAPTER 6 OF THE XXDP+ USER'S MANUAL). WHEN YOU ANSWER THIS QUESTION WITH A "Y", THE RUNTIME SERVICES WILL ASK FOR THE NUMBER OF UNITS (IN DECIMAL). YOU WILL THEN BE ASKED THE FOLLOWING QUESTIONS FOR EACH UNIT.

```
UNIT 0
RPCS1 ADRS (O)  176700 ?
VECTOR ADRS (O)  254 ?
BR LEVEL (O)  5 ?
DRIVE # (O)  0 ?
```

THE 1ST QUESTION "RPCS1 ADRS" REQUIRES THAT THE USER INPUT THE ADDRESS OF RPCS1 OF THE CONTROLLER WHICH IS CONNECTED TO THE DRIVE UNDER TEST. DEFAULT IS 176700 (OCTAL).

THE 2ND QUESTION "VECTOR ADRS" REQUIRES THE USER TO INPUT THE INTERRUPT VECTOR ADDRESS OF THE RHXX CONTROLLER. DEFAULT IS 254 (OCTAL).

THE 3RD QUESTION "BR LEVEL" REQUIRES THE USER TO INPUT THE CONTROLLER INTERRUPT PRIORITY LEVEL. DEFAULT IS LEVEL 5.

THE 4TH QUESTION "DRIVE #" REQUIRES THE USER TO SPECIFY THE DRIVE NUMBER OF THE DRIVE TO BE TESTED. DEFAULT IS 0 (OCTAL).

2.5 SOFTWARE QUESTIONS

AFTER YOU HAVE ANSWERED THE HARDWARE QUESTIONS OR AFTER A RESTART OR CONTINUE COMMAND, THE RUNTIME SERVICES WILL ASK FOR SOFTWARE PARAMETERS. THESE PARAMETERS WILL GOVERN SOME DIAGNOSTIC SPECIFIC

OPERATION MODES. YOU WILL BE PROMPTED BY "CHANGE SW (L) ?", IF YOU WISH TO CHANGE ANY PARAMETERS, ANSWER BY TYPING "Y". THE SOFTWARE QUESTIONS AND THE DEFAULT VALUES ARE DESCRIBED AS FOLLOWS:

CHANGE DRIVE PARAMETER (L) N ?

IF THE RESPONSE TO THE PREVIOUS QUESTION IS 'N' THE FOLLOWING DRIVE PARAMETER QUESTIONS WILL BE SKIPPED AND PROGRAM WILL PROCEED AS NORMAL. A 'Y' RESPONSE WILL ALLOW THE USER TO ANSWER THE FOLLOWING DRIVE PARAMETER QUESTIONS.

```
STARTING  CYL (D)  0 ?       **(TESTS 2-4,6-8,11,13,14,17,18)
ENDING    CYL (D)  629 ?     **(TESTS 2-4,6,8,10,14,17,18)
INCREMENT CYL (D)  1 ?       **(TESTS 2)
STARTING  TRK (D)  0 ?       **(TESTS 2-7,11,13,16,17)
ENDING    TRK (D)  31 ?      **(TESTS 3-6,11,14,16-18)
INCREMENT TRK (D)  1 ?       **(TESTS 11,16,17)
STARTING  SEC (D)  0 ?       **(TESTS 2,5-7,13)
ENDING    SEC (D)  49 ?      **(TESTS 5,6,14,18)
DATA  PATTERN (O)  030221 ?  **(TESTS 16,17,18)
```

IF THE FIELD VERSION OF THIS PROGRAM IS BEING RUN, THE FOLLOWING QUESTION WILL BE ASKED.

DO YOU WANT TO WRITE ANYWHERE ON MEDIA (L) N ?

IF THE RESPONSE TO THE PREVIOUS QUESTION IS 'N', THE FOLLOWING QUESTION WILL BE SKIPPED AND PROGRAM WILL PROCEED AS NORMAL. A 'Y' RESPONSE WILL PRINT THE FOLLOWING WARNING MESSAGE TO THE OUTPUT DEVICE AND ASK THE FOLLOWING QUESTION.

! CUSTOMER DATA WILL BE OVERWRITTEN !

CONTINUE (L) ?
**(TESTS 17,18)

IF THE RESPONSE TO THE PREVIOUS QUESTION IS 'N', THE FOLLOWING QUESTION WILL BE SKIPPED AND THE PROGRAM WILL NOT ALLOW TESTS 17-18 TO BE SELECTED FOR TESTING. A 'Y' RESPONSE WILL ASK THE FOLLOWING QUESTION.

USE RANDOM DATA PATTERNS FOR RANDOM WRITE TEST (L) N ?
**(TESTS 18)

PERFORM READ HEADER & DATA DURING SEEKS (L) Y ?
**(TESTS 2-6)

TYPE TIME REPORTS (L) N ?
**(TESTS 7-10,14,18)

INHIBIT SOFTWARE TIMEOUTS (L) N ?
**(ALL TESTS)

TIMING TESTS, STALL BETWEEN SEEKS: RANDOM INSTEAD OF 2 MSEC (L) N ?
**(TESTS 7-10,14,18)

STALL AFTER EVERY DRIVE FUNCTION IN NON-TIMING TESTS (L) N ?

**(TESTS 1-6,11,13,14-18)

*USE RANDOM STALL TIMES (L) N ?
**(TESTS 1-6,11,13,14-18)

* THAT QUESTION IS ASKED WHEN YES IS ANSWERED TO THE QUESTION.
** INDICATES NOT PART OF THE DIALOGUE.

STALL DEFINITIONS

THERE ARE TWO DISTINCT STALLS :

1. SELECTABLE STALL, VIA SOFTWARE (SW) DIALOGUE: 10. MSEC OR RANDOM (1-64 MSEC) STALL TIME AFTER EVERY DRIVE FUNCTION IN NON-TIMING TESTS.

2. NON-SELECTABLE, 2 MSEC OR RANDOM STALL BETWEEN SEEKS IN TIMING TESTS 8. THRU 10.

A 'N' RESPONSE TO THE SUPERVISOR QUESTION "CHANGE SW (L)?" WILL ASSUME THE ASSIGNED SOFTWARE (SW) DEFAULT CONDITIONS: REPEATS = 1, STARTING CYLINDER = 0, ENDING CYLINDER = 629, STARTING TRACK = 0, ENDING TRACK = 31, INCREMENT TRACK = 1, STARTING SECTOR = 0, ENDING SECTOR = 49, PATTERN = 030221, WRITE ON ALL CYLINDERS WITHIN SPECIFIED LIMITS, RUN TESTS 1-18, DO READ HEADER AND DATA COMMAND IN SEEK TESTS 2-6, NO STALL, NO TIME REPORTS, SOFTWARE TIMEOUTS ENABLED.

NOTE

IF RUNNING THE FIELD VERSION OF THIS PROGRAM, TESTS 17 AND 18 WILL ONLY BE RUN WHEN THE "WRITE DATA ANYWHERE ON THE MEDIA" OPTION IS SELECTED BY THE OPERATOR.

2.6 EXTENDED P-TABLE DIALOGUE

WHEN YOU ANSWER THE HARDWARE QUESTIONS, YOU ARE BUILDING ENTRIES IN A TABLE THAT DESCRIBES THE DEVICES UNDER TEST. THE SIMPLEST WAY TO BUILD THIS TABLE IS TO ANSWER ALL QUESTIONS FOR EACH UNIT TO BE TESTED. IF YOU HAVE A MULTIPLEXED DEVICE SUCH AS A MASS STORAGE CONTROLLER WITH SEVERAL DRIVES OR A COMMUNICATION DEVICE WITH SEVERAL LINES, THIS BECOMES TEDIOUS SINCE MOST OF THE ANSWERS ARE REPETITIOUS.

TO ILLUSTRATE A MORE EFFICIENT METHOD, SUPPOSE YOU ARE TESTING A FICTIONAL DEVICE, THE XY11. SUPPOSE THIS DEVICE CONSISTS OF A CONTROL MODULE WITH EIGHT UNITS (SUB-DEVICES) ATTACHED TO IT. THESE UNITS ARE DESCRIBED BY THE OCTAL NUMBERS 0 THROUGH 7. THERE IS ONE HARDWARE PARAMETER THAT CAN VARY AMONG UNITS CALLED THE Q-FACTOR. THIS Q-FACTOR MAY BE 0 OR 1. BELOW IS A SIMPLE WAY TO BUILD A TABLE FOR ONE XY11 WITH EIGHT UNITS.

UNITS (D) ? 8<CR>

UNIT 1

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

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

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

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

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

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

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

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

NOTICE THAT THE DEFAULT VALUE FOR THE Q-FACTOR CHANGES WHEN A NON-DEFAULT RESPONSE IS GIVEN. BE CAREFUL WHEN SPECIFYING MULTIPLE UNITS!

AS YOU CAN SEE FROM THE ABOVE EXAMPLE, THE HARDWARE PARAMETERS DO NOT VARY SIGNIFICANTLY FROM UNIT TO UNIT. THE PROCEDURE SHOWN IS NOT VERY EFFICIENT.

THE RUNTIME SERVICES CAN TAKE MULTIPLE UNIT SPECIFICATIONS HOWEVER. LET'S BUILD THE SAME TABLE USING THE MULTIPLE SPECIFICATION FEATURE.

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

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

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

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

AS YOU CAN SEE IN THE ABOVE DIALOGUE, THE RUNTIME SERVICES WILL BUILD AS MANY ENTRIES AS IT CAN WITH THE INFORMATION GIVEN IN ANY ONE PASS THROUGH THE QUESTIONS. IN THE FIRST PASS, TWO ENTRIES ARE BUILT SINCE TWO SUB-DEVICES AND Q-FACTORS WERE SPECIFIED. THE SERVICES ASSUME THAT THE CSR ADDRESS IS 160000 FOR BOTH SINCE IT WAS SPECIFIED ONLY ONCE. IN THE SECOND PASS, FOUR ENTRIES WERE BUILT. THIS IS BECAUSE FOUR SUB-DEVICES WERE SPECIFIED. THE "-" CONSTRUCT TELLS THE RUNTIME SERVICES TO INCREMENT THE DATA FROM THE FIRST NUMBER TO THE SECOND. IN THIS CASE, SUB-DEVICES 2, 3, 4 AND 5 WERE SPECIFIED. (IF THE SUB-DEVICE WERE SPECIFIED BY ADDRESSES, THE INCREMENT WOULD BE BY 2 SINCE ADDRESSES MUST BE ON AN EVEN BOUNDARY.) THE CSR ADDRESSES AND Q-FACTORS FOR THE FOUR ENTRIES ARE ASSUMED TO BE 160000 AND 0 RESPECTIVELY SINCE THEY WERE ONLY SPECIFIED ONCE. THE LAST TWO UNITS ARE SPECIFIED IN THE THIRD PASS.

THE WHOLE PROCESS COULD HAVE BEEN ACCOMPLISHED IN ONE PASS AS SHOWN BELOW.

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

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

AS YOU CAN SEE FROM THIS EXAMPLE, NULL REPLIES (COMMAS ENCLOSING A NULL FIELD) TELL THE RUNTIME SERVICES TO REPEAT THE LAST REPLY.

2.7 QUICK START-UP PROCEDURE (XXDP+)

TO START-UP THIS PROGRAM:

1. BOOT XXDP+
2. GIVE THE DATE AND ANSWER THE LSI AND 50HZ (IF THERE IS A CLOCK) QUESTIONS
3. TYPE "R NAME", WHERE NAME IS THE NAME OF THE BIN OR BIC FILE FOR THIS PROGRAM
4. TYPE "START"
5. ANSWER THE "CHANGE HW" QUESTION WITH "Y"

6. ANSWER ALL THE HARDWARE QUESTIONS

7. ANSWER THE "CHANGE SW" QUESTION WITH "N"

WHEN YOU FOLLOW THIS PROCEDURE YOU WILL BE USING ONLY THE DEFAULTS FOR FLAGS AND SOFTWARE PARAMETERS. THESE DEFAULTS ARE DESCRIBED IN SECTIONS 2.3 AND 2.5.

3.0 ERROR INFORMATION

3.1 TYPES OF ERROR MESSAGES

THERE ARE THREE LEVELS OF ERROR MESSAGES THAT MAY BE ISSUED BY A DIAGNOSTIC: GENERAL, BASIC AND EXTENDED. GENERAL ERROR MESSAGES ARE ALWAYS PRINTED UNLESS THE "IER" FLAG IS SET (SECTION 2.3). THE GENERAL ERROR MESSAGE IS OF THE FORM:

```
NAME  TYPE  NUMBER  ON UNIT NUMBER  TST NUMBER PC:XXXXXX
ERROR MESSAGE

,WHERE; NAME = DIAGNOSTIC NAME
        TYPE = ERROR TYPE (SYS FATAL, DEV FATAL, HARD OR SOFT)
        NUMBER = ERROR NUMBER
        UNIT NUMBER = 0 - N (N IS LAST UNIT IN PTABLE)
        TST NUMBER = TEST AND SUBTEST WHERE ERROR OCCURRED
        PC:XXXXXX = ADDRESS OF ERROR MESSAGE CALL
```

BASIC ERROR MESSAGES ARE MESSAGES THAT CONTAIN SOME ADDITIONAL INFORMATION ABOUT THE ERROR. THESE ARE ALWAYS PRINTED UNLESS THE "IER" OR "IBR" FLAGS ARE SET (SECTION 2.3). THESE MESSAGES ARE PRINTED AFTER THE ASSOCIATED GENERAL MESSAGE.

EXTENDED ERROR MESSAGES CONTAIN SUPPLEMENTARY ERROR INFORMATION SUCH AS REGISTER CONTENTS OR GOOD/BAD DATA. THESE ARE ALWAYS PRINTED UNLESS THE "IER", "IBR" OR "IXR" FLAGS ARE SET (SECTION 2.3). THESE MESSAGES ARE PRINTED AFTER THE ASSOCIATED GENERAL ERROR MESSAGE AND ANY ASSOCIATED BASIC ERROR MESSAGES.

3.2 ERROR PRINTOUT

THE ERROR PRINTOUT WILL CONTAIN A ONE LINE ERROR DESCRIPTION FOLLOWED BY COLUMN HEADINGS AND COLUMNS OF REGISTER CONTENTS IN OCTAL.

EXAMPLE:

```
CZRXXX  HRD  ERR  OOXXX  ON UNITXX  TSTXX  SUBXX  PCXXXXX
RP07 ADDRESSING ERROR (IAE AOE)
CYL XXX.  TRK XX.  SEC XX.     RPER2  (HEX) XXXX

DRIVE  RPCS1  RPWC   RPBA   RPDA   RPCS2  RPDS
XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX
RPER1  RPAS   RPLA   RPDB   RPMR1  RPDT   RPSN
XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX
RPOF   RPDC   RPCC   RPER2  RPER3  RPEC1  RPEC2
XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX
```

THE FIRST LINE OF THE ERROR MESSAGE IS PRODUCED BY THE DIAGNOSTIC SUPERVISOR. THERE ARE SEVEN ITEMS REPRESENTED IN THE FIRST LINE OF OUTPUT. THEY ARE: 1) THE MAINDEC NUMBER, 2) THE TYPE OF ERROR, IE: HARD, DEVICE FATAL, 3) THE ERROR MESSAGE NUMBER, 4) THE FAILING LOGICAL UNIT NUMBER, 5) THE NUMBER OF THE FAILING TEST, 6) THE NUMBER OF THE FAILING SUB-TEST, 7) THE ACTUAL PROGRAM COUNT OF THE FAILURE MESSAGE.

THE SECOND LINE PRODUCES INFORMATION ABOUT THE SPECIFIC FAILURE MODE. THE BALANCE OF THE ERROR REPORT CONTAINS REGISTER STATUS TO AID THE F.E. IN FAULT DETECTION AND POSSIBLE ISOLATION.

3.3 SPECIFIC ERROR MESSAGES

INIT CODE ERRORS

ON A START COMMAND OR ON A NEW PASS, THE DRIVE AVAILIBILITY IS CHECKED IN THE INIT CODE, BEFORE RUNNING THE TESTS. A DRIVE NOT AVAILABLE IS APPROPRIATELY REPORTED AND THE CURRENT PASS ABORTED FOR THAT UNIT:

```
DRIVE N UNSAFE
DRIVE N NON-EXISTENT
DRIVE N OFF-LINE
DRIVE N NOT A RP07
```

WHERE 'N' IS THE DRIVE NUMBER THAT FAILED

NUMBERED ERROR LIST

```
 1:   RHXX CONTROL BUS PARITY ERROR MCPE=1
 2:   RHXX DATA BUS PARITY ERROR MDPE=1
 3:   RHXX ILLEGAL CONDITIONS SET (NED,NEM,PGE,MXF)
 4:   WRITE CHECK ERROR
 5:   DATA LATE ERROR
 6:   DRIVE PROGRAMMING ERROR (PGE)
 7:   LOSTS BIT CLOCK (LBC)
11:   WRITE CLOCK FAILS
12:   WRITE LOCK ERROR
13:   DATA ERROR (DCK)
14:   DRIVE BUS PARITY ERROR (DPE)
15:   ILLEGAL CONDITIONS SET (ILF,ILR,RMR)
16:   ADDRESSING ERROR (IAE,AOE)
17:   SEEK ERROR (SKI,LCE)
20:   CLOCK (KW11-P) OVERFLOW IN TIMING TEST
21:   EARLY WARNING (EWN)
22:   READ AND WRITE HEAD FAILS
23:   DATA FORMAT BIT ERROR (FER)
24:   HEADER INFORMATION ERROR (HCE)
25:   DRIVE HAS BECOME NON-EXISTENT                          (1)
26:   DRIVE HAS NOT RESPONDED TO PORT REQUEST
27:   SOFTWARE TIMEOUT ON THIS DRIVE
30:   FATAL MASSBUS PARITY ERROR (MCPE=1 OR PAR=1)           (1)
31:   OFFLINE OR UNSAFE DRIVE REQUESTED                      (1)
32:   WRITE-READY UNSAFE
```

```
33:  DC POWER UNSAFE
34:  INDEX UNSAFE
35:  PROCESSOR HANDSHAKE FAILURE
36:  DRIVE OFF-LINE OR NOT A RP07                                   (1)
41:  OPERATION INCOMPLETE (OPI)
42:  IMPROPER HEADER DATA                                           (2)
43:  ECC LOGIC FAILURE
44:  MISC DRIVE ERROR: RPER1, RPER2, RPER3
45:  DRIVE TIMING ERROR (DTE)
46:  HEADER CRC ERROR (HCRC)
47:  UNCORRECTABLE ECC ERROR
50:  LAST BLOCK TFR LBT NOT SET WHEN READING LAST SECTOR            (4)
51:  AD OVFL AOE NOT SET WHEN READING PAST LAST SECTOR              (4)
52:  HARD ERROR -                                                   (3)
53:  SOFT ERROR -                                                   (3)
54:  OM OF RPDS NOT SET ON OFFSET CMD                               (4)
55:  OM OF RPDS NOT RESET ON RET CENTER CMD                         (4)
```

MOST OF THE NUMBERED ERRORS ABOVE WILL ALSO CAUSE A DUMP OF THE FORMAT BELOW, CONSISTING OF 2 PARTS, A BASIC, THEN AN EXTENDED ERROR MESSAGE, BOTH CONTROLLED BY IBR AND IXR FLAGS:

```
CYL XXX.  TRK XX.  SEC XX.     RPER2  (HEX) XXXX

DRIVE  RPCS1  RPWC   RPBA   RPDA   RPCS2  RPDS
XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX
RPER1  RPAS   RPLA   RPDB   RPMR1  RPDT   RPSN
XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX
RPOF   RPDC   RPCC   RPER2  RPER3  RPEC1  RPEC2
XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX
```

EXCEPTIONS:

(1) DRIVE N

(2) DRV CYL TRK SEC
XXX XXX XXX XXX
GDCYL GDTRK GDSEC BDCYL BDTRK BDSEC
XXX XXX XXX XXX XXX XXX

(3) # OF OPERATIONS WITH A LOST REVOLUTION: XXXX
XXXX OPERATIONS TIMED

ALLOWABLE OPERATION TIME LIMIT
MAX= XXXXX US

(4) NO ADDITIONAL MESSAGES

(5) TIMING TESTS 7, 14, 18:

UNRECOVERABLE SEARCH ERROR
ABORT TEST

SEARCH FAILED AFTER 16 RETRIES
ABORT TEST

(6) TIMING TESTS 8-10, 14, 18:

POSITION ERROR: ABORT TEST

3.4 ERROR TYPE

THE FIRST LINE OF ERROR MESSAGES PRODUCED BY THE DIAGNOSTIC SUPERVISOR IDENTIFIES THE TYPE OF ERROR REPORTED. THEY ARE CLASSIFIED BY THE DIAGNOSTICS IN 3 CATEGORIES:

1. 'SFT' - SOFT: THE FIRST LOST D'SC REVOLUTION IN THE ADDRESS MARK DETECTION TESTS.
2. 'HRD' - HARD: ALL ERRORS, EXCEPT DEVICE FATAL ERRORS AND SOFT ERRORS.
3. 'DVC FTL' - DEVICE FATAL: AN ERROR THAT FAILS THE DEVICE; DEVICE NOT READY, NON-EXISTENT OR NOT AN RP07.

4.0 PERFORMANCE AND PROGRESS REPORTS

AT THE END OF EACH PASS, THE PASS COUNT IS GIVEN ALONG WITH THE TOTAL NUMBER OF ERRORS REPORTED SINCE THE DIAGNOSTIC WAS STARTED. THE "EOP" SWITCH CAN BE USED TO CONTROL HOW OFTEN THE END OF PASS MESSAGE IS PRINTED. SECTION 2.2 DESCRIBES SWITCHES.

5.0 TEST SUMMARIES

TEST 1: RECAL TEST

THIS TEST EXECUTES A RECALIBRATE COMMAND, THEN EXECUTES A READ HEADER AND DATA COMMAND TO VERIFY CORRECT POSITION.

NOTE

IN SEEK TESTS 2-6, SEEK POSITIONING IS VERIFIED VIA READ HEADER AND DATA COMMAND, UNSUPERSEDED BY SOFTWARE (SW) DIALOGUE, IN WHICH CASE SEEK POSITIONING IS NOT VERIFIED.

TEST 2: INCREMENTAL SEEK TEST

THIS TEST EXECUTES FORWARD SEEKS TO ADVANCE THE FIRST(STARTING) CYLINDER ADDRESS TO THE LAST(ENDING) CYLINDER ADDRESS INCREMENTALLY. WHEN THE LAST(ENDING) CYLINDER IS REACHED, THE TEST IS REPEATED IN THE REVERSE DIRECTION. THE INCREMENT/DECREMENT VALUE IS 1 BY DEFAULT, CHANGEABLE VIA SW DIALOGUE.

TEST 3: RANDOM SEEK TEST

THIS TEST EXECUTES 1024. SEEK OPERATIONS RANDOMLY BETWEEN THE GIVEN FIRST(STARTING) CYLINDER ADDRESS AND LAST(ENDING) CYLINDER ADDRESS.

TEST 4: RECAL/RANDOM SEEK TEST

THIS TEST EXECUTES A RECALIBRATE COMMAND, FOLLOWED BY A SEEK TO A RANDOMLY SELECTED CYLINDER. THIS SEQUENCE IS REPEATED 10. TIMES.

TEST 5: SEEK DIFFERENTIAL TEST

THIS TEST CONSISTS OF 3 SUBTESTS TO TEST THE HEAD POSITIONER AND SERVO SYSTEM RESPONSE TO 3 UNIQUE DIFFERENTIAL SEEK PROFILES:

1. 6 CYLINDER DIFFERENTIAL SEEK: FORCES A SLEW RATE CHANGE BY SEEKING FROM CYLINDER 0 TO 5, 1 TO 6, 2 TO 7, ... 624 TO 629, TO TEST THE POSITIONAL LOGIC.

2. 33 CYLINDER DIFFERENTIAL SEEK: WORST CASE SEEK OVERSHOOT TEST, FORCED BY SEEKING FROM CYLINDER 0 TO 32, 1 TO 33, 2 TO 34, ... 597 TO 629.

3. 400 CYLINDER DIFFERENTIAL SEEK: FORCES MAXIMUM ACCELERATION AND DECELERATION OF CARRIAGE ASSEMBLY, FORCED BY SEEKING FROM CYLINDER 0 TO 399, 1 TO 400, 2 TO 401, ... 230 TO 629.

TEST 6: OSCILLATING SEEK TEST

THIS TEST SHALL EXECUTE A SERIES OF SEEK OPERATIONS TO CAUSE AN OSCILLATING MOVEMENT OF THE HEAD POSITIONER. THAT MOVEMENT SHALL RESULT FROM SEEKING TO THE FOLLOWING PATTERN OF DESIRED CYLINDERS: FROM THE MAXIMUM DISTANCE SEEK OF CYLINDER 0 TO LAST(ENDING) CYLINDER (LC), FROM CYLINDER 1 TO LC-1, FROM CYLINDER 2 TO LC-2, ... DOWN TO THE MEDIAN CYLINDER, THEN, REVERSING THE ORDER OF THOSE SEEKS FROM THE MEDIAN CYLINDER BACK UP TO THE MAXIMUM DISTANCE SEEK OF CYLINDER 0 TO LC.

NOTE

THE TESTS NUMBERED 7-10., 14., 18. CONTAIN TIMING TESTS. THEY REQUIRE THAT A KW11P P-CLOCK BE INSTALLED ON THE SYSTEM IN-ORDER TO RUN. AT THE COMPLETION OF EACH OF THE TIMING TESTS, THE MAXIMUM AND THE MINIMUM TIMES, AND THE AVERAGE SEEK TIME FOR EACH TEST ARE CHECKED AGAINST THE TOLERANCES GIVEN BY THE ENGINEERING SPECS. THE PROGRAM WILL PRINT THE MEASURED TIMES ONLY IF THEY ARE OVER THE TIMING TOLERANCES, PROVIDED THE PRINT WAS REQUESTED VIA SOTWARE (SW) DIALOGUE. IF A SYSTEM CLOCK IS NOT FOUND TO BE PRESENT, TIMING TESTS WILL NOT BE EXECUTED. THE OPERATOR WILL BE NOTIFIED VIA A MESSAGE.

TEST 7: ROTATIONAL SPEED TIMING TEST

THIS TEST EXECUTES A SEARCH COMMAND TO CYLINDER FC, TRACK FT AND SECTOR FS. AS SOON AS THE SEARCH OPERATION IS DONE, THE TEST SETS THE "GO" BIT TO EXECUTE ANOTHER SEARCH COMMAND WITH THE SAME RHXX/RP07 REGISTER CONTENTS. THE TIME INTERVAL IS MEASURED AGAINST A TOLERANCE OF 16.515 MSEC +-3%. REPEAT THIS SEQUENCE 10 TIMES. IN CASE ANY RECOVERABLE READ ERROR EXISTS, THE PROGRAM WILL EXECUTE THE SEARCH COMMAND 16 TIMES. IF THE RETRY SEQUENCE FAILS THE PROGRAM WILL ABORT THE TEST, GENERATING A MESSAGE TELLING WHY THE PROGRAM WAS ABORTED.

TEST 8: ONE CYLINDER SEEK TIMING TEST

THIS TEST EXECUTES FORWARD SEEK FROM THE FIRST(STARING) CYLINDER TO THE FIRST(STARTING) CYLINDER + 1 AND THE OPERATION IS TIMED AGAINST A TOLERANCE OF 5 MSEC.. AFTER EXECUTING THE TEST CYCLE, THE FIRST(STARING) CYLINDER ADDRESS IS INCREMENTED BY ONE. THIS PROCEDURE CONTINUES UNTIL THE FIRST(STARTING) CYLINDER ADDRESS REACHES 629 THE USER SPECIFIED ENDING CYLINDER, THEN THE TEST IS REPEATED IN THE REVERSE DIRECTION. DO THIS SEQUENCE TWICE. THE AVERAGE ONE CYLINDER SEEK TIME WILL BE COMPUTED AND REPORTED WHEN THE "TYPE TIME REPORTS (L)" QUESTION IS RESPONDED TO IN THE AFFIRMATIVE. THE AVERAGE SEEK TIME FOR A SINGLE CYLINDER SEEK IS COMPUTED PER FORMULA:

$$T\ (AVG) = \frac{T1 + T2 + \ldots T629 + T629 + \ldots T2 + T1}{629 + 629}$$

WHERE TX IS THE SINGLE CYLINDER SEEK TIME.

TEST 9: AVERAGE SEEK TIME MEASUREMENT

THIS TEST WILL MEASURE THE AVERAGE SEEK TIME BY USING THE FOLLOWING CALCULATION:

$$T\ (AVG) = \frac{2 \times [\ (T1 \times 629)+(T2 \times 628)+\ldots+(T629 \times 1)]}{629 \times 629}$$

WHERE:
THE TX IS THE FORWARD (REVERSE) SEEK TIME FROM CYLINDER 0 TO CYLINDER X (CYLINDER X TO CYLINDER 0). THE NUMBER 2X629 IS THE TOTAL NUMBER OF SEEKS EXECUTED.
AVERAGE SEEK TIME TOLERANCE IS 23 MSEC.

TEST 10: MAXIMUM SEEK TIMING TEST

THIS TEST EXECUTES FORWARD SEEK FROM CYLINDER 0 TO THE LAST(ENDING) CYLINDER, THEN A REVERSE SEEK FROM THE LAST(ENDING) CYLINDER TO CYLINDER 0. BOTH SEEKS ARE TIMED AGAINST A TOLERANCE OF 46 MSEC.. A TOTAL NUMBER OF 1024 SEEKS WILL BE EXECUTED TO CALCULATE THE MAXIMUM SEEK TIME(512 FORWARD, 512 REVERSE).

TEST 11: MID TRANSFER SEEK TEST

THIS TEST EXECUTES READ DATA COMMANDS FOR EVERY TRACK ON THE FIRST (STARTING) CYLINDER, WITH WORD COUNT BEING SET TO EQUAL A FULL TRACK PLUS ONE SECTOR. THIS TEST ENSURES THAT EACH READ HEAD WORKS PROPERLY AND ALSO ENSURES THAT THE SPIRAL READ DATA OPERATION, REQUIRING A MID-TRANSFER SEEK, WORKS PROPERLY.

TEST 12: ERROR REGISTER BIT TEST

EXECUTE A READ DATA COMMAND ON THE LAST USER ADDRESSABLE SECTOR, TESTING FOR THE ASSERTION OF LAST BLOCK TRANSFERRED (LBT) BIT OF THE STATUS REG RPDS. REISSUE READ DATA COMMAND TO LAST SECTOR WITH A WORD COUNT GREATER THAN 256 WORDS, TESTING FOR THE ASSERTION OF THE ADDRESS OVERFLOW ERROR (AOE) BIT OF THE ERROR REG. RPER1.

TEST 13: OFFSET/RETURN TO CENTER LINE TEST

VERIFY THAT THE OFFSET AND RETURN TO CENTER LINE COMMAND WORK PROPERLY.

ISSUE AN OFFSET COMMAND, PROCESS THE ATTENTION INTERRUPT AND CHECK FOR ERRORS, VERIFY THE ASSERTION OF THE OFFSET MODE (OM) BIT OF RPDS.

ISSUE A RETURN TO CENTER LINE COMMAND, PROCESS THE ATTENTION INTERRUPT AND CHECK FOR ERRORS, VERIFY THE RESETTING OF OM.

TEST 14: RANDOM READ TEST / ADDRESS MARK DETECTION TEST

IF THERE IS NO P-CLOCK, THIS TEST RANDOMLY SELECTS A SECTOR, THEN EXECUTES A READ DATA COMMAND TO THIS SECTOR TO VERIFY THAT NO DATA TRANSFER ERROR OCCURS. REPEAT 1024 TIMES.

IF THERE IS A P-CLOCK, THE ADDRESS MARK DETECTION TIMING TEST VERIFIES THAT DATA CAN BE READ CORRECTLY WITHIN THE SAME REVOLUTION AS A SECTOR DETECTION. THE TEST RANDOMLY SELECTS A SECTOR, SEARCHES FOR THE PRECEDING LOGICAL SECTOR, THEN READS THE SELECTED SECTOR. THE TIME INTERVAL SEARCH DONE - READ DONE IS MEASURED AND CHECKED TO BE WITHIN THE SAME DISC REVOLUTION. REPEAT THIS SEQUENCE 1024 TIMES. AT THE END OF THE TEST, AN ERROR MESSAGE SHALL INDICATE THE NUMBER OF OPERATIONS WITH A REVOLUTION LOST, IF ANY.

TEST 15: FE CYLINDER ADDRESS TEST

THIS TEST EXECUTES READ-HEADER AND DATA COMMANDS TO VERIFY THE ADDRESSING OF SECTOR 0 ON ALL TRACKS OF THE FIRST FE CYLINDER, THEN EXECUTES AN EXPLICIT SEEK TO ACCESS THE SECOND FE CYLINDER.

TEST 16: FE CYLINDER WRITE AND WRITE-CHECK TEST

THIS TEST WILL WRITE ON THE FIRST FE CYLINDER FROM THE

FIRST(STARTING) TO THE LAST(ENDING) TRACK TO VERIFY THAT THE DRIVE CAN WRITE DATA WITHOUT DETECTABLE ERROR. THE TEST WRITES THE DEFAULT DATA PATTERN 030221 OR A USER SPECIFIED DATA PATTERN ONTO THE MEDIA, FOLLOWED BY EXECUTING A WRITE-CHECK COMMAND. THE TEST CHANGES THE DATA PATTERN TO ITS COMPLEMENT VALUE AND REPEATS THE TEST CYCLE. THE WORD COUNT IS SET TO DO TWO HALF TRACK DATA TRANSFERS.

TEST 17: WRITE TEST

IF RUNNING THE FIELD VERSION OF THIS PROGRAM, THIS TEST IS ONLY RUN IF THE "WRITE DATA ANYWHERE ON THE MEDIA" OPTION IS SELECTED BY THE OPERATOR, IN THE SOFTWARE PARAMETER QUESTIONS.

THIS TEST WRITES DATA AND WRITE CHECKS DATA ON EVERY TRACK FROM THE FIRST(STARTING) TO LAST(ENDING) TRACK OF THE FIRST (STARTING) CYLINDER FC AND THE LAST(ENDING) CYLINDER. THE WORD COUNT IS SET TO DO TWO HALF TRACK DATA TRANSFERS.

TEST 18: RANDOM WRITE TEST /ADDRESS MARK DETECTION TEST

IF RUNNING THE FIELD VERSION OF THIS PROGRAM, THIS TEST IS ONLY RUN IF THE "WRITE DATA ANYWHERE ON THE MEDIA" OPTION IS SELECTED BY THE OPERATOR, IN THE SOFTWARE PARAMETER QUESTIONS.

IF THERE IS NO P-CLOCK, THIS TEST WRITES DATA AND WRITE CHECKS DATA RANDOMLY ON THE MEDIA, WITH A TRANSFER SIZE OF 1 SECTOR, 1024 TIMES. THE DATA PATTERN IS RANDOM OR A SPECIFIED PATTERN.

IF THERE IS A P-CLOCK, THE ADDRESS MARK DETECTION TIMING TEST VERIFIES THAT DATA CAN BE WRITTEN CORRECTLY WITHIN THE SAME REVOLUTION AS A SECTOR DETECTION. THE TEST RANDOMLY SELECTS A SECTOR, SEARCHES FOR THE PRECEDING SECOND LOGICAL SECTOR, THEN WRITES THE SELECTED SECTOR. THE TIME INTERVAL SEARCH DONE - WRITE DONE IS MEASURED AND CHECKED TO BE WITHIN THE SAME DISC REVOLUTION. A WRITE CHECK DATA IS THEN ISSUED ON THE SELECTED SECTOR. REPEAT 1024 TIMES. AT THE END OF THE TEST, AN ERROR MESSAGE SHALL INDICATE THE NUMBER OF OPERATIONS WITH A REVOLUTION LOST, IF ANY.

```
.REM @

        VERSION (CZRJL-A-0)

            1.  THIS VERSION IS THE STARTING POINT FOR CX DIAGNOSTIC SUPPORT OF
                THE RP07 DISK DRIVE.

@
```

```
HISTORY

                        ;*LAST REVISION 01-JAN-83
                        .TITLE  CZRJLA0 RP07 FCTNL TEST
                        .SBTTL  PROGRAM HEADER

000000                          .ENABL  AMA,ABS
002000                  .       =       2000

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


002000                  L$NAME::                ;DIAGNOSTIC NAME
002000  103                     .ASCII /C/
002001  132                     .ASCII /Z/
002002  122                     .ASCII /R/
002003  112                     .ASCII /J/
002004  114                     .ASCII /L/
002005  000                     .BYTE   0
002006  000                     .BYTE   0
002007  000                     .BYTE   0
002010                  L$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  000060                  .WORD   60
002016                  L$HPCP::                ;POINTER TO H.W. QUES.
002016  041026                  .WORD   L$HARD
002020                  L$SPCP::                ;POINTER TO S.W. QUES.
002020  041144                  .WORD   L$SOFT
002022                  L$HPTP::                ;PTR. TO DEF. H.W. PTABLE
002022  002172                  .WORD   L$HW
002024                  L$SPTP::                ;PTR. TO S.W. PTABLE
002024  002204                  .WORD   L$SW
002026                  L$LADP::                ;DIAG. END ADDRESS
002026  074614                  .WORD   L$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$PRIO::                ;DIAGNOSTIC RUN PRIORITY
002042  000000                  .WORD   0
002044                  L$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  003020                  .WORD   L$DVTYP
002062                  L$REPP::                ;PTR. TO REPORT CODE
002062  000000                  .WORD   0
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  000000                  .WORD   0
002074                  L$LUN::                 ;LUN FOR EXERCISERS TO FILL
002074  000000                  .WORD   0
002076                  L$DESP::                ;POINTER TO DIAG. DESCRIPTION
002076  003026                  .WORD   L$DESC
002100                  L$LOAD::                ;GENERATE SPECIAL AUTOLOAD EMT
002100  104035                  EMT     E$LOAD
002102                  L$ETP::                 ;POINTER TO ERRTBL
002102  000000                  .WORD   0
002104                  L$ICP::                 ;PTR. TO INIT CODE
002104  025460                  .WORD   L$INIT
002106                  L$CCP::                 ;PTR. TO CLEAN-UP CODE
002106  026504                  .WORD   L$CLEAN
002110                  L$ACP::                 ;PTR. TO AUTO CODE
002110  026502                  .WORD   L$AUTO
002112                  L$PRT::                 ;PTR. TO PROTECT TABLE
002112  025452                  .WORD   L$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
325
```

```
                        .SBTTL  DISPATCH TABLE

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

002122  000022                  .WORD   18
002124                  L$DISPATCH::
002124  026610                  .WORD   T1
002126  026660                  .WORD   T2
002130  026766                  .WORD   T3
002132  027220                  .WORD   T4
002134  027434                  .WORD   T5
002136  027664                  .WORD   T6
002140  027772                  .WORD   T7
002142  031050                  .WORD   T8
002144  032040                  .WORD   T9
002146  032756                  .WORD   T10
002150  033632                  .WORD   T11
002152  034036                  .WORD   T12
002154  034264                  .WORD   T13
002156  034454                  .WORD   T14
002160  035772                  .WORD   T15
002162  036250                  .WORD   T16
002164  036636                  .WORD   T17
002166  037160                  .WORD   T18
```

```
                                .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.
                                ;--

 002170  000004                        .WORD   L10000-L$HW/2
 002172                         L$HW::
 002172                         DFPTBL::
 002172  176700                         .WORD 176700    ;RPCS1 BASE REGISTER ADDRESS
 002174  000254                         .WORD 254       ;VECTOR ADDRESS
 002176  000240                         .WORD 240       ;BR LEVEL 5 DEVICE
 002200  000000                         .WORD 0         ;DRIVE NUMBER


 002202                         L10000:
```

```
                        .SBTTL  SOFTWARE P-TABLE

                        ;++
                        ; THE SOFTWARE P-TABLE CONTAINS THE VALUES OF THE PROGRAM
                        ; PARAMETERS THAT CAN BE CHANGED BY THE OPERATOR.
                        ;--

002202  000016                  .WORD   L10001-L$SW/2
002204                  L$SW::
002204                  SFPTBL::
002204  000000          FC:     .WORD   0       ;FIRST CYLINDER         ;TESTS: 2-4,6-8,11,13,14,17,18
002206  001165          LC:     .WORD   629.    ;LAST  CYLINDER         ;TESTS: 2-4,6,8-10,14,17,18
002210  000001          IC:     .WORD   1       ;INCREMENT CYLINDER     ;TESTS: 2
002212  000000          FT:     .WORD   0       ;FIRST TRACK            ;TESTS: 2-7,11,13,16,17
002214  000037          LT:     .WORD   31.     ;LAST TRACK             ;TESTS: 3-6,11,14,16-18
002216  000001          IT:     .WORD   1       ;INCREMENT TRACK        ;TESTS: 11,16,17
002220  000000          FS:     .WORD   0       ;FIRST SECTOR           ;TESTS: 2,5-7,13
002222  000061          LS:     .WORD   49.     ;LAST SECTOR            ;TESTS: 5,6,14,18
002224  030221          PAT:    .WORD   030221  ;WRITE DATA PATTERN     ;TESTS: 16-18 (WORST CASE)

002226  001            REDHDR: .BYTE   1       ;READ HEADER AND DATA CMD FLAG - DEFAULT: YES - SEEK TESTS 2-6
002227  001            TIMTYP: .BYTE   1       ;TYPE TIME - DEFAULT: YES - TIMING TESTS 7-10,14,18
002230  000            TIMSTL: .BYTE   0       ;TIMING TESTS,STALL BETWEEN SEEKS: RANDOM INSTEAD OF 2 MSEC
002231  000            STALLF: .BYTE   0       ;STALL FLAG: AFTER EVERY DRIVE FUNCTION - DEFAULT: NO
                                               ;NON-TIMING TESTS 1-6,11,14-18
002232  000            STALRD: .BYTE   0       ;RANDOM STALL FLAG - DEFAULT: NO - PREREQUISITE: STALLF=1
002233  000            STOFLG: .BYTE   0       ;SOFTWARE TIMEOUT INHIBIT FLAG - DEFAULT: NO - ALL TESTS
002234  000            RANPAT: .BYTE   0       ;RANDOM WRITE PATTERN - DEFAULT: NO - TEST: 18
002235  000            WRTALL: .BYTE   0       ;WRITE DATA ALL OVER THE MEDIA FLAG - DEFAULT: NO
                                               ;TESTS: 17,18
002236  000            CHANGE: .BYTE   0       ;CHANGE DRIVE PARAMETER FLAG

                                .EVEN

002240                  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
                                ;
000040                          EF.START==      32.                     ; START COMMAND WAS ISSUED
000037                          EF.RESTART==    31.                     ; RESTART COMMAND WAS ISSUED
000036                          EF.CONTINUE==   30.                     ; CONTINUE COMMAND WAS ISSUED
000035                          EF.NEW==        29.                     ; A NEW PASS HAS BEEN STARTED
000034                          EF.PWR==        28.                     ; A POWER-FAIL/POWER-UP OCCURRED
                                ;
                                ;
                                ; PRIORITY LEVEL DEFINITIONS
                                ;
000340                          PRI07== 340
000300                          PRI06== 300
000240                          PRI05== 240
000200                          PRI04== 200
000140                          PRI03== 140
000100                          PRI02== 100
```

GLOBAL EQUATES SECTION

```
000040                  PRI01== 40
000000                  PRI00== 0
                        ;
                        ;OPERATOR FLAG BITS
                        ;
000004                  EVL==          4
000010                  LOT==         10
000020                  ADR==         20
000040                  IDU==         40
000100                  ISR==        100
000200                  UAM==        200
000400                  BOE==        400
001000                  PNT==       1000
002000                  PRI==       2000
004000                  IXE==       4000
010000                  IBE==      10000
020000                  IER==      20000
040000                  LOF==      40000
100000                  HOE==     100000
```

```
                                .SBTTL  RHXX REGISTERS
                                ;
                                ;CONTROL AND STATUS REGISTER 1 (RPCS1)
                                ;
000100                          IE      == 100                  ;INTERRUPT ENABLE (BIT #6)
000200                          RDY     == 200                  ;READY (BIT #7)
000400                          A16     == 400                  ;HIGH ORDER BUS ADDRESS BIT (BIT #8)
001000                          A17     == 1000                 ;HIGH ORDER BUS ADDRESS BIT (BIT #9)
                                ;PSEL   == 2000                 ;PORT SELECT (BIT #10)
020000                          MCPE    == 20000                ;MASSBUSS PARITY ERROR (BIT #13)
040000                          TRE     == 40000                ;TRANSFER ERROR (BIT #14)
100000                          MSSC    == 100000               ;SPECIAL CONDITION (BIT #15)
                                ;
                                ;
                                ;WORD COUNT REGISTER (RPWC)
                                ;(EACH BIT IS CALLED BY BIT NUMBER)
                                ;
                                ;
                                ;BUS ADDRESS REGISTER (RPBA)
                                ;(EACH BIT IS CALLED BY BIT NUMBER)
                                ;
                                ;
                                ;CONTROL AND STATUS REGISTER 2 (RPCS2)
                                ;
                                ;US1     == 1                   ;UNIT SELECT (BIT #0)
                                ;US2     == 2                   ;UNIT SELECT (BIT #1)
                                ;US4     == 4                   ;UNIT SELECT (BIT #2)
                                ;BAI     == 10                  ;BUS ADDRESS INCREMENT INHIBIT (BIT #3)
                                ;MSPAT   == 20                  ;MASSBUS PARITY TEST (BIT #4)
000040                          CLR     == 40                   ;CLEAR (BIT #5)
                                ;IR      == 100                 ;INPUT READY (BIT #6)
                                ;OR      == 200                 ;OUTPUT READY (BIT #7)
000400                          MPE     == 400                  ;MASS BUS PARITY ERROR (BIT #8)
001000                          MXF     == 1000                 ;MISSED TRANSFER ERROR (BIT #9)
002000                          MSPGE   == 2000                 ;PROGRAM ERROR (BIT #10)
004000                          NEM     == 4000                 ;NON EXISTENT MEMORY (BIT #11)
010000                          NED     == 10000                ;NON EXISTENT DRIVE (BIT #12)
020000                          UPE     == 20000                ;UNIBUS PARITY ERROR (BIT #13)
040000                          WCE     == 40000                ;WRITE CHECK ERROR (BIT #14)
100000                          DLT     == 100000               ;DATA LATE (BIT #15)
                                ;
                                ;
                                ;DATA BUFFER REGISTER (RPDB)
                                ;(EACH BIT IS CALLED BY BIT NUMBER)
                                ;
                                ;
                                .SBTTL  RP07 REGISTERS
                                ;
                                ;CONTROL AND STATUS 1 REGISTER. (#00)
                                ;
                                ;GO      == 1                   ;GO BIT (BIT #0)
                                ;F1      == 2                   ;FUNCTION CODE BIT #1
                                ;F2      == 4                   ;FUNCTION CODE BIT #2
                                ;F3      == 10                  ;FUNCTION CODE BIT #3
                                ;F4      == 20                  ;FUNCTION CODE BIT #4
                                ;F5      == 40                  ;FUNCTION CODE BIT #5
004000                          DVA     == 4000                 ;DEVICE AVAILABLE (BIT #11)
```

```
                                ;DRIVE STATUS REGISTER (RPDS) (#01)

000001          OM      == 1                    ;OFFSET MODE
000002          EWN     == 2                    ;ERROR WARNING
000004          ILV     == 4                    ;SECTOR INTERLEAVE MODE IS ENABLED TH. H.W
                ;VV     == 100                  ;VOLUME VALID (BIT #6)
                ;DRY    == 200                  ;DRIVE READY (BIT #7)
                ;DPR    == 400                  ;DRIVE PRESENT (BIT #8)
                ;PGM    == 1000                 ;PROGRAMABLE (BIT #9)
002000          LST     == 2000                 ;LAST SECTOR TRANSFERRED (BIT #10)
                ;WRL    == 4000                 ;WRITE LOCK (BIT #11)
                ;MOL    == 10000                ;MEDIUM ON-LINE (BIT #12)
                ;PIP    == 20000                ;POSITIONING OPERATION IN PROGRESS (BIT #13)
040000          ERR     == 40000                ;COMPOSITE ERROR (BIT #14)
100000          ATA     == 100000               ;ATTENTION ACTIVE (BIT #15)


                ;ERROR REGISTER #01 (RPER1) (#02)

000001          ILF     == 1                    ;ILLEGAL FUNCTION (BIT #0)
000002          ILR     == 2                    ;ILLEGAL REGISTER (BIT #1)
000004          RMR     == 4                    ;REGISTER MODIFICATION REFUSED (BIT #2)
                ;PAR    == 10                   ;PARITY ERROR (BIT #3)
000020          FER     == 20                   ;FORMAT ERROR (BIT #4)
000040          WCF     == 40                   ;WRITE CLOCK FAIL (BIT #5)
000100          ECH     == 100                  ;ECC HARD ERROR (BIT #6)
000200          HCE     == 200                  ;HEADER COMPARE ERROR (BIT #7)
000400          HCRC    == 400                  ;HEADER CRC ERROR (BIT #8)
001000          AOE     == 1000                 ;ADDRESS OVERFLOW ERROR (BIT #9)
002000          IAE     == 2000                 ;INVALID ADDRESS ERROR (BIT #10)
004000          WLE     == 4000                 ;WRITE LOCK ERROR (BIT #11)
010000          DTE     == 10000                ;DRIVE TIMING ERROR (BIT #12)
020000          OPI     == 20000                ;OPERATION INCOMPLETE (BIT #13)
040000          UNS     == 40000                ;DRIVE UNSAFE (BIT #14)
100000          DCK     == 100000               ;DATA CHECK ERROR (BIT 15)


                ;MAINTAINABILITY REGISTER #01 (RPMR1)(#03)

100000          DMD     == 100000               ;DIAGNOSTIC MODE


                ;ATTENTION SUMMARY PSEUDO-REGISTER (RPAS) (#04)

                ;AT0    == 1                    ;DEVICE 0 (BIT #0)
                ;AT1    == 2                    ;DEVICE 1 (BIT #1)
                ;AT2    == 4                    ;DEVICE 2 (BIT #2)
                ;AT3    == 10                   ;DEVICE 3 (BIT #3)
                ;AT4    == 20                   ;DEVICE 4 (BIT #4)
                ;AT5    == 40                   ;DEVICE 5 (BIT #5)
                ;AT6    == 100                  ;DEVICE 6 (BIT #6)
                ;AT7    == 200                  ;DEVICE 7 (BIT #7)


                ;DESIRED SECTOR/TRACK ADDRESS REGISTER (RPDA) (#05)
```

```
                                ;(EACH BIT IS CALLED BY BIT NUMBER)


                                ;DRIVE TYPE REGISTER (RPDT) (#06)

                                ;DT00    == 1                   ;DRIVE TYPE NUMBER BIT 1
                                ;DT01    == 2                   ;DRIVE TYPE NUMBER BIT 2
                                ;DT02    == 4                   ;DRIVE TYPE NUMBER BIT 3
                                ;DT03    == 10                  ;DRIVE TYPE NUMBER BIT 4
                                ;DT04    == 20                  ;DRIVE TYPE NUMBER BIT 5
                                ;DT05    == 40                  ;DRIVE TYPE NUMBER BIT 6
                                ;DT06    == 100                 ;DRIVE TYPE NUMBER BIT 7
                                ;DT07    == 200                 ;DRIVE TYPE NUMBER BIT 8
                                ;DT08    == 400                 ;DRIVE TYPE NUMBER BIT 9
                                ;DRQ     == 4000                ;DRIVE REQUEST REQUIRED (BIT #11)
                                ;MOH     == 20000               ;MOVING HEAD (BIT #13)
                                ;TAP     == 40000               ;TAPE DRIVE (BIT #14)
                                ;NBA     == 100000              ;NOT BLOCK ADDRESSED (BIT #15)


                                ;LOOK-AHEAD REGISTER (RPLA) (#07)

                                ;SC0     == 100                 ;SECTOR COUNT FIELD 0 (BIT #6)
                                ;SC1     == 200                 ;SECTOR COUNT FIELD 1 (BIT #7)
                                ;SC2     == 400                 ;SECTOR COUNT FIELD 2 (BIT #8)
                                ;SC3     == 1000                ;SECTOR COUNT FIELD 3 (BIT #9)
                                ;SC4     == 2000                ;SECTOR COUNT FIELD 4 (BIT #10)


                                ;RP07 ERROR REGISTER #02 (RPER2) (#10)

000400                          WRYUNS   == 400                 ;WRITE OFF TRACK CENTER (WRITE UNSAFE)
001000                          WOR      == 1000                ;WRITE OVERRUN ERROR
002000                          RWU1     == 2000                ;W/R UNSAFE ERROR 1 (WRITE ERROR)
004000                          RWU2     == 4000                ;W/R UNSAFE ERROR 2 (READ OR WRITE ERROR)
010000                          RWU3     == 10000               ;W/R UNSAFE ERROR 3 (WRITE ERROR)
100000                          PGE      == 100000              ;PROGRAM ERROR


                                ;RP07 ERROR REGISTER #03 (RPER3)

                                ;DGE     == 1                   ;DIAGNOSTIC COMMAND
000010                          DPE      == 10                  ;DATA PARITY  DURING WRITE
000020                          SDF      == 20                  ;SERDES DATA FAILURE
000040                          DCU      == 40                  ;DC LOW UNSAFE
000100                          IXU      == 100                 ;INDEX PULSE UNSAFE
000200                          DVC      == 200                 ;DRIVE CHECK
000400                          PHF      == 400                 ;TACH CALIBRATE FAILURE
001000                          LCE      == 1000                ;LOST CYLINDER (POSITIONER IN GUARD BAND)
002000                          LBC      == 2000                ;LOST BIT CLOCK
040000                          SKI      == 40000               ;SEEK INCOMPLETE
100000                          BSE      == 100000              ;BAD SECTOR


                                ;OFFSET REGISTER (RPOF) (#11)

002000                          HCI      == 2000                ;HEADER COMPARE INHIBIT (BIT #10)
```

```
                        ECI     == 4000                 ;ERROR CORRECTION CODE INHIBIT (BIT #11)
                        FMT16   == 10000                ;FORMAT BIT (BIT #12
                        CMOD    == 100000               ;COMMAND MODIFIER BIT (BIT #13)


                        ;DESIRED CYLINDER ADDRESS (RPDC) (#12)
                        ;(EACH BIT IS CALLED BY BIT NUMBER)


                        ;CURRENT CYLINDER ADDRESS (RPCC) (#13)
                        ;(EACH BIT IS CALLED BY BIT NUMBER)


                        ;SERIAL NUMBER REGISTER (RPSN) (#14)
                        ;(EACH IS CALLED BY BIT NUMBER)


                        ;ECC POSITION REGISTER (RPEC1) (#16)
                        ;(EACH BIT IS CALLED BY BIT NUMBER)


                        ;ECC PATTERN REGISTER (RPEC2) (#17)
                        ;(EACH BIT IS CALLED BY BIT NUMBER)


                        .SBTTL  RP07 DRIVER COMMANDS

000101                  NOOP    == 101                  ;NO OPERATION
000105                  SEEK    == 105                  ;SEEK
000107                  RECAL   == 107                  ;RECALIBRATE
000111                  DRVCLR  == 111                  ;DRIVE CLEAR
000113                  RELSE   == 113                  ;RELEASE
000115                  OFFSET  == 115                  ;OFFSET
000117                  RTC     == 117                  ;RETURN TO CENTER LINE
000121                  READIN  == 121                  ;READ IN PRESET
000131                  SEARCH  == 131                  ;SEARCH
000135                  DIAG    == 135                  ;DIAGNOSTIC MODE
000143                  ILLCMD  == 143                  ;ILLEGAL COMMAND
000151                  WCKD    == 151                  ;WRITE CHECK DATA
000153                  WCKHD   == 153                  ;WRITE CHECK HEADER AND DATA
000161                  WRTDAT  == 161                  ;WRITE DATA
000163                  FMTRK   == 163                  ;FORMAT TRACK
000165                  WRTTD   == 165                  ;WRITE TRACK DSECRIPTOR
000171                  RDDAT   == 171                  ;READ DATA
000173                  RDHD    == 173                  ;READ HEADER AND DATA
000175                  RDTD    == 175                  ;READ TRACK DSECRIPTOR

177400                  SCTRWC  ==  -256.               ;DEFAULT WORD COUNT

                        ;THE FOLLOWING ARE SPECIAL DRIVER COMMANDS (NOT CONTROLLER COMMANDS)

000141                  GETREG  == 141  ;READ RPCS1, RPWC, RPBA, RPDA AND STORE THEM AT ADDRESS
                                        ;POINTED TO BY 'DPB'+6.
000145                  MAINT   == 145  ;WRITE MAINTENANCE REGISTER RPMR1
000147                  SETFORM == 147  ;SET FORMAT PSEUDO-CMD:  WRITE OFFSET REGISTER.  SETFORM
                                        ;FIRST READS RPOF, EXTRACT ITS LO BYTE, CHANGES ITS HI BYTE
                                        ;PER 'DPB', MERGES BOTH BYTES TO WRITE RPOF.  HENCE SETFORM
```

```
                                        ;WRITES RPOF WITH HI BYTE PER 'DPB', LO BYTE UNCHANGED. THE
                                        ;COMMAND OFFSET DOES THE OPPOSITE.
```

```
                        .SBTTL  GLOBAL DATA SECTION

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

002240  000001          ITCNT:: .WORD   1               ;TEST ITERATION COUNTER
002242  000000          ISRCNT:: .WORD  0               ;INTERRUPT SERVICE COUNTER
002244  002000          XTIMES:: .WORD 1024.            ;TEST ITERATION COUNT;  TESTS 14. & 18.
002246  000000          DOTWO:: .WORD   0               ;USED TO FORCE TWO ITERATIONS OF AN OPERATION
002250  000000          CLKSTA:: .WORD  0               ;CLOCK STATUS (NO CLOCK= 0,KW11-P= 1 OR KW11-L= -1
002252  000000          BYPASS:: .WORD  0               ;BYPASS ROUTE ADR; SET IN CALL ERRABO
                                                        ;CALLERS;  CALL.A/B/C, DRVCAL, SRCH00.
002254  000000          SVSTAT:: .WORD  0               ;STATUS/ERROR INDICATOR IS;  SAVED HERE ON AN ERROR

002256  001165          NC1::    .WORD   629.           ;LAST PHYSICAL CYL
002260  001166          NC2::    .WORD   630.           ;FIRST FE CYL
002262  000037          NT1::    .WORD   31.            ;LAST PHYSICAL TRK
002264  000061          NS1::    .WORD   49.            ;LAST PHYSICAL SEC

002266  000000          CYL.RD:: .WORD  0               ;CYLINDER READ
002270  000000          TRK.RD:: .WORD  0               ;TRACK READ
002272  000000          SEC.RD:: .WORD  0               ;SECTOR READ
002274  000000          CYL.DS:: .WORD  0               ;CYLINDER DESIRED
002276  000000          SEC.DS:: .WORD  0               ;SECTOR DESIRED
002300  000000          TRK.DS:: .WORD  0               ;TRACK DESIRED

002302  000000          TIM.UP:: .WORD  0               ;MINIMUM TIME
002304  000000                   .WORD  0               ;NUMBER OF COUNTS BELOW MIN. LIMIT
002306  000000                   .WORD  0               ;MAXIMUM TIME
002310  000000                   .WORD  0               ;NUMBER OF COUNTS ABOVE MAX. LIMIT
002312  000000  000000           .WORD  0,0             ;TOTAL TIME OF ALL SEEKS
002316  000000                   .WORD  0               ;NUMBER OF SEEKS PERFORMED

002320  000000          TIM.DN:: .WORD  0               ;MINIMUM TIME
002322  000000                   .WORD  0               ;NUMBER OF COUNTS BELOW MIN. LIMIT
002324  000000                   .WORD  0               ;MAXIMUM TIME
002326  000000                   .WORD  0               ;NUMBER OF COUNTS ABOVE MAX. LIMIT
002330  000000  000000           .WORD  0,0             ;TOTAL TIME OF ALL SEEKS
002334  000000                   .WORD  0               ;NUMBER OF SEEKS PERFORMED
002336  000000          TIM.PT:: .WORD  0               ;POINTS TO TABLE OF TIMES
002340  000000          WCEFLG:: .WORD  0               ;FATAL WRITE CHECK ERROR FLAG
002342  000000          DELTA::  .WORD  0               ;MEMORY SIZING SCRATCH LOCATION
002344  163400          TRKWC::  .WORD  -<256.*25.>     ;WORD COUNT FOR HALF A TRACK IN 16 BIT MODE
002346  000012          STALL1:: .WORD  10.             ;10 MILLISECONDS STALL
002350  000012          STALL2:: .WORD  10.             ;10 MILLISECONDS STALL

                        ;BIT TABLE
002352  000001          BITS::   .WORD  BIT00
002354  000002                   .WORD  BIT01
002356  000004                   .WORD  BIT02
002360  000010                   .WORD  BIT03
002362  000020                   .WORD  BIT04
002364  000040                   .WORD  BIT05
002366  000100                   .WORD  BIT06
002370  000200                   .WORD  BIT07
```

```
                        .WORD   BIT08
                        .WORD   BIT09
                        .WORD   BIT10
                        .WORD   BIT11
                        .WORD   BIT12
                        .WORD   BIT13
                        .WORD   BIT14
                        .WORD   BIT15
                        .WORD   BIT00
                        .WORD   BIT01
                        .WORD   BIT02
                        .WORD   BIT03
                        .WORD   BIT04
                        .WORD   BIT05
                        .WORD   BIT06
                        .WORD   BIT07

                .SBTTL  TIMING LIMITS

                ;ROTATIONAL TEST TABLES FOR RP07 DRIVE
                ;50HZ AND 60HZ TABLE
T7A::           .WORD   ROTATE
                .WORD   0
                .WORD   1603.           ;LO LIMIT (16.515MS + 3%)
                .WORD   1702.           ;HI LIMIT (16.515MS - 3%)

                ;SEEK TEST TABLES
TIMT10::        .WORD   ONECYL          ;FORWARD
                .WORD   REV             ;REVERSE
                .WORD   0               ;NO LO LIMIT
                .WORD   500.            ;HI LIMIT (5.0MS)

TIMT11::        .WORD   AVERGE          ;FORWARD
                .WORD   REV             ;REVERSE
                .WORD   0               ;NO LO LIMIT
                .WORD   2300.           ;HI LIMIT (23.0MS)

TIMT12::        .WORD   MXSEEK          ;FORWARD
                .WORD   REV             ;REVERSE
                .WORD   0               ;NO LO LIMIT
                .WORD   4600.           ;HI LIMIT (46.0MS)

T1420::         .WORD   MARK            ;ADDR MARK TEST
                .WORD   0               ;2ND MSG; NONE
                .WORD   0               ;NO LO LIMIT
                .WORD   1702.           ;HI LIMIT (16.515MS - 3%)


                ;SPECS. MESSAGE TABLES FOR ROTATIONAL AND TIMING TESTS

                ;ROTATIONAL MESSAGE AND LO/HI LIMITS
                ;50HZ AND 60HZ TABLE
SP7::           .WORD   MSG7X           ;MSG
                .WORD   1603.           ;LO LIMIT (16.515MS + 3%)
                .WORD   1702.           ;HI LIMIT (16.515MS - 3%)

                ;TIMING TEST MESSAGES AND LO/HI LIMITS
```

```
    115 002510  005132                SP10::  .WORD   MSG10X          ;MSG
    116 002512  000000                          .WORD   0              ;NO LO LIMIT
    117 002514  000764                          .WORD   500.           ;HI LIMIT (5.0MS)
    118
    119 002516  005132                SP11::  .WORD   MSG11X          ;MSG
    120 002520  000000                          .WORD   0              ;NO LO LIMIT
    121 002522  004374                          .WORD   2300.          ;HI LIMIT (23.0MS)
    122
    123 002524  005132                SP12::  .WORD   MSG12X          ;MSG
    124 002526  000000                          .WORD   0              ;NO LO LIMIT
    125 002530  010770                          .WORD   4600.          ;HI LIMIT (46.0MS)
    126
    127 002532  005132                S1420:: .WORD   MSG14X          ;MSG
    128 002534  000000                          .WORD   0              ;NO LO LIMIT
    129 002536  003246                          .WORD   1702.          ;HI LIMIT (16.515MS - 3%)
```

```
                                ;DPB (DRIVE PARAMETER BLOCK)

002540      000         DPB.A:: .BYTE   0           ;(0) DRIVE NUMBER
002541      000                 .BYTE   0           ;(1) OFFSET VALUE OR FMT16, ECI, AND HCI
002542      000                 .BYTE   0           ;(2) COMMAND
002543      000                 .BYTE   0           ;(3) PSEL AND A17 AND A16
002544   000000                 .WORD   0           ;(4) WORD COUNT (MUST BE NEG.)
002546   042610                 .WORD   DBUFF       ;(6) BUFFER ADDRESS OR
                                                    ;REGISTER TABLE POINTER
002550      000                 .BYTE   0           ;(10) SECTOR ADDRESS OR
                                                    ;FIRST REG. INDEX
002551      000                 .BYTE   0           ;(11) TRACK ADDRESS OR
                                                    ;LAST REG. INDEX
002552   000000                 .WORD   0           ;(12) CYLINDER ADDRESS
002554   002744                 .WORD   REG         ;(14) ERROR TABLE POINTER
                                                    ;POINTS TO THE FIRST OF TWENTY
                                                    ;LOCATIONS OF WHERE THE DRIVER
                                                    ;IS TO STORE THE RHXX/RP07
                                                    ;REGISTERS ON AN ERROR. IF LEFT
                                                    ;ZERO REGISTERS ARE NOT SAVED.
002556   000000                 .WORD   0           ;(16) STATUS/ERROR INDICATOR
                                                    ;BIT15=1=>ERROR OCCURRED
                                                    ;BIT07=1=>DONE
                                                    ;BIT14-BIT09 AND BIT06-BIT03
                                                    ;INDICATE TYPE OF ERROR

002560      000         DPB.B:: .BYTE   0           ;(0) DRIVE NUMBER
002561      000                 .BYTE   0           ;(1) OFFSET VALUE OR FMT16, ECI, AND HCI
002562      000                 .BYTE   0           ;(2) COMMAND
002563      000                 .BYTE   0           ;(3) PSEL AND A17 AND A16
002564   177776                 .WORD   -2          ;(4) WORD COUNT (MUST BE NEG.)
002566   042610                 .WORD   DBUFF       ;(6) BUFFER ADDRESS OR
                                                    ;REGISTER TABLE POINTER
002570      000                 .BYTE   0           ;(10) SECTOR ADDRESS OR
                                                    ;FIRST REG. INDEX
002571      000                 .BYTE   0           ;(11) TRACK ADDRESS OR
                                                    ;LAST REG. INDEX
002572   000000                 .WORD   0           ;(12) CYLINDER ADDRESS
002574   002744                 .WORD   REG         ;(14) ERROR TABLE POINTER
                                                    ;POINTS TO THE FIRST OF TWENTY
                                                    ;LOCATIONS OF WHERE THE DRIVER
                                                    ;IS TO STORE THE RHXX/RP07
                                                    ;REGISTERS ON AN ERROR. IF LEFT
                                                    ;ZERO REGISTERS ARE NOT SAVED.
002576   000000                 .WORD   0           ;(16) STATUS/ERROR INDICATOR
                                                    ;BIT15=1=>ERROR OCCURRED
                                                    ;BIT07=1=>DONE
                                                    ;BIT14-BIT09 AND BIT06-BIT03
                                                    ;INDICATE TYPE OF ERROR

002600      000         DPB.C:: .BYTE   0           ;(0) DRIVE NUMBER
002601      000                 .BYTE   0           ;(1) OFFSET VALUE OR FMT16, ECI, AND HCI
002602      000                 .BYTE   0           ;(2) COMMAND
002603      000                 .BYTE   0           ;(3) PSEL AND A17 AND A16
002604   177776                 .WORD   -2          ;(4) WORD COUNT (MUST BE NEG.)
002606   042610                 .WORD   DBUFF       ;(6) BUFFER ADDRESS OR
                                                    ;REGISTER TABLE POINTER
```

```
                                        .BYTE   0               ;(10) SECTOR ADDRESS OR
                                                                ;FIRST REG. INDEX
                                        .BYTE   0               ;(11) TRACK ADDRESS OR
                                                                ;LAST REG. INDEX
                                        .WORD   0               ;(12) CYLINDER ADDRESS
                                        .WORD   REG             ;(14) ERROR TABLE POINTER
                                                                ;POINTS TO THE FIRST OF TWENTY
                                                                ;LOCATIONS OF WHERE THE DRIVER
                                                                ;IS TO STORE THE RHXX/RP07
                                                                ;REGISTERS ON AN ERROR. IF LEFT
                                                                ;ZERO REGISTERS ARE NOT SAVED.
                                        .WORD   0               ;(16) STATUS/ERROR INDICATOR
                                                                ;BIT15=1=>ERROR OCCURRED
                                                                ;BIT07=1=>DONE
                                                                ;BIT14-BIT09 AND BIT06-BIT03
                                                                ;INDICATE TYPE OF ERROR

                                DTADPB::.BYTE   0               ;(0) DRIVE NUMBER
                                        .BYTE   0               ;(1) OFFSET VALUE OR FMT16, ECT, AND HCI
                                        .BYTE   0               ;(2) COMMAND
                                        .BYTE   0               ;(3) PSEL AND A17 AND A16
                                        .WORD   0               ;(4) WORD COUNT (MUST BE NEG.)
                                        .WORD   DBUFF           ;(6) BUFFER ADDRESS OR
                                                                ;REGISTER TABLE POINTER
                                        .BYTE   0               ;(10) SECTOR ADDRESS OR
                                                                ;FIRST REG. INDEX
                                        .BYTE   0               ;(11) TRACK ADDRESS OR
                                                                ;LAST REG. INDEX
                                        .WORD   0               ;(12) CYLINDER ADDRESS
                                        .WORD   REG             ;(14) ERROR TABLE POINTER
                                                                ;POINTS TO THE FIRST OF TWENTY
                                                                ;LOCATIONS OF WHERE THE DRIVER
                                                                ;IS TO STORE THE RHXX/RP07
                                                                ;REGISTERS ON AN ERROR. IF LEFT
                                                                ;ZERO REGISTERS ARE NOT SAVED.
                                        .WORD   0               ;(16) STATUS/ERROR INDICATOR
                                                                ;BIT15=1=>ERROR OCCURRED
                                                                ;BIT07=1=>DONE
                                                                ;BIT14-BIT09 AND BIT06-BIT03
                                                                ;INDICATE TYPE OF ERROR
```

```
                                
002640  000000                  UNIT::  .WORD   0               ;USED TO SELECT A UNIT FOR TEST
002642  176700                  RPADR:: .WORD   176700          ;CONTAINS RPCS1 BASE ADDRESS
002644  000254  000240          RPVEC:: .WORD   254.+32.        ;CONTAINS VECTOR ADDRESS & BR LEVEL
002650  000050                  RHEXT:: .WORD   50              ;CONTAINS RH70 OFFSET TO RPBAE
002652  000000                  RHTYPE::.WORD   0               ;CONTAINS RHXX TYPE; RH11= 0, RH70= 1
002654  000000                  DRVNO:: .WORD   0               ;DRIVE NUMBER
002656  000000                  DRVSN:: .WORD   0               ;STORAGE FOR EACH S/N DIGIT
                                
002660  176700                  RPCS1:: .WORD   176700          ;BASE ADDRESS USED FOR THE DRIVE
002662  176702                  RPWC::  .WORD   176702          ;WORD COUNT REGISTER
002664  176704                  RPBA::  .WORD   176704          ;BYTE ADDRESS REGISTER
002666  176706                  RPDA::  .WORD   176706          ;DESIRED SECTOR/TRACK ADDRESS
002670  176710                  RPCS2:: .WORD   176710          ;RP07 STATUS REGISTER
002672  176712                  RPDS::  .WORD   176712          ;RP07 DRIVE STATUS
002674  176714                  RPER1:: .WORD   176714          ;RP07 ERROR REGISTER #1
002676  176716                  RPAS::  .WORD   176716          ;RP07 ATTENTION SUMMARY PSEUDO REGISTER
002700  176720                  RPLA::  .WORD   176720          ;RP07 LOOK AHEAD REGISTER
002702  176722                  RPDB::  .WORD   176722          ;RP07 DATA BUFFER
002704  176724                  RPMR1:: .WORD   176724          ;RP07 MAINTENANCE REGISTER #1
002706  176726                  RPDT::  .WORD   176726          ;DRIVE TYPE REGISTER
002710  176730                  RPSN::  .WORD   176730          ;RP07 SERIAL NUMBER
002712  176732                  RPOF::  .WORD   176732          ;RP07 OFFSET REGISTER
002714  176734                  RPDC::  .WORD   176734          ;RP07 DESIRED CYLINDER
002716  176736                  RPCC::  .WORD   176736          ;RP07 CURRENT CYLINDER
002720  176740                  RPER2:: .WORD   176740          ;RP07 ERROR REGISTER #2
002722  176742                  RPER3:: .WORD   176742          ;RP07 ERROR REGISTER #3
002724  176744                  RPEC1:: .WORD   176744          ;RP07 ERROR POSITION
002726  176746                  RPEC2:: .WORD   176746          ;RP07 ERROR PATTERN
002730  176750                  RPBAE:: .WORD   176750          ;RH70 REGISTER
002732  176752                  RPCS3:: .WORD   176752          ;RH70 REGISTER
                                
                                ;ATTENTION BITS TABLE (ATABIT=8 BYTES)
                                        ;THIS TABLE CONTAINS THE CORRESPONDING BIT TO EACH DRIVES
                                        ;ATTENTION BIT
                                
002734      001                 ATABIT::.BYTE   1               ;DRIVE 0
002735      002                         .BYTE   2               ;DRIVE 1
002736      004                         .BYTE   4               ;DRIVE 2
002737      010                         .BYTE   10              ;DRIVE 3
002740      020                         .BYTE   20              ;DRIVE 4
002741      040                         .BYTE   40              ;DRIVE 5
002742      100                         .BYTE   100             ;DRIVE 6
002743      200                         .BYTE   200             ;DRIVE 7
                                
                                ; STORAGE FOR DEVICE REGISTERS
                                ;
002744                          REG::   .BLKW 22.               ;SAVE REGISTERS HERE
                                
```

```
                                .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
                                ;
003020                          L$DVTYP::
003020  122     120     060             .ASCIZ  /RP07/
                                        .EVEN

                                ; TEST DESCRIPTION
                                ;
003026                          L$DESC::
003026  122     120     060             .ASCIZ  /RP07 FUNCTIONAL TEST/
                                        .EVEN

                                ; FORMAT STATEMENTS USED IN PRINT CALLS
                                ;
003054  045     116     000     CRLF::  .ASCIZ  /%N/
003057  045     101     104     DH25A:: .ASCIZ  /%ADRIVE %O1%N/
003075  045     101     103     DH44A:: .ASCIZ  /%ACYL %D3%A.  /
003114  045     101     124     DH44B:: .ASCIZ  /%ATRK %D2%A.  /
003133  045     101     123     DH44C:: .ASCIZ  /%ASEC %D2%A.  /
003152  045     101     122     DH44D:: .ASCIZ  /%ARPER2 (HEX) %T%T%T%T/
003201  045     116     045     DH44E:: .ASCIZ  /%N%ADRIVE   RPCS1   RPWC    RPBA    RPDA    RPCS2   RPDS/
003272  045     116     045     DH44F:: .ASCIZ  /%N%O6%A  %O6%A  %O6%A  %O6%A  %O6%A  %O6%A  %O6/
003352  045     116     045     DH44G:: .ASCIZ  /%N%ARPER1   RPAS    RPLA    RPDB    RPMR1   RPDT    RPSN/
003443  045     116     045     DH44H:: .ASCIZ  /%N%O6%A  %O6%A  %O6%A  %O6%A  %O6%A  %O6%A  %O6/
003523  045     116     045     DH44I:: .ASCIZ  /%N%ARPOF    RPDC    RPCC    RPER2   RPEC    RPEC1   RPEC2/
003615  045     116     045     DH44J:: .ASCIZ  /%N%O6%A  %O6%A  %O6%A  %O6%A  %O6%A  %O6%A  %O6%N/
003677  045     101     122     DH44K:: .ASCIZ  /%ARPBAE   RPCS3/
003717  045     116     045     DH44L:: .ASCIZ  /%N%O6%A  %O6%N/

003736  045     101     104     DH45A:: .ASCIZ  /%ADRV CYL  TRK  SEC%N/
003764  045     117     063     DH45B:: .ASCIZ  /%O3%A %D3%A. %D3%A. %D3%A.%N/
004021  045     101     107     DH45C:: .ASCIZ  /%AGDCYL  GDTRK  GDSEC  BDCYL  BDTRK  BDSEC%N/
004076  045     104     063     DH45D:: .ASCIZ  /%D3%A.%S3%D3%A.%S3%D3%A.%S3%D3%A.%S3%D3%A.%S3%D3%A.%N/

004164  045     116     045     DH52A:: .ASCIZ  /%N%ANUMBER OF LOST REVOLUTIONS=%D4%A./

004232  045     116     045     NOCLK:: .ASCIZ  /%N%ANO P-CLOCK, TIMING TESTS WILL NOT BE EXECUTED%N/
004316  045     116     045     DSNMSG:: .ASCIZ /%N%ADRIVE %O1%A, PG/
004342  045     124     000     SNDIGT:: .ASCIZ /%T/
004345  045     101     124     WRTENM:: .ASCIZ /%ATEST %D2%A. NOT RUN, NOT ENABLED BY USER%N/
004422  045     101     125     SEAERR:: .ASCIZ /%AUNRECOVERABLE SEARCH ERROR%N/
004461  045     101     123     SEABAD:: .ASCIZ /%ASEARCH FAILED AFTER 16. RETRIES%N/
004525  045     101     101     ABOTST:: .ASCIZ /%AABORT TEST%N/
004544  045     101     120     POSERR:: .ASCIZ /%APOSITION ERROR, TEST ABORTED%N/
```

```
     71 004605     045     116     045  ROTATE:: .ASCIZ /%N%AROTATIONAL SPEED TIMES%N%A * /
     72 004647     045     116     045  ONECYL:: .ASCIZ /%N%AONE CYLINDER SEEK TIMES%N%A * FORWARD/
     73 004721     045     116     045  AVERGE:: .ASCIZ /%N%AAVERAGE SEEK TIMES%N%A * FORWARD/
     74 004766     045     116     045  MXSEEK:: .ASCIZ /%N%AMAXIMUM SEEK TIMES%N%A * FORWARD/
     75 005033     045     116     045  MARK::  .ASCIZ  /%N%AADDRESS MARK DETECT TIMES%N%A * /
     76 005100     045     101     040  FWD::    .ASCIZ /%A * FORWARD/
     77 005115     045     101     040  REV::    .ASCIZ /%A * REVERSE/
     78
     79 005132                          MSG7X::
     80 005132                          MSG10X::
     81 005132                          MSG11X::
     82 005132                          MSG14X::
     83 005132     045     101     040  MSG12X:: .ASCIZ /%A * LIMIT(S)/
     84
     85 005160     045     116     045  UNSMSG:: .ASCIZ /%N%ADRIVE %01%A UNSAFE%N/
     86 005201     045     116     045  NEDMSG:: .ASCIZ /%N%ADRIVE %01%A NON-EXISTENT%N/
     87 005240     045     116     045  OFLMSG:: .ASCIZ /%N%ADRIVE %01%A OFF-LINE%N/
     88 005273     045     116     045  NOTMSG:: .ASCIZ /%N%ADRIVE %01%A NOT AN RP07%N/
     89
     90                               .SBTTL  GLOBAL ASCII MESSAGE SECTION
     91
     92 005331     122     110     130  EM1::    .ASCIZ  /RHXX CONTROL BUS PARITY ERROR MCPE=1/
     93 005376     122     110     130  EM2::    .ASCIZ  /RHXX DATA BUS PARITY ERROR MDPE=1/
     94 005440     122     110     130  EM3::    .ASCIZ  /RHXX ILLEGAL CONDITIONS SET (NED,NEM,PGE,MXF)/
     95 005516     127     122     111  EM4::    .ASCIZ  /WRITE CHECK ERROR/
     96 005540     104     101     124  EM5::    .ASCIZ  /DATA LATE ERROR/
     97 005560     104     122     111  EM6::    .ASCIZ  /DRIVE PROGRAMMING ERROR (PGE)/
     98 005616     114     117     123  EM7::    .ASCIZ  /LOSTS BIT CLOCK (LBC)/
     99
    100 005644     127     122     111  EM11::   .ASCIZ  /WRITE CLOCK FAILS/
    101 005666     127     122     111  EM12::   .ASCIZ  /WRITE LOCK ERROR/
    102 005707     104     101     124  EM13::   .ASCIZ  /DATA ERROR (DCK)/
    103 005730     104     122     111  EM14::   .ASCIZ  /DRIVE BUS PARITY ERROR (DPE)/
    104 005765     111     114     114  EM15::   .ASCIZ  /ILLEGAL CONDITIONS SET (ILF,ILR,RMR)/
    105 006032     101     104     104  EM16::   .ASCIZ  /ADDRESSING ERROR (IAE,AOE)/
    106 006065     123     105     105  EM17::   .ASCIZ  /SEEK ERROR (SKI,LCE)/
    107
    108 006112     103     114     117  EM20::   .ASCIZ  @CLOCK (KW11-P) OVERFLOW IN TIMING TEST@
    109 006161     105     101     122  EM21::   .ASCIZ  /EARLY WARNING (EWN)/
    110 006205     122     105     101  EM22::   .ASCIZ  /READ & WRITE HEAD FAILS/
    111 006235     104     101     124  EM23::   .ASCIZ  /DATA FORMAT BIT ERROR (FER)/
    112 006271     110     105     101  EM24::   .ASCIZ  /HEADER INFORMATION ERROR (HCE)/
    113 006330     104     122     111  EM25::   .ASCIZ  @DRIVE HAS BECOME NON-EXISTENT@
    114 006366     104     122     111  EM26::   .ASCIZ  @DRIVE HAS NOT RESPONDED TO PORT REQUEST@
    115 006436     123     117     106  EM27::   .ASCIZ  @SOFTWARE TIMEOUT ON THIS DRIVE@
    116
    117 006475     106     101     124  EM30::   .ASCIZ  @FATAL MASSBUS PARITY ERROR (MCPE=1 OR PAR=1)@
    118 006552     117     106     106  EM31::   .ASCIZ  @OFFLINE OR UNSAFE DRIVE REQUESTED@
    119 006614     127     122     111  EM32::   .ASCIZ  /WRITE-READY UNSAFE/
    120 006637     104     103     040  EM33::   .ASCIZ  /DC POWER UNSAFE/
    121 006657     111     116     104  EM34::   .ASCIZ  /INDEX UNSAFE/
    122 006674     120     122     117  EM35::   .ASCIZ  /PROCESSOR HANDSHAKE FAILURE/
    123 006730     104     122     111  EM36::   .ASCIZ  /DRIVE OFFLINE OR NOT AN RP07/
    124
    125 006765     117     120     105  EM41::   .ASCIZ  /OPERATION INCOMPLETE (OPI)/
    126 007020     111     115     120  EM42::   .ASCIZ  /IMPROPER HEADER DATA/
    127 007045     105     103     103  EM43::   .ASCIZ  /ECC LOGIC FAILURE/
```

```
    128 007067      115     111     123  EM44::  .ASCIZ  /MISC DRIVE ERROR; RPER1, RPER2, RPER3/
    129 007135      104     122     111  EM45::  .ASCIZ  /DRIVE TIMING ERROR (DTE)/
    130 007166      110     105     101  EM46::  .ASCIZ  /HEADER CRC ERROR (HCRC)/
    131 007216      125     116     103  EM47::  .ASCIZ  /UNCORRECTABLE ECC ERROR/
    132
    133 007246      114     101     123  EM50::  .ASCIZ  /LAST BLOCK TRANSF 'LBT' NOT SET AFTER READING LAST SECTOR/
    134 007340      101     104     122  EM51::  .ASCIZ  /ADRS OVERFLOW BIT 'AOE' NOT SET AFTER READING LAST SECTOR/
    135 007432      114     117     123  EM52::  .ASCIZ  /LOST REVOLUTION ERROR/
    136 007460      122     120     104  EM54::  .ASCIZ  /RPDS, 'OM' NOT SET ON OFFSET CMD/
    137 007521      122     120     104  EM55::  .ASCIZ  /RPDS, 'OM' NOT RESET ON RETURN-TO-CENTER-LINE CMD/
    138
    139                                  .EVEN
    153
    154
```

```
                                .SBTTL  GLOBAL ERROR REPORT SECTION

                                DH44::
007604                          MOV     CYL.RD,-(SP)
007604  013746  002266          MOV     #DH44A,-(SP)
007610  012746  003075          MOV     #2,-(SP)
007614  012746  000002          MOV     SP,R0
007620  010600                  TRAP    C$PNTB
007622  104414                  ADD     #6,SP
007624  062706  000006          MOV     TRK.RD,-(SP)
007630  013746  002270          MOV     #DH44B,-(SP)
007634  012746  003114          MOV     #2,-(SP)
007640  012746  000002          MOV     SP,R0
007644  010600                  TRAP    C$PNTB
007646  104414                  ADD     #6,SP
007650  062706  000006          MOV     SEC.RD,-(SP)
007654  013746  002272          MOV     #DH44C,-(SP)
007660  012746  003133          MOV     #2,-(SP)
007664  012746  000002          MOV     SP,R0
007670  010600                  TRAP    C$PNTB
007672  104414                  ADD     #6,SP
007674  062706  000006          MOV     REG+40,-(SP)    ;PRINT RPER2 ERROR CODE IN HEX
007700  013746  003004          BIC     #177400,(SP)
007704  042716  177400          JSR     PC,OCTHEX
007710  004737  011430          MOV     #PSTACK+6,-(SP)
007714  012746  011572          MOV     #PSTACK+4,-(SP)
007720  012746  011570          MOV     #PSTACK+2,-(SP)
007724  012746  011566          MOV     #PSTACK,-(SP)
007730  012746  011564          MOV     #DH44D,-(SP)
007734  012746  003152          MOV     #5,-(SP)
007740  012746  000005          MOV     SP,R0
007744  010600                  TRAP    C$PNTB
007746  104414                  ADD     #14,SP
007750  062706  000014
                                ;PRINT 'DRIVE   RPCS1   RPWC    RPBA    RPDA    RPCS2   RPDS'
007754  012746  003201          MOV     #DH44E,-(SP)
007760  012746  000001          MOV     #1,-(SP)
007764  010600                  MOV     SP,R0
007766  104415                  TRAP    C$PNTX
007770  062706  000004          ADD     #4,SP
007774  013746  002756          MOV     REG+12,-(SP)
010000  013746  002754          MOV     REG+10,-(SP)
010004  013746  002752          MOV     REG+06,-(SP)
010010  013746  002750          MOV     REG+04,-(SP)
010014  013746  002746          MOV     REG+02,-(SP)
010020  013746  002744          MOV     REG,-(SP)
010024  013746  002654          MOV     DRVNO,-(SP)
010030  012746  003272          MOV     #DH44F,-(SP)
010034  012746  000010          MOV     #10,-(SP)
010040  010600                  MOV     SP,R0
010042  104415                  TRAP    C$PNTX
010044  062706  000022          ADD     #22,SP
                                ;PRINT 'RPER1   RPAS    RPLA    RPDB    RPMR1   RPDT    RPSN'
010050  012746  003352          MOV     #DH44G,-(SP)
010054  012746  000001          MOV     #1,-(SP)
010060  010600                  MOV     SP,R0
010062  104415                  TRAP    C$PNTX
010064  062706  000004          ADD     #4,SP
```

```
    16 010070  013746  002774          MOV     REG+30,-(SP)
       010074  013746  002772          MOV     REG+26,-(SP)
       010100  013746  002770          MOV     REG+24,-(SP)
       010104  013746  002766          MOV     REG+22,-(SP)
       010110  013746  002764          MOV     REG+20,-(SP)
       010114  013746  002762          MOV     REG+16,-(SP)
       010120  013746  002760          MOV     REG+14,-(SP)
       010124  012746  003443          MOV     #DH44H,-(SP)
       010130  012746  000010          MOV     #10,-(SP)
       010134  010600                  MOV     SP,R0
       010136  104415                  TRAP    C$PNTX
       010140  062706  000022          ADD     #22,SP
    17                                          ;PRINT 'RPOF   RPDC   RPCC   RPER2  RPER3  RPEC1  RPEC2'
    18 010144  012746  003523          MOV     #DH44I,-(SP)
       010150  012746  000001          MOV     #1,-(SP)
       010154  010600                  MOV     SP,R0
       010156  104415                  TRAP    C$PNTX
       010160  062706  000004          ADD     #4,SP
    19 010164  013746  003012          MOV     REG+46,-(SP)
       010170  013746  003010          MOV     REG+44,-(SP)
       010174  013746  003006          MOV     REG+42,-(SP)
       010200  013746  003004          MOV     REG+40,-(SP)
       010204  013746  003002          MOV     REG+36,-(SP)
       010210  013746  003000          MOV     REG+34,-(SP)
       010214  013746  002776          MOV     REG+32,-(SP)
       010220  012746  003615          MOV     #DH44J,-(SP)
       010224  012746  000010          MOV     #10,-(SP)
       010230  010600                  MOV     SP,R0
       010232  104415                  TRAP    C$PNTX
       010234  062706  000022          ADD     #22,SP
    20 010240  005737  002652          TST     RHTYPE          ;IS IT RH70 CONTROLLER ?
    21 010244  001424                  BEQ     1$              ;BR IF NO
    22                                          ;PRINT 'RPBAE  RPCS3'
    23 010246  012746  003677          MOV     #DH44K,-(SP)
       010252  012746  000001          MOV     #1,-(SP)
       010256  010600                  MOV     SP,R0
       010260  104415                  TRAP    C$PNTX
       010262  062706  000004          ADD     #4,SP
    24 010266  013746  003016          MOV     REG+52,-(SP)
       010272  013746  003014          MOV     REG+50,-(SP)
       010276  012746  003717          MOV     #DH44L,-(SP)
       010302  012746  000003          MOV     #3,-(SP)
       010306  010600                  MOV     SP,R0
       010310  104415                  TRAP    C$PNTX
       010312  062706  000010          ADD     #10,SP
    25 010316                  1$:                          ;CR-LF
    26 010316  012746  003054          MOV     #CRLF,-(SP)
       010322  012746  000001          MOV     #1,-(SP)
       010326  010600                  MOV     SP,R0
       010330  104414                  TRAP    C$PNTB
       010332  062706  000004          ADD     #4,SP
    27 010336                  L10002:
       010336  104423                  TRAP    C$MSG
    28
    29 010340                  DH45::
    30 010340  012746  003736          MOV     #DH45A,-(SP)
       010344  012746  000001          MOV     #1,-(SP)
```

```
            010350  010600                  MOV     SP,R0
            010352  104414                  TRAP    C$PNTB
            010354  062706  000004          ADD     #4,SP
     31     010360  013746  002276          MOV     SEC.DS,-(SP)
            010364  013746  002300          MOV     TRK.DS,-(SP)
            010370  013746  002274          MOV     CYL.DS,-(SP)
            010374  013746  002654          MOV     DRVNO,-(SP)
            010400  012746  003764          MOV     #DH45B,-(SP)
            010404  012746  000005          MOV     #5,-(SP)
            010410  010600                  MOV     SP,R0
            010412  104414                  TRAP    C$PNTB
            010414  062706  000014          ADD     #14,SP
     32     010420  012746  004021          MOV     #DH45C,-(SP)
            010424  012746  000001          MOV     #1,-(SP)
            010430  010600                  MOV     SP,R0
            010432  104415                  TRAP    C$PNTX
            010434  062706  000004          ADD     #4,SP
     33     010440  013746  002272          MOV     SEC.RD,-(SP)
            010444  013746  002270          MOV     TRK.RD,-(SP)
            010450  013746  002266          MOV     CYL.RD,-(SP)
            010454  013746  002276          MOV     SEC.DS,-(SP)
            010460  013746  002300          MOV     TRK.DS,-(SP)
            010464  013746  002274          MOV     CYL.DS,-(SP)
            010470  012746  004076          MOV     #DH45D,-(SP)
            010474  012746  000007          MOV     #7,-(SP)
            010500  010600                  MOV     SP,R0
            010502  104415                  TRAP    C$PNTX
            010504  062706  000020          ADD     #20,SP
     34                                                     ;CR-LF
     35     010510  012746  003054          MOV     #CRLF,-(SP)
            010514  012746  000001          MOV     #1,-(SP)
            010520  010600                  MOV     SP,R0
            010522  104414                  TRAP    C$PNTB
            010524  062706  000004          ADD     #4,SP
     36     010530                  L10003:
            010530  104423                  TRAP    C$MSG
     37
     38     010532                  DH52::
     39     010532  013746  002310          MOV     TIM.UP+6,-(SP)
            010536  012746  004164          MOV     #DH52A,-(SP)
            010542  012746  000002          MOV     #2,-(SP)
            010546  010600                  MOV     SP,R0
            010550  104414                  TRAP    C$PNTB
            010552  062706  000006          ADD     #6,SP
     40                                                     ;CR-LF
     41     010556  012746  003054          MOV     #CRLF,-(SP)
            010562  012746  000001          MOV     #1,-(SP)
            010566  010600                  MOV     SP,R0
            010570  104414                  TRAP    C$PNTB
            010572  062706  000004          ADD     #4,SP
     42     010576                  L10004:
            010576  104423                  TRAP    C$MSG
     43
     44     010600                  DH25::
     45     010600  013746  002654          MOV     DRVNO,-(SP)
            010604  012746  003057          MOV     #DH25A,-(SP)
            010610  012746  000002          MOV     #2,-(SP)
```

```
        010614  010600                          MOV     SP,R0
        010616  104414                          TRAP    C$PNTB
        010620  062706  000006                  ADD     #6,SP
    46                                                          ;CR-LF
    47  010624  012746  003054                  MOV     #CRLF,-(SP)
        010630  012746  000001                  MOV     #1,-(SP)
        010634  010600                          MOV     SP,R0
        010636  104414                          TRAP    C$PNTB
        010640  062706  000004                  ADD     #4,SP
    48  010644                          L10005:
        010644  104423                          TRAP    C$MSG
    49
```

```
                                .SBTTL  GLOBAL SUBROUTINES SECTION

                                ;*SAVE R0-R5
                                ;*CALL:
                                ;*      JSR     PC,SAVREG
010646                          SAVREG:
010646  010046                          MOV     R0,-(SP)        ;;PUSH R0 ON STACK
010650  010146                          MOV     R1,-(SP)        ;;PUSH R1 ON STACK
010652  010246                          MOV     R2,-(SP)        ;;PUSH R2 ON STACK
010654  010346                          MOV     R3,-(SP)        ;;PUSH R3 ON STACK
010656  010446                          MOV     R4,-(SP)        ;;PUSH R4 ON STACK
010660  010546                          MOV     R5,-(SP)        ;;PUSH R5 ON STACK
010662  016646  000020                  MOV     20(SP),-(SP)    ;;SAVE PUSHED PARAMETER
010666  016646  000020                  MOV     20(SP),-(SP)    ;;SAVE PC OF MAIN FLOW
010672  016646  000020                  MOV     20(SP),-(SP)    ;;SAVE PC OF SAVREG CALL
010676  000207                          RTS     PC

                                ;*RESTORE R0-R5
                                ;*CALL:
                                ;*      JSR     PC,RESREG
010700                          RESREG:
010700  012666  000020                  MOV     (SP)+,20(SP)    ;;RESTORE PC OF RESREG CALL
010704  012666  000020                  MOV     (SP)+,20(SP)    ;;RESTORE PC OF MAIN FLOW
010710  012666  000020                  MOV     (SP)+,20(SP)    ;;RESTORE PUSHED PARAMETER
010714  012605                          MOV     (SP)+,R5        ;;POP STACK INTO R5
010716  012604                          MOV     (SP)+,R4        ;;POP STACK INTO R4
010720  012603                          MOV     (SP)+,R3        ;;POP STACK INTO R3
010722  012602                          MOV     (SP)+,R2        ;;POP STACK INTO R2
010724  012601                          MOV     (SP)+,R1        ;;POP STACK INTO R1
010726  012600                          MOV     (SP)+,R0        ;;POP STACK INTO R0
010730  000207                          RTS     PC
```

```
                                ;AUTO SIZE FOR RH70 CONTROLLER AND DETERMINE IF IT IS JUMPERED FOR 22 OR
                                ;32 REGISTERS
                                ;CALL
                                ;       JSR     PC,SIZE70       ;CALL ROUTINE
                                ;
                                ;R5 MUST CONTAIN POINTER TO NEW RPCS1 BASE ADDRESS

 010732  005037  002650        SIZE70: CLR     RHEXT           ;CLEAR RPBAE OFFSET
 010736  005037  002652                CLR     RHTYPE          ;CLEAR RHXX TYPE REGISTER (RH11)
 010742  013746  000004                MOV     ERRVEC,-(SP)    ;SAVE CONTENTS OF ERROR VECTOR
 010746  012737  011016  000004        MOV     #2$,ERRVEC      ;SETUP 'TRAP' RETURN ADDRESS
 010754  011500                        MOV     (R5),R0         ;GET RPCS1 ADDRESS
 010756  062700  000050                ADD     #50,R0          ;GET REGISTER OFFSET FOR RH70
 010762  012702  000012                MOV     #10.,R2         ;GET NUMBER OF REGISTERS TO CHECK
 010766  005720                        TST     (R0)+           ;TRAP IF NOT A VALID RPBAE
 010770  005720                        TST     (R0)+           ;TRAP IF NOT A VALID RPCS3
 010772  012737  000050  002650        MOV     #50,RHEXT       ;LOAD OFFSET FOR RPBAE (22 REGISTER RH)
 011000  005720                1$:     TST     (R0)+           ;TRAP IF NOT A VALID REGISTER
 011002  005302                        DEC     R2              ;DONE WITH ALL 32 REGISTERS ?
 011004  001375                        BNE     1$              ;BR IF NO
 011006  012737  000074  002650        MOV     #74,RHEXT       ;LOAD OFFSET FOR RPBAE (32 REGISTER RH)
 011014  000403                        BR      3$
 011016  012716  011024        2$:     MOV     #3$,(SP)        ;SETUP RETURN ADDRESS
 011022  000002                        RTI

 011024  011500                3$:     MOV     (R5),R0         ;GET RPCS1 REGISTER
 011026  013702  002650                MOV     RHEXT,R2        ;GET RPBAE REGISTER OFFSET
 011032  001415                        BEQ     4$              ;BR IF NONE
 011034  060002                        ADD     R0,R2           ;GET RPBAE REGISTER
 011036  052710  001400                BIS     #A17!A16,(R0)   ;SET EXTENDED ADDRESS BITS IN RPCS1
 011042  022712  000003                CMP     #3,(R2)         ;ARE THE EXTENDED BITS SET IN RPBAE ?
 011046  001007                        BNE     4$              ;BR IF NO
 011050  005012                        CLR     (R2)            ;CLEAR EXTENDED ADDRESS BITS IN RPBAE
 011052  011046                        MOV     (R0),-(SP)      ;SAVE RPCS1 REG CONTENTS
 011054  042726  176377                BIC     #^C<A17!A16>,(SP)+      ;ARE THE EXTEND BITS CLEAR IN RPCS1 ?
 011060  001002                        BNE     4$              ;BR IF NO
 011062  005237  002652                INC     RHTYPE          ;SET RHXX TYPE REGISTER (RH70)
 011066  012637  000004        4$:     MOV     (SP)+,ERRVEC    ;RESTORE CONTENTS OF ERROR VECTOR
 011072  000207                        RTS     PC
```

```
                                ;       INTEGER DIVIDE ROUTINE
                                ;*THIS ROUTINE WILL DIVIDE A 32-BIT TWO'S COMPLEMENT INTEGER
                                ;*DIVIDEND BY A 16-BIT TWO'S COMPLEMENT INTEGER DIVISOR GIVING
                                ;*A 16-BIT TWO'S COMPLEMENT INTEGER QUOTIENT AND A 16-BIT REMAINDER.
                                ;*DIVISION WILL BE PERFORMED SO THAT THE REMAINDER IS OF THE
                                ;*SAVE SIGN AS THE DIVIDEND.
                                ;*CALL:
                                ;*      MOV     LOW DIVIDEND,-(SP)      ;;THE HIGH DIVIDEND MUST BE < 1/2
                                ;*      MOV     HIGH DIVIDEND,-(SP)     ; AS LARGE AS THE DIVISOR
                                ;*      MOV     DIVISOR,-(SP)
                                ;*      JSR     PC,$DIV
                                ;*      RETURN                          ;;QUOTIENT & REMAINDER ARE ON THE STACK
                                ;*      "V"=0   IMPLIES NO ERROR
                                ;*      "V"=1   IMPLIES ERROR OCCURRED
                                ;*              "C"=0   DIVIDE OVERFLOW OCCURRED
                                ;*              "C"=1   ATTEMPTED TO DIVIDE BY ZERO
                                ;*
                                ;*
                                ;*      STACK   NO ERROR        OVERFLOW        DIVIDE BY ZERO
                                ;*      -----   --------        --------        --------------
                                ;*      TOP     REMAINDER       ALL ZEROS       ALL ONES
                                ;*      +2      QUOTIENT        ALL ZEROS       ALL ONES

011074  005046                  $DIV:   CLR     -(SP)   ;;CLEAR DIV STATUS WORD: RESERVED TO SET C AND V BITS
011076  010046                          MOV     R0,-(SP)        ;;PUSH R0 ON STACK
011100  010146                          MOV     R1,-(SP)        ;;PUSH R1 ON STACK
011102  010246                          MOV     R2,-(SP)        ;;PUSH R2 ON STACK
011104  010346                          MOV     R3,-(SP)        ;;PUSH R3 ON STACK
011106  005046                          CLR     -(SP)           ;;SAVE A PLACE FOR SIGNS
011110  012746  000021                  MOV     #17.,-(SP)      ;;SETUP THE ITERATION COUNTER
011114  016601  000024                  MOV     24(SP),R1       ;;PICKUP THE DIVIDEND
011120  016600  000022                  MOV     22(SP),R0
011124  100005                          BPL     1$              ;;CHECK THE SIGN
011126  105366  000003                  DECB    3(SP)           ;;KEEP TRACK OF THE SIGN
011132  005400                          NEG     R0              ;;AND NEGATE THE ORIGINAL
011134  005401                          NEG     R1              ;;NUMBER
011136  005600                          SBC     R0
011140  016602  000020          1$:     MOV     20(SP),R2       ;;PICKUP THE DIVISOR
011144  002407                          BLT     2$              ;;CHECK THE SIGN
011146  003011                          BGT     3$              ;;DIVISOR OF 0 IS A NO-NO
011150  052766  000003  000014          BIS     #3,14(SP)       ;;SET "V" & "C" IN DIV STAT WORD
011156  012700  177777                  MOV     #-1,R0          ;;SET REMAINDER TO ALL ONES
011162  000424                          BR      7$              ;;EXIT
011164  005266  000002          2$:     INC     2(SP)           ;;KEEP TRACK OF DIVISORS SIGN
011170  000401                          BR      4$
011172  005402                  3$:     NEG     R2              ;;NEGATE THE ORIGINAL NUMBER
011174  000241                  4$:     CLC                     ;;CLEAR "C" IN PSW
011176  000405                          BR      6$              ;;START FORMING QUOTIENT
011200  006100                  5$:     ROL     R0              ;;POSITION MSB'S
011202  010003                          MOV     R0,R3           ;;COPY
011204  060203                          ADD     R2,R3           ;;COMPARE DIVIDEND & DIVISOR
011206  103001                          BCC     6$              ;;BR IF DIVIDEND > DIVISOR
011210  010300                          MOV     R3,R0           ;;REMAINDER AFTER THIS LOOP
011212  006101                  6$:     ROL     R1              ;;QUOTIENT BIT ENTERS HERE
011214  005316                          DEC     (SP)            ;;DONE?
011216  001370                          BNE     5$              ;;BR IF NO
```

```
 58 011220  005701                          TST     R1              ;;OVERFLOW?
 59 011222  100005                          BPL     8$              ;;BR IF NO
 60 011224  052766  000002  000014          BIS     #2,14(SP)       ;;SET "V" IN DIV STATUS WORD
 61 011232  005000                          CLR     R0              ;;SET REMAINDER TO ALL ZEROS
 62 011234  010001                  7$:     MOV     R0,R1           ;;COPY REMAINDER INTO QUOTIENT
 63 011236  005726                  8$:     TST     (SP)+           ;;CLEAR COUNTER FROM STACK
 64 011240  005716                          TST     (SP)            ;;REMAINDER SIGN CORRECTION NEEDED?
 65 011242  002004                          BGE     9$              ;;BR IF NO
 66 011244  005400                          NEG     R0              ;;NEGATE REMAINDER
 67 011246  105066  000001                  CLRB    1(SP)           ;;CLEAR SIGN
 68 011252  005316                          DEC     (SP)            ;;BUT DON'T FORGET QUOTIENT
 69 011254  005726                  9$:     TST     (SP)+           ;;QUOTIENT SIGN CORRECTION NEEDED?
 70 011256  001401                          BEQ     10$             ;;BR IF NO
 71 011260  005401                          NEG     R1              ;;NEGATE QUOTIENT
 72 011262  010166  000020          10$:    MOV     R1,20(SP)       ;;RETURN QUOTIENT AND
 73 011266  010066  000016                  MOV     R0,16(SP)       ;;REMAINDER TO USER
 74 011272  012603                          MOV     (SP)+,R3        ;;POP STACK INTO R3
 75 011274  012602                          MOV     (SP)+,R2        ;;POP STACK INTO R2
 76 011276  012601                          MOV     (SP)+,R1        ;;POP STACK INTO R1
 77 011300  012600                          MOV     (SP)+,R0        ;;POP STACK INTO R0
 78 011302  006226                          ASR     (SP)+           ;;COPY C IN PSW PER C IN DIV STAT WORD
 79 011304  000242                          CLV                     ;;CLEAR V IN PSW
 80 011306  001401                          BEQ     11$             ;;V=0 IN DIV STAT WORD, EXIT
 81 011310  000262                          SEV                     ;;V=1 IN DIV STAT WORD, COPY V IN PSW
 82 011312  012616                  11$:    MOV     (SP)+,(SP)      ;;MOVE RETURN ADR UP ONE PLACE, OVERRIDING DIVISOR
 83 011314  000207                          RTS     PC              ;;RETURN WITH SP POINTING TO REMAINDER
```

```
                                ;       INTEGER MULTIPLY ROUTINE
                                ;
                                ;*CALL
                                ;*      MOV     MULTIPLER,-(SP)
                                ;*      MOV     MULTIPLICAND,-(SP)
                                ;*      JSR     PC,$MULT
                                ;*      RETURN                  ;;PRODUCT IS ON THE STACK
                                ;*
                                ;*      STACK   PRODUCT
                                ;*      -----   -------
                                ;*      TOP     LSB'S
                                ;*      +2      MSB'S
                                
011316  010046          $MULT:  MOV     R0,-(SP)        ;;PUSH R0 ON STACK
011320  010146                  MOV     R1,-(SP)        ;;PUSH R1 ON STACK
011322  010246                  MOV     R2,-(SP)        ;;PUSH R2 ON STACK
011324  005046                  CLR     -(SP)           ;;CLEAR THE SIGN KEY
011326  016601  000012          MOV     12(SP),R1       ;;GET THE MULTIPLICAND
011332  100002                  BPL     1$              ;;BR IF PLUS
011334  005216                  INC     (SP)            ;;SET THE SIGN KEY
011336  005401                  NEG     R1              ;;MAKE THE MULTIPLICAND POSTIVE
011340  016602  000014  1$:     MOV     14(SP),R2       ;;GET THE MULTIPLIER
011344  100002                  BPL     2$              ;;BR IF PLUS
011346  005316                  DEC     (SP)            ;;UPDATE THE SIGN KEY
011350  005402                  NEG     R2              ;;MAKE THE MULTIPLIER POSTIVE
011352  012746  000021  2$:     MOV     #17.,-(SP)      ;;SET THE LOOP COUNT
011356  005000                  CLR     R0              ;;SETUP FOR THE MULTIPLY LOOP
011360  103001          3$:     BCC     4$              ;;DON'T ADD IF MULTIPLICAND = 0
011362  060200                  ADD     R2,R0
011364  006000          4$:     ROR     R0              ;;POSITION THE PARITIAL PRODUCT AND
011366  006001                  ROR     R1              ;;THE MULTIPLICAND
011370  005316                  DEC     (SP)            ;;HAS ALL BITS OF THE MULTIPLICAND BEEN DONE?
011372  001372                  BNE     3$              ;;BR IF NO
011374  022616                  CMP     (SP)+,(SP)      ;;SHOULD PRODUCT BE NEGATIVE?
011376  001403                  BEQ     5$              ;;GO TO EXIT IF NO
011400  005400                  NEG     R0              ;;YES--SO MAKE IT SO
011402  005401                  NEG     R1
011404  005600                  SBC     R0
011406  005726          5$:     TST     (SP)+           ;;CLEAR SIGN INFO. OFF OF STACK
011410  010066  000012          MOV     R0,12(SP)       ;;PUT THE PRODUCT ON THE STACK (MSB'S)
011414  010166  000010          MOV     R1,10(SP)       ;;LSB'S
011420  012602                  MOV     (SP)+,R2        ;;POP STACK INTO R2
011422  012601                  MOV     (SP)+,R1        ;;POP STACK INTO R1
011424  012600                  MOV     (SP)+,R0        ;;POP STACK INTO R0
011426  000207                  RTS     PC
```

```
                                ;OCTAL TO HEXADECIMAL CONVERSION ROUTINE
                                ;
011430  010146          OCTHEX: MOV     R1,-(SP)        ;SAVE R1
011432  010246                  MOV     R2,-(SP)        ;SAVE R2
011434  012700  011564          MOV     #PSTACK,R0      ;SET UP THE BUFFER ADDRESS
011440  012702  000004          MOV     #4,R2           ;GET THE ITERATION VALUES
011444  012701  000004  1$:     MOV     #4,R1           ;AND DUPLICATE FOR TWO LOOPS
011450  005010                  CLR     (R0)            ;INITIALIZE THE BUFFER
011452  006310          2$:     ASL     (R0)            ;MOVE THE PREVIOUS BIT(S) OVER
011454  000241                  CLC                     ;CARRY = 0
011456  006366  000006          ASL     6(SP)           ;ROTATE A BIT FROM THE TEST VALUE
011462  103002                  BCC     3$              ;IF ZERO, SKIP NEXT INSTRUCTION
011464  052710  000001          BIS     #BIT0,(R0)      ;MARK THE BIT AS BEING SET
011470  005301          3$:     DEC     R1              ;ONE LESS ITERATION TO GO
011472  003367                  BGT     2$              ;BUT NOT DONE UNTIL = 0!
011474  005720                  TST     (R0)+           ;NEXT BUFFER LOCATION
011476  005302                  DEC     R2              ;ONE LESS ITERATION TO-GO
011500  003361                  BGT     1$              ;IF NOT ZERO, KEEP GOING!
011502  012702  000004          MOV     #4,R2           ;GET THE NEW ITERATION COUNT
011506  012700  011564          MOV     #PSTACK,R0      ;AND GET THE BUFFER ADDRESS AGAIN
011512  005710          4$:     TST     (R0)            ;CONTENTS ZERO?
011514  003005                  BGT     5$              ;IF NOT, SKIP NEXT
011516  012720  000060          MOV     #60,(R0)+       ;SET THIS CHARACTER = NULL
011522  005302                  DEC     R2              ;ONE LESS CHARACTER TO GO
011524  003372                  BGT     4$              ;IF NOT ZERO, KEEP GOING
011526  000412                  BR      8$              ;DONE, RETURN!
011530  021027  000011  5$:     CMP     (R0),#11        ;ALPHA OR NUMERIC CHARACTER?
011534  101003                  BHI     6$              ;IF > 11, ALPHA!
011536  062720  000060          ADD     #60,(R0)+       ;MAKE NUMERIC ASCII
011542  000402                  BR      7$              ;AND GO-ON
011544  062720  000067  6$:     ADD     #55.,(R0)+      ;MAKE HEX ASCII
011550  005302          7$:     DEC     R2              ;ONE LESS ITERATION TO-GO
011552  003366                  BGT     5$              ;ONE LESS ITERATION, IF NOT ZERO
011554  012602          8$:     MOV     (SP)+,R2        ;RESTORE R2
011556  012601                  MOV     (SP)+,R1        ;AND R1
011560  012616                  MOV     (SP)+,(SP)      ;MOVE STACK OVER INPUT VALUE
011562  000207                  RTS     PC              ;AND RETURN

011564          PSTACK: .BLKW   10.     ;SOTWARE PSEUDO STACK
```

```
                                        ;SUBR TO GENERATE A PSEUDO RANDOM NUMBER
                                        ;THE NUMBER IS RETURNED IN $RP1
                                        ;THERE ARE 3 SEED VALUES THAT CAN BE SAVED
                                        ;TO GENERATE THE PSEUDO RANDOM NUMBER

011610  010046              RAND:   MOV     R0,-(SP)        ;SAVE R0
011612  013700  011672              MOV     $RP1,R0         ;GET A SEED
011616  000241                      CLC                     ;
011620  005337  011670              DEC     $RNCON  ;
011624  006100                      ROL     R0
011626  006100                      ROL     R0
011630  063700  011670              ADD     $RNCON,R0
011634  063700  011674              ADD     $RP2,R0
011640  010037  011672              MOV     R0,$RP1
011644  006100                      ROL     R0
011646  006100                      ROL     R0
011650  063700  011674              ADD     $RP2,R0
011654  006100                      ROL     R0
011656  006100                      ROL     R0
011660  010037  011674              MOV     R0,$RP2
011664  012600                      MOV     (SP)+,R0        ;RESTORE R0
011666  000207                      RTS     PC

011670  000000              $RNCON: 0
011672  001233              $RP1:   1233
011674  007622              $RP2:   7622
```

```
                                ;DETERMINE IF THERE IS A CLOCK ON SYSTEM. START THE CLOCK. "CLKSTA" WILL
                                ;INDICATE THE CLOCK TYPE.
                                ;        0= NO CLOCK
                                ;       +1= KW11-P
                                ;       -1= KW11-L
                                ;THIS ROUTINE WILL ALSO SETUP "TICKMS" (TIME PER CLOCK TICK IN MILLISECONDS)
                                ;AND "TICKUS" (TIME PER CLOCK TICK IN MICROSECONDS) AS PER LINE FREQUENCY.
                                ;CALL
                                ;       JSR     PC,ST.CLK       ;START THE CLOCK
                                ;       RETURN

011676  005037  002250          ST.CLK: CLR     CLKSTA          ;ASSUME "NO CLOCK"
011702  005037  012142                  CLR     HERTZ           ;ASSUME "UNKNOWN" HERTZ
                                                                ;IS THERE A P-CLOCK PRESENT ?
011706  012700  000120                  MOV     #'P,R0
011712  104462                          TRAP    C$CLCK
011714  010005                          MOV     R0,R5
                                                                ;GO TO 1$ IF NO
011716  103031                          BCC     1$

                                        ;SET P-CLOCK P-TABLE & START P-CLOCK

011720  010537  012116                  MOV     R5,PCLKTB       ;SAVE P-CLOCK TABLE ADDRESS
011724  011537  012120                  MOV     (R5),PKCS       ;GET 'CSR' ADDRESS
011730  011537  012122                  MOV     (R5),PKB        ;MAKE PKB ADDRESS BY
011734  062737  000002  012122          ADD     #2,PKB          ;ADDING 2
011742  012537  012124                  MOV     (R5)+,PKC       ;MAKE PKC ADDRESS BY
011746  062737  000004  012124          ADD     #4,PKC          ;ADDING 4
011754  005725                          TST     (R5)+           ;SKIP OVER 'BR LEVEL'
011756  012537  012126                  MOV     (R5)+,PKV       ;GET 'VECTOR' ADDRESS
011762  012537  012142                  MOV     (R5)+,HERTZ     ;GET 'HERTZ' LINE FREQUENCY
011766  012737  000001  002250          MOV     #1,CLKSTA       ;SET P-CLOCK FLAG
011774  004737  012144                  JSR     PC,ST.PCLK      ;START P-CLOCK AS A WATCH DOG TIMER
012000  000423                          BR      2$
012002                          1$:                             ;IS THERE A L-CLOCK PRESENT ?
012002  012700  000114                  MOV     #'L,R0
012006  104462                          TRAP    C$CLCK
012010  010005                          MOV     R0,R5
                                                                ;GO TO 3$ IF NO
012012  103036                          BCC     3$

                                        ;SET L-CLOCK P-TABLE, START L-CLOCK

012014  010537  012132                  MOV     R5,LCLKTB       ;SAVE L-CLOCK TABLE ADDRESS
012020  012537  012134                  MOV     (R5)+,LKS       ;GET 'CSR' ADDRESS
012024  005725                          TST     (R5)+           ;SKIP OVER 'BR LEVEL'
012026  012537  012136                  MOV     (R5)+,LKV       ;GET 'VECTOR' ADDRESS
012032  012537  012142                  MOV     (R5)+,HERTZ     ;GET 'HERTZ' LINE FREQUENCY
012036  012737  177777  002250          MOV     #-1,CLKSTA      ;L-CLOCK FLAG
012044  004737  012216                  JSR     PC,ST.LCLK      ;START L-CLOCK AS A WATCH DOG TIMER

                                        ;GET THE CLOCK TICK COUNT

012050  012737  000024  012112  2$:     MOV     #20.,TICKMS     ;ASSUME 20.0 MSEC &
012056  012737  047040  012114          MOV     #20000.,TICKUS  ;20000.0 USEC
012064  023727  012142  000062          CMP     HERTZ,#50.      ;IS IT 50 HERTZ LINE FREQUENCY ?
```

```
012072  001406                          BEQ     3$              ;BR IF YES
012074  012737  000020  012112          MOV     #16.,TICKMS     ;MUST BE 60HZ, 16.666 MSEC &
012102  012737  040432  012114          MOV     #16666.,TICKUS  ;16666.0 USEC
012110  000207                  3$:     RTS     PC

012112  000020                  TICKMS: .WORD   16.              ;16 MILLISECONDS PER CLOCK TICK
012114  040432                  TICKUS: .WORD   16666.           ;16666 MICROSECONDS PER CLOCK TICK

                                ;KW11-P CLOCK TABLE, CSR REG, PKB REG, PKC REG & VEC ADR

012116  000000                  PCLKTB: .WORD   0                ;P-CLK TBL ADR

012120  172540                  PKCS:   .WORD   172540           ;CONTROL & STATUS
012122  172542                  PKB:    .WORD   172542           ;COUNT SET BFR
012124  172544                  PKC:    .WORD   172544           ;COUNTER
012126  000104  000106          PKV:    .WORD   104,106          ;VECTOR

                                ;KW11-L CLOCK TABLE, CSR REG & VEC ADR

012132  000000                  LCLKTB: .WORD   0                ;L-CLK TBL ADR

012134  177546                  LKS:    .WORD   177546           ;CONTROL & STATUS
012136  000100  000102          LKV:    .WORD   100,102          ;VECTOR

012142  000000                  HERTZ:  .WORD   0                ;60 HZ. OR 50 HZ. LINE FREQUENCY

012144                  ST.PCLK:
012144  105737  002233                  TSTB    STOFLG          ;ALLOW SOFTWARE TIMEOUTS ?
012150  001021                          BNE     1$              ;NO--BRANCH
                                                                ;SETUP VECTOR FOR P-CLOCK
012152  012746  000300                  MOV     #PRI06,-(SP)
012156  012746  012312                  MOV     #KWSRV,-(SP)
012162  013746  012126                  MOV     PKV,-(SP)
012166  012746  000003                  MOV     #3,-(SP)
012172  104437                          TRAP    C$SVEC
012174  062706  000010                  ADD     #10,SP
012200  012777  000001  177714          MOV     #1,@PKB         ;COUNT ONE TICK
012206  012777  000115  177704          MOV     #115,@PKCS      ;"INT.EN.",COUNT DOWN", "MODE 1 (REPEAT)",
                                                                ;"LINE FREQ", AND "RUN"
012214  000207                  1$:     RTS     PC              ;RETURN

012216                  ST.LCLK:
012216  105737  002233                  TSTB    STOFLG          ;ALLOW SOFTWARE TIMEOUTS ?
012222  001016                          BNE     1$              ;NO--BRANCH
                                                                ;SETUP VECTOR FOR L-CLOCK
012224  012746  000300                  MOV     #PRI06,-(SP)
012230  012746  012312                  MOV     #KWSRV,-(SP)
012234  013746  012136                  MOV     LKV,-(SP)
012240  012746  000003                  MOV     #3,-(SP)
012244  104437                          TRAP    C$SVEC
012246  062706  000010                  ADD     #10,SP
012252  012777  000100  177654          MOV     #100,@LKS       ;START THE KW11-L
012260  000207                  1$:     RTS     PC              ;RETURN

                                ;THIS ROUTINE IS USED TO STOP THE SYSTEM CLOCK
                                ;CALL
                                ;       JSR     PC,STOPCK       ;CALL ROUTINE
```

```
                                                ;IS THERE A CLOCK AVAILABLE ?
012262  005737  002250          STOPCK: TST     CLKSTA
012266  001410                  BEQ     2$      ;BR IF NO
012270  100404                  BMI     1$      ;BR IF L-CLOCK
012272  042777  000101  177620  BIC     #101,@PKCS      ;STOP THE P-CLOCK
012300  000403                  BR      2$
012302  042777  000100  177624  1$:     BIC     #100,@LKS       ;STOP THE L-CLOCK
012310  000207                  2$:     RTS     PC

                                ;KW11 CLOCK INTERRUPT SERVICE ROUTINE

012312  013746  012112          KWSRV:  MOV     TICKMS,-(SP)    ;TIME PER TICK IN MILLISECONDS
012316  004737  023732                  JSR     PC,RPTMR        ;COUNT THE ELASPED TIME
012322                          L10006:
012322  000002                  RTI

                                ;THIS SUBROUTINE IS USED TO RELOAD THE CLOCK FOR A 4 SECOND TIMEOUT DURING
                                ;A RECALIBRATE COMMAND

012324  042777  000101  177566  FORSEC: BIC     #101,@PKCS      ;STOP CLOCK
012332  017746  177570          MOV     @PKV,-(SP)      ;SAVE THE OLD CLOCK VECTOR ADDRESS
                                                        ;SETUP VECTOR FOR P-CLOCK
012336  012746  000300          MOV     #PRI06,-(SP)
012342  012746  012402          MOV     #1$,-(SP)
012346  013746  012126          MOV     PKV,-(SP)
012352  012746  000003          MOV     #3,-(SP)
012356  104437                  TRAP    C$SVEC
012360  062706  000010          ADD     #10,SP
012364  012777  000360  177530          MOV     #240.,@PKB      ;4 SEC  DELAY AT LINE FREQ
012372  012777  000105  177520          MOV     #105,@PKCS      ;RUN AT LINE FREQ, DOWN MODE, IE=1
012400  000001                  WAIT                    ;WAIT FOR CLK INTER
012402  042777  000101  177510  1$:     BIC     #101,@PKCS      ;STOP CLOCK
012410  012716  012416          MOV     #2$,(SP)        ;ADJUST FOR RETURN
012414                          L10007:
012414  000002                  RTI
012416                          2$:                     ;RESTORE OLD VECTOR ADDRESS FOR P-CLOCK
012416  012746  000300          MOV     #PRI06,-(SP)
012422  012646                  MOV     (SP)+,-(SP)
012424  013746  012126          MOV     PKV,-(SP)
012430  012746  000003          MOV     #3,-(SP)
012434  104437                  TRAP    C$SVEC
012436  062706  000010          ADD     #10,SP
012442  005077  177454          CLR     @PKB            ;CLEAR CLK BFR COUNT
012446  000207                  RTS     PC

                                ;ROUTINE TO PROVIDE A 2 MS STALL AFTER A SEEK OPERATION IN THE SEEK TIMING
                                ;TESTS.  THIS STALL IS REQUIRED TO COMPENSATE FOR THE 'ACCESS READY' DELAY
                                ;IN THE RP07.  THIS STALL TIME IS NOT INCLUDED IN THE CALCULATED SEEK TIMES.
                                ;CALL
                                ;       JSR     PC,TWOMS
                                ;       RETURN

012450  042777  000101  177442  TWOMS:  BIC     #101,@PKCS      ;STOP THE P-CLOCK
012456  017746  177444          MOV     @PKV,-(SP)      ;SAVE THE OLD CLOCK VECTOR ADDRESS
                                                        ;SETUP VECTOR FOR P-CLOCK
012462  012746  000300          MOV     #PRI06,-(SP)
012466  012746  012554          MOV     #2$,-(SP)
```

```
                012472  013746  012126                  MOV     PKV,-(SP)
                012476  012746  000003                  MOV     #3,-(SP)
                012502  104437                          TRAP    C$SVEC
                012504  062706  000010                  ADD     #10,SP
156             012510  012777  000310  177404          MOV     #200.,@PKB      ;LOAD THE CLOCK BUFFER
157             012516  105737  002230                  TSTB    TIMSTL          ;RANDOM STALL?
158             012522  001410                          BEQ     1$              ;NO
159             012524  004737  011610                  JSR     PC,RAND         ;YES, FETCH A RANDOM NUMBER
160             012530  013746  011672                  MOV     $RP1,-(SP)      ;GET RANDOM NUMBER
161             012534  042716  173000                  BIC     #^C4777,(SP)    ;LIMIT IT TO 25 MSEC
162             012540  062677  177356                  ADD     (SP)+,@PKB      ;ADD IT TO THE BASIC 2 MSEC STALL
163             012544  012777  000101  177346  1$:     MOV     #101,@PKCS      ;START THE CLOCK
164             012552  000001                          WAIT                    ;WAIT FOR 2 MS
166             012554  042777  000101  177336  2$:     BIC     #101,@PKCS      ;STOP THE P-CLOCK
167             012562  012716  012570                  MOV     #3$,(SP)        ;ADJUST FOR RETURN
168             012566                          L10010:
                012566  000002                          RTI
169             012570                          3$:                             ;RESTORE OLD VECTOR ADDRESS FOR P-CLOCK
170             012570  012746  000300                  MOV     #PR106,-(SP)
                012574  012646                          MOV     (SP)+,-(SP)
                012576  013746  012126                  MOV     PKV,-(SP)
                012602  012746  000003                  MOV     #3,-(SP)
                012606  104437                          TRAP    C$SVEC
                012610  062706  000010                  ADD     #10,SP
171             012614  005077  177302                  CLR     @PKB            ;SET COUNT = 0
172             012620  000207                          RTS     PC              ;RETURN
176
177                                             ;THIS ROUTINE LOADS A READ HEADER AND DATA COMMAND OR A SEEK COMMAND
178                                             ;INTO DPB.B+2 AND DPB.C+2, DEPENDING ON THE STATE OF REDHDR FLAG
179                                             ;THAT CAN BE ALTERED BY THE OPERATOR.
180                                             ;CALL
181                                             ;       JSR     PC,LDCMD
182                                             ;       RETURN
183
184             012622                          LDCMD:
185             012622  105737  002226                  TSTB    REDHDR          ;DO EXPLICIT SEEKS FOR VERIFYING ?
186             012626  001407                          BEQ     1$              ;NO--BRANCH
187             012630  012737  000173  002562          MOV     #RDHD,DPB.B+2   ;NO--SET UP FOR READ HEADER AND
188             012636  012737  000173  002602          MOV     #RDHD,DPB.C+2   ;DATA COMMAND
189             012644  000406                          BR      2$
190             012646  012737  000105  002562  1$:     MOV     #SEEK,DPB.B+2 ;SETUP FOR SEEK COMMAND
191             012654  012737  000105  002602          MOV     #SEEK,DPB.C+2
192             012662  000207                  2$:     RTS     PC
```

```
                                ;ERROR ANALYSIS ROUTINE
                                ;R0     NOT USED
                                ;R1     DPB ADDRESS
                                ;R2     BASE ADDRESS OF SAVED REG'S TABLE
                                ;R3     TEMP STORAGE
                                ;R4
                                ;R5     LINK AND RET
                                ;
                                ;       CALLING SEQ:
                                ;       JSR     R5,ERRANY
                                ;       DPB
                                ;       RET
                                ;
012664                          ERRANY:
012664  010146                          MOV     R1,-(SP)        ;;PUSH R1 ON STACK
012666  010246                          MOV     R2,-(SP)        ;;PUSH R2 ON STACK
012670  010346                          MOV     R3,-(SP)        ;;PUSH R3 ON STACK
012672  010446                          MOV     R4,-(SP)        ;;PUSH R4 ON STACK
012674  005037  002254                  CLR     SVSTAT          ;PROGRAM FLAGS: EACH BIT INDICATES ERROR TYPE
012700  012501                          MOV     (R5)+,R1        ;DPB ADDRESS
012702  016102  000014                  MOV     14(R1),R2       ;ADDRESS OF SAVED REGISTER TABLE
012706  016237  000036  002266          MOV     36(R2),CYL.RD   ;GET CURRENT CYLINDER
012714  116237  000006  002272          MOVB    6(R2),SEC.RD    ;GET CURRENT SECTOR
012722  116237  000007  002270          MOVB    7(R2),TRK.RD    ;GET CURRENT TRACK
012730  126127  000002  000150          CMPB    2(R1),#150      ;IF DATA TFR CMD
012736  002402                          BLT     1$
012740  004737  014206                  JSR     PC,ADJUST       ;THEN GET THE DECREMENTED SECTOR ADDRESS
012744  032762  020000  000000  1$:     BIT     #MCPE,0(R2)     ;MCPE ERROR ?
012752  001406                          BEQ     2$              ;BRANCH IF NOT
012754  104456                          TRAP    C$ERHRD
012756  000001                          .WORD   1
012760  005331                          .WORD   EM1
012762  007604                          .WORD   DH44
012764  000137  014042                  JMP     31$             ;EXIT
                                ;
012770  032762  020400  000010  2$:     BIT     #MPE!UPE,10(R2) ;PARITY PROBLEM ?
012776  001406                          BEQ     3$              ;BRANCH IF NONE
013000  104456                          TRAP    C$ERHRD
013002  000002                          .WORD   2
013004  005376                          .WORD   EM2
013006  007604                          .WORD   DH44
013010  000137  014052                  JMP     32$             ;EXIT
                                ;
013014  032762  017000  000010  3$:     BIT     #NED!NEM!MSPGE!MXF,10(R2)       ;ILLEGAL CONDITIONS ?
013022  001412                          BEQ     4$              ;BRANCH IF NONE
013024  032762  040000  000012          BIT     #ERR,12(R2)     ;ANY DRIVE ERROR ?
013032  001006                          BNE     4$              ;REPORT THE DRIVE ERROR
013034  104456                          TRAP    C$ERHRD
013036  000003                          .WORD   3
013040  005440                          .WORD   EM3
013042  007604                          .WORD   DH44
013044  000137  014052                  JMP     32$             ;EXIT
                                ;
013050  032762  040000  000010  4$:     BIT     #WCE,10(R2)     ;ANY DATA PATTERN ERROR ?
013056  001406                          BEQ     5$              ;BRANCH IF NONE
013060  104456                          TRAP    C$ERHRD
```

```
                013062  000004                          .WORD   4
                013064  005516                          .WORD   EM4
                013066  007604                          .WORD   DH44
     45 013070  000137  014052                          JMP     32$             ;EXIT
     46
     47 013074  032762  100000  000010  5$:     BIT     #DLT,10(R2)     ;ANY DATA LATE ERROR ?
     48 013102  001406                          BEQ     6$              ;BRANCH IF NONE
     49 013104  104456                          TRAP    C$ERHRD
                013106  000005                  .WORD   5
                013110  005540                  .WORD   EM5
                013112  007604                  .WORD   DH44
     50 013114  000137  014052                  JMP     32$             ;EXIT
     51
     52 013120  032762  040000  000012  6$:     BIT     #ERR,12(R2)     ;ANY DRIVE ERROR ?
     53 013126  001002                          BNE     7$              ;BRANCH IF ANY
     54 013130  000137  014174                  JMP     43$             ;EXIT
     55
     56 013134  032762  100000  000040  7$:     BIT     #PGE,40(R2)     ;DRIVE PROGRAMMING ERROR ?
     57 013142  001406                          BEQ     8$              ;BRANCH IF NONE
     58 013144  104456                          TRAP    C$ERHRD
                013146  000006                  .WORD   6
                013150  005560                  .WORD   EM6
                013152  007604                  .WORD   DH44
     59 013154  000137  014062                  JMP     33$             ;EXIT
     60
     61 013160  032762  002000  000042  8$:     BIT     #LBC,42(R2)     ;LOST BIT CLOCK ?
     62 013166  001406                          BEQ     9$              ;BRANCH IF NONE
     63 013170  104456                          TRAP    C$ERHRD
                013172  000007                  .WORD   7
                013174  005616                  .WORD   EM7
                013176  007604                  .WORD   DH44
     64 013200  000137  014072                  JMP     34$             ;EXIT
     65
     66 013204  032762  000040  000014  9$:     BIT     #WCF,14(R2)     ;WRITE CLOCK FAILS ?
     67 013212  001406                          BEQ     10$             ;BRANCH IF NONE
     68 013214  104456                          TRAP    C$ERHRD
                013216  000013                  .WORD   11
                013220  005644                  .WORD   EM11
                013222  007604                  .WORD   DH44
     69 013224  000137  014072                  JMP     34$             ;EXIT
     70
     71 013230  032762  004000  000014  10$:    BIT     #WLE,14(R2)     ;WRITE LOCK ERROR ?
     72 013236  001406                          BEQ     11$             ;BRANCH IF NONE
     73 013240  104456                          TRAP    C$ERHRD
                013242  000014                  .WORD   12
                013244  005666                  .WORD   EM12
                013246  007604                  .WORD   DH44
     74 013250  000137  014072                  JMP     34$             ;EXIT
     75
     76 013254  032762  010000  000014  11$:    BIT     #DTE,14(R2)     ;DATA ERROR ON DRIVE ?
     77 013262  001042                          BNE     16$             ;REPORT THE DRIVE TIMING ERROR
     78 013264  032762  100000  000014          BIT     #DCK,14(R2)     ;ANY DATA ERROR ?
     79 013272  001444                          BEQ     17$             ;BRANCH IF NONE
     80 013274  032762  000100  000014          BIT     #ECH,14(R2)     ;ECH SET, THEN RPEC1=10040
     81 013302  001412                          BEQ     13$             ;EXIT IF NOT SET
     82 013304  022762  010040  000044  12$:    CMP     #10040,44(R2)   ;POSITION REG=10040
     83 013312  001012                          BNE     14$             ;REPORT ECC LOGIC FAILURE
```

```
 84 013314  104456                          TRAP    C$ERHRD
    013316  000057                          .WORD   47
    013320  007216                          .WORD   EM47
    013322  007604                          .WORD   DH44
 85 013324  000137  014072                  JMP     34$             ;EXIT
 86
 87 013330  022762  010040  000044  13$:    CMP     #10040,44(R2)   ;LEGICAL POSITION REG CONTENTS ?
 88 013336  101006                          BHI     15$             ;BRANCH IF SO
 89 013340                          14$:
    013340  104456                          TRAP    C$ERHRD
    013342  000053                          .WORD   43
    013344  007045                          .WORD   EM43
    013346  007604                          .WORD   DH44
 90 013350  000137  014072                  JMP     34$             ;EXIT
 91
 92 013354                          15$:
    013354  104456                          TRAP    C$ERHRD
    013356  000015                          .WORD   13
    013360  005707                          .WORD   EM13
    013362  007604                          .WORD   DH44
 93 013364  000137  014072                  JMP     34$             ;EXIT
 94
 95 013370                          16$:
    013370  104456                          TRAP    C$ERHRD
    013372  000055                          .WORD   45
    013374  007135                          .WORD   EM45
    013376  007604                          .WORD   DH44
 96 013400  000137  014072                  JMP     34$             ;EXIT
 97
 98 013404  032762  000010  000042  17$:    BIT     #DPE,42(R2)     ;DRIVE DATA BUS PARITY ?
 99 013412  001406                          BEQ     18$             ;BRANCH IF NONE
100 013414  104456                          TRAP    C$ERHRD
    013416  000016                          .WORD   14
    013420  005730                          .WORD   EM14
    013422  007604                          .WORD   DH44
101 013424  000137  014072                  JMP     34$             ;EXIT
102
103 013430  032762  000007  000014  18$:    BIT     #ILF!ILR!RMR,14(R2)     ;INTERFACE PROBLEM ?
104 013436  001406                          BEQ     19$             ;BRANCH IF NONE
105 013440  104456                          TRAP    C$ERHRD
    013442  000017                          .WORD   15
    013444  005765                          .WORD   EM15
    013446  007604                          .WORD   DH44
106 013450  000137  014102                  JMP     35$             ;EXIT
107
108 013454  032762  003000  000014  19$:    BIT     #IAE!AOE,14(R2) ;POSITION ERROR
109 013462  001406                          BEQ     20$             ;BRANCH IF NONE
110 013464  104456                          TRAP    C$ERHRD
    013466  000020                          .WORD   16
    013470  006032                          .WORD   EM16
    013472  007604                          .WORD   DH44
111 013474  000137  014112                  JMP     36$             ;EXIT
112
113 013500  032762  020000  000014  20$:    BIT     #OPI,14(R2)     ;OPERATION INCOMPLETE ?
114 013506  001406                          BEQ     21$             ;BRANCH IF SO
115 013510  104456                          TRAP    C$ERHRD
    013512  000051                          .WORD   41
```

```
                013514  006765                          .WORD   EM41
                013516  007604                          .WORD   DH44
    116         013520  000137  014112                  JMP     36$             ;EXIT
    117
    118         013524  032762  041000  000042  21$:    BIT     #SKI!LCE,42(R2) ;SERVO OR ACTUATOR SEEK ERROR ?
    119         013532  001406                          BEQ     22$             ;BRANCH IF NONE
    120         013534  104456                          TRAP    C$ERHRD
                013536  000021                          .WORD   17
                013540  006065                          .WORD   EM17
                013542  007604                          .WORD   DH44
    121         013544  000137  014112                  JMP     36$
    122
    123         013550  032762  000002  000012  22$:    BIT     #EWN,12(R2)     ;PROBLEM ?
    124         013556  001406                          BEQ     23$             ;BRANCH IF SO
    125         013560  104456                          TRAP    C$ERHRD
                013562  000025                          .WORD   21
                013564  006161                          .WORD   EM21
                013566  007604                          .WORD   DH44
    126         013570  000137  014122                  JMP     37$             ;EXIT
    127
    128         013574  016203  000014          23$:    MOV     14(R2),R3       ;CHECK IF HEAD MISSING
    129         013600  042703  177057                  BIC     #^C<FER!ECH!HCRC!HCE>,R3         ;CHOP THE REST BITS
    130         013604  022703  000720                  CMP     #FER!ECH!HCRC!HCE,R3             ;MISSING HEAD ?
    131         013610  001006                          BNE     24$             ;BRANCH IF NOT
    132         013612  104456                          TRAP    C$ERHRD
                013614  000026                          .WORD   22
                013616  006205                          .WORD   EM22
                013620  007604                          .WORD   DH44
    133         013622  000137  014132                  JMP     38$             ;EXIT
    134
    135         013626  032762  000020  000014  24$:    BIT     #FER,14(R2)     ;FORMAT ERROR ?
    136         013634  001406                          BEQ     25$             ;BRANCH IF NOT
    137         013636  104456                          TRAP    C$ERHRD
                013640  000027                          .WORD   23
                013642  006235                          .WORD   EM23
                013644  007604                          .WORD   DH44
    138         013646  000137  014132                  JMP     38$             ;EXIT
    139
    140         013652  032762  000600  000014  25$:    BIT     #HCRC!HCE,14(R2)        ;HEADER INFORMATION ERROR ?
    141         013660  001420                          BEQ     27$             ;BRANCH IF NONE
    142         013662  032762  000400  000014          BIT     #HCRC,14(R2)    ;HEADER CRC ERROR ?
    143         013670  001006                          BNE     26$             ;BRACH IF SO
    144         013672  104456                          TRAP    C$ERHRD
                013674  000030                          .WORD   24
                013676  006271                          .WORD   EM24
                013700  007604                          .WORD   DH44
    145         013702  000137  014132                  JMP     38$             ;EXIT
    146
    147         013706                          26$:
                013706  104456                          TRAP    C$ERHRD
                013710  000056                          .WORD   46
                013712  007166                          .WORD   EM46
                013714  007604                          .WORD   DH44
    148         013716  000137  014132                  JMP     38$             ;EXIT
    149
    150         013722  032762  017400  000040  27$:    BIT     #WRYUNS!WOR!RWU1!RWU2!RWU3,40(R2)        ;WRITE AND READ UNSAFE ?
    151         013730  001406                          BEQ     28$             ;BRANCH IF NONE
```

```
152 013732  104456                          TRAP    C$ERHRD
    013734  000040                          .WORD   32
    013736  006614                          .WORD   EM32
    013740  007604                          .WORD   DH44
153 013742  000137  014142                  JMP     39$             ;EXIT
154
155 013746  032762  000040  000042  28$:    BIT     #DCU,42(R2)     ;DC LOW ?
156 013754  001406                          BEQ     29$             ;BRANCH IF NONE
157 013756  104456                          TRAP    C$ERHRD
    013760  000041                          .WORD   33
    013762  006637                          .WORD   EM33
    013764  007604                          .WORD   DH44
158 013766  000137  014142                  JMP     39$             ;EXIT
159
160 013772  032762  000100  000042  29$:    BIT     #IXU,42(R2)     ;INDEX UNSAFE ?
161 014000  001406                          BEQ     30$             ;BRANCH IF NONE
162 014002  104456                          TRAP    C$ERHRD
    014004  000042                          .WORD   34
    014006  006657                          .WORD   EM34
    014010  007604                          .WORD   DH44
163 014012  000137  014142                  JMP     39$             ;EXIT
164
165 014016  032762  000400  000042  30$:    BIT     #PHF,42(R2)     ;PROCESSOR HANDSHAKE FAILURE??
166 014024  001452                          BEQ     42$             ;BRANCH IF NOT
167 014026  104456                          TRAP    C$ERHRD
    014030  000043                          .WORD   35
    014032  006674                          .WORD   EM35
    014034  007604                          .WORD   DH44
168 014036  000137  014142                  JMP     39$
169
170 014042  052737  000001  002254  31$:    BIS     #BIT0,SVSTAT    ;MCPE=1,RHXX A-SYNC CONTROL BUS PARITY
171 014050  000451                          BR      43$
172
173 014052  052737  000002  002254  32$:    BIS     #BIT1,SVSTAT    ;RHXX DATA BUS PARITY,ILLEGAL CONDITION
174 014060  000445                          BR      43$             ;DATA LATE, WRITE CHECK.
175
176 014062  052737  000004  002254  33$:    BIS     #BIT2,SVSTAT    ;PROGRAM ERROR: PROHIBITED COMMANDS
177 014070  000441                          BR      43$             ;WERE EXECUTED (WRITE/READ TRACK DES,
178                                                                 ;FORMAT TRACK).
179
180 014072  052737  000010  002254  34$:    BIS     #BIT3,SVSTAT    ;DRIVE CLOCK, TIMING, DATA ERROR
181 014100  000435                          BR      43$             ;RETRY SHOULD BE ALLOWED.
182
183 014102  052737  000020  002254  35$:    BIS     #BIT4,SVSTAT    ;ILLEGAL CONDITION ,DECODER, INTERFACE
184 014110  000431                          BR      43$             ;PROBLEM
185
186 014112  052737  000040  002254  36$:    BIS     #BIT5,SVSTAT    ;POSITIONING ERROR
187 014120  000425                          BR      43$
188
189 014122  052737  000100  002254  37$:    BIS     #BIT6,SVSTAT    ;MECHANICAL FAILURE : AIR, TEMP ETC.
190 014130  000421                          BR      43$
191
192 014132  052737  000200  002254  38$:    BIS     #BIT7,SVSTAT    ;HEADER INFORMATION ( HEADER FAILURE,
193 014140  000415                          BR      43$             ;OR UNFORMAT TRACK )
194
195 014142  052737  000400  002254  39$:    BIS     #BIT8,SVSTAT    ;UNSAFE (READ/WRITE, INDEX, TACH)
196 014150  000411                          BR      43$
```

```
197
198 014152  032762  100000  000042  42$:    BIT     #BSE,42(R2)     ;BAD SECTOR DETECTED ?
199 014160  001005                          BNE     43$             ;EXIT NOT REPORT ERROR
200 014162  104456                          TRAP    C$ERHRD
    014164  000054                          .WORD   44
    014166  007067                          .WORD   EM44
    014170  007604                          .WORD   DH44
201 014172  000763                          BR      39$             ;EXIT
202 014174                          43$:
    014174  012604                          MOV     (SP)+,R4        ;;POP STACK INTO R4
    014176  012603                          MOV     (SP)+,R3        ;;POP STACK INTO R3
    014200  012602                          MOV     (SP)+,R2        ;;POP STACK INTO R2
    014202  012601                          MOV     (SP)+,R1        ;;POP STACK INTO R1
203 014204  000205                          RTS     R5
```

```
                                ;SUBROUTINE TO ADJUST THE SECTOR ADDRESS BECAUSE IT IS AUTOMATICALLY
                                ;INCREMENTED AT THE END OF A TRANSFER
                                ;CALL
                                ;       JSR     PC,ADJUST       ;CALL ROUTINE

 014206  005737  002272         ADJUST: TST     SEC.RD          ;SECTOR 0?
 014212  001014                         BNE     1$              ;BR IF NOT
 014214  013737  002264 002272         MOV     NS1,SEC.RD      ;MAKE IT LAST PHYSICAL SECTOR AND DECR TRACK
 014222  005737  002270                 TST     TRK.RD          ;LAST TRACK?
 014226  001011                         BNE     2$              ;BR IF NOT
 014230  013737  002262 002270         MOV     NT1,TRK.RD      ;MAKE IT LAST PHYSICAL TRACK AND DECR CYL
 014236  005337  002266                 DEC     CYL.RD          ;DECR CYL
 014242  000405                         BR      3$              ;EXIT
 014244  005337  002272         1$:     DEC     SEC.RD          ;
 014250  000402                         BR      3$              ;EXIT
 014252  005337  002270         2$:     DEC     TRK.RD          ;ADJUST TRACK
 014256  000207                 3$:     RTS     PC

                                ;THIS ROUTINE WILL CALL THE RP07 DRIVER AND THEN WAIT ON THE FUNCTION
                                ;TO COMPLETE. IF AN ERROR OCCURS IT IS REPORTED.
                                ;CALL
                                ;       FILL "DPB" WITH COMMAND INFORMATION
                                ;       JSR     R4,CALL.A
                                ;       RETURN

 014260  004437  020750         CALL.A: JSR     R4,RP07         ;CALL RP07 DRIVER
 014264  002540                         DPB.A
 014266  000774                         BR      CALL.A
 014270  005737  002556         1$:     TST     DPB.A+16        ;DONE?
 014274  001775                         BEQ     1$              ;NO--LOOP
 014276  100036                         BPL     3$              ;BRANCH IF NO ERROR
 014300  013737  002552 002274         MOV     DPB.A+12,CYL.DS ;CYLINDER
 014306  113737  002551 002300         MOVB    DPB.A+11,TRK.DS ;TRACK
 014314  113737  002550 002276         MOVB    DPB.A+10,SEC.DS ;SECTOR
 014322  004537  015100                 JSR     R5,ERRABO       ;CHECK THE ABORT CONDITION
 014326  002540                         DPB.A                   ;PARAMETER BLOCK ADDRESS
 014330  004537  012664                 JSR     R5,ERRANY       ;DETECT ERROR
 014334  002540                         DPB.A
 014336  022737  000200 002254         CMP     #BIT7,SVSTAT    ;HEADER ERROR?
 014344  001013                         BNE     3$              ;IF NOT MATCH, NO
 014346  013746  002542                 MOV     DPB.A+2,-(SP)
 014352  112737  000107 002542         MOVB    #RECAL,DPB.A+2  ;SET UP FOR A RECAL COMMAND
 014360  004437  020750                 JSR     R4,RP07         ;ISSUE THE COMMAND
 014364  002540                         DPB.A                   ;THIS BUFFER
 014366  000240                         NOP                     ;FILLER FOR THE DRIVER
 014370  012637  002542                 MOV     (SP)+,DPB.A+2
 014374  000204                 3$:     RTS     R4              ;RETURN

                                ;THIS ROUTINE IS THE SAME AS "CALL.A" EXCEPT FOR THE DPB USED AND IF
                                ;THE COMMAND IS A READ HEADER AND DATA THE HEADER (CYLINDER, TRACK,
                                ;AND SECTOR) READ IS CHECKED FOR VALIDITY.
                                ;CALL
                                ;       FILL DPB
                                ;       JSR     R4,CALL.B
                                ;       RETURN

 014376  004437  020750         CALL.B: JSR     R4,RP07         ;CALL  DRIVER
```

```
 56 014402  002560                          DPB.B
 57 014404  000774                          BR      CALL.B
 58 014406  005737  002576          1$:     TST     DPB.B+16        ;DONE?
 59 014412  001775                          BEQ     1$              ;NO--BRANCH
 60 014414  100037                          BPL     3$              ;BRANCH IF NO ERROR
 61 014416  013737  002572  002274          MOV     DPB.B+12,CYL.DS ;CYLINDER
    014424  113737  002571  002300          MOVB    DPB.B+11,TRK.DS ;TRACK
    014432  113737  002570  002276          MOVB    DPB.B+10,SEC.DS ;SECTOR
 62 014440  004537  015100                  JSR     R5,ERRABO       ;CHECK THE ABORT CONDITION
 63 014444  002560                          DPB.B
 64 014446  004537  012664                  JSR     R5,ERRANY
 65 014452  002560                          DPB.B
 66 014454  022737  000200  002254          CMP     #BIT7,SVSTAT    ;HEADER ERRORS?
 67 014462  001013                          BNE     2$              ;TAKE BRANCH IF NOT MATCH
 68 014464  013746  002562                  MOV     DPB.B+2,-(SP)
 69 014470  112737  000107  002562          MOVB    #RECAL,DPB.B+2  ;SET UP A RECAL COMMAND
 70 014476  004437  020750                  JSR     R4,RP07         ;ISSUE THE COMMAND
 71 014502  002560                          DPB.B                   ;THIS BUFFER
 72 014504  000240                          NOP                     ;FILLER FOR THE DRIVER
 73 014506  012637  002562                  MOV     (SP)+,DPB.B+2           ;RESTORE THE COMMAND
 74 014512  000421                  2$:     BR      5$              ;EXIT
 75 014514  123727  002562  000173  3$:     CMPB    DPB.B+2,#RDHD   ;DOING IMPLIED SEEKS?
 76 014522  001007                          BNE     4$              ;NO--BRANCH
 77 014524  005737  002576                  TST     DPB.B+16        ;ERROR DETECTED ?
 78 014530  100404                          BMI     4$              ;BRANCH IF SO
 79 014532  004437  015354                  JSR     R4,VERIFY       ;GO CHECK THE DATA
 80 014536  002570                          DPB.B+10
 81 014540  000406                          BR      5$              ;ERROR DURING VERIFY
 82 014542                          4$:
 83 014542  105737  002231                  TSTB    STALLF          ;STALL ?
 84 014546  001403                          BEQ     5$              ;NO--BRANCH
 85 014550  004437  015274                  JSR     R4,STALL        ;YES--CALL STALL ROUTINE
 86 014554  002346                          .WORD   STALL1          ;STALL TIME POINTER
 87 014556  000204                  5$:     RTS     R4              ;RETURN
 88
 89                                 ;THIS ROUTINE IS THE SAME AS "CALL.B" EXCEPT FOR THE DPB USED.
 90                                 ;CALL
 91                                 ;       FILL DPB
 92                                 ;       JSR     R4,CALL.C
 93                                 ;       RETURN
 94
 95 014560  004437  020750          CALL.C: JSR     R4,RP07         ;CALL  DRIVER
 96 014564  002600                          DPB.C
 97 014566  000774                          BR      CALL.C
 98 014570  005737  002616          1$:     TST     DPB.C+16        ;DONE?
 99 014574  001775                          BEQ     1$              ;NO--LOOP
100 014576  100037                          BPL     3$              ;YES--BRANCH IF NO ERROR
101 014600  013737  002612  002274          MOV     DPB.C+12,CYL.DS ;CYLINDER
    014606  113737  002611  002300          MOVB    DPB.C+11,TRK.DS ;TRACK
    014614  113737  002610  002276          MOVB    DPB.C+10,SEC.DS ;SECTOR
102 014622  004537  015100                  JSR     R5,ERRABO
103 014626  002600                          DPB.C                   ;CHECK THE ABORT CONDITION
104 014630  004537  012664                  JSR     R5,ERRANY
105 014634  002600                          DPB.C
106 014636  022737  000200  002254          CMP     #BIT7,SVSTAT    ;HEADER ERRORS?
107 014644  001013                          BNE     2$              ;IF NO MATCH, NO!
108 014646  013746  002602                  MOV     DPB.C+2,-(SP)
```

```
 109 014652  112737  000107  002602          MOVB    #RECAL,DPB.C+2  ;SET UP A RECAL COMMAND
 110 014660  004437  020750                  JSR     R4,RP07         ;ISSUE THE COMMAND
 111 014664  002600                          DPB.C                   ;FROM THIS BUFFER
 112 014666  000240                          NOP                     ;FILLER FOR THE DRIVER
 113 014670  012637  002602                  MOV     (SP)+,DPB.C+2
 114 014674  000421                  2$:     BR      5$              ;EXIT
 115
 116 014676  123727  002602  000173  3$:     CMPB    DPB.C+2,#RDHD   ;DOING IMPLIED SEEK?
 117 014704  001007                          BNE     4$              ;NO--EXIT
 118 014706  005737  002616                  TST     DPB.C+16        ;ANY ERROR ?
 119 014712  100404                          BMI     4$              ;EXIT
 120 014714  004437  015354                  JSR     R4,VERIFY       ;YES--CHECK THE DATA
 121 014720  002610                          DPB.C+10
 122 014722  000406                          BR      5$              ;ERROR DURING VERIFY
 123 014724  105737  002231          4$:     TSTB    STALLF          ;STALL ?
 124 014730  001403                          BEQ     5$              ;NO--BRANCH
 125 014732  004437  015274                  JSR     R4,STALL        ;YES--CALL STALL ROUTINE
 126 014736  002346                          .WORD   STALL1          ;STALL TIME POINTER
 127 014740  000204                  5$:     RTS     R4
```

```
                                ;THIS ROUTINE IS THE SAME AS "CALL.A" EXCEPT FOR THE DPB USED AND
                                ;ON AN ERROR LOCATION "ERR.CT" IS EXAMINED. IF ERR.CT IS EQUAL TO
                                ;$ERFLG EXIT IS TO THE NEXT TEST.
                                ;CALL
                                ;       FILL DPB
                                ;       JSR     R4,DRVCAL
                                ;       RETURN

014742  005037  002340          DRVCAL: CLR     WCEFLG          ;CLEAR WRITE CHECK ERROR FLAG
014746  004437  020750                  JSR     R4,RP07         ;CALL  DRIVER
014752  002620                          DTADPB
014754  000772                          BR      DRVCAL
014756  005737  002636          3$:     TST     DTADPB+16       ;DONE
014762  001775                          BEQ     3$              ;NO--LOOP
014764  100401                          BMI     1$              ;BR IF ERRORS
014766  000417                          BR      4$              ;NO ERRORS
014770                          1$:
014770  013737  002632  002274          MOV     DTADPB+12,CYL.DS        ;CYLINDER
014776  113737  002631  002300          MOVB    DTADPB+11,TRK.DS        ;TRACK
015004  113737  002630  002276          MOVB    DTADPB+10,SEC.DS        ;SECTOR
015012  004537  015100                  JSR     R5,ERRABO       ;CHECK THE ABORT CONDITION
015016  002620                          DTADPB                  ;DATA BLOCK ADDRESS
015020  004537  012664                  JSR     R5,ERRANY
015024  002620                          DTADPB
015026                          4$:
015026  105737  002231                  TSTB    STALLF          ;STALL ?
015032  001403                          BEQ     5$              ;NO--BRANCH
015034  004437  015274                  JSR     R4,STALL        ;YES--CALL STALL ROUTINE
015040  002350                          .WORD   STALL2          ;STALL TIME POINTER
015042  000204                  5$:     RTS     R4


                                ;SUBR TO EXECUTE A COMMAND STORED IN DTADPB.
                                ;SIMILAR TO SUBR CALL.A EXCEPT THAT HARD AND SOFT ERRORS ARE NOT CHECKED
                                ;I.E. NO CALL TO ERRANY.

015044  004437  020750          EXECMD: JSR     R4,RP07                 ;EXEC CMD
015050  002620                          DTADPB                          ;DPB PTR
015052  000774                          BR      EXECMD                  ;WAIT FOR Q NOT FULL
015054  005737  002636          2$:     TST     DTADPB+16               ;DONE?
015060  001775                          BEQ     2$                      ;WAIT FOR DONE
015062  100003                          BPL     3$                      ;SKIP ON ERROR FREE DONE
015064  004537  015100                  JSR     R5,ERRABO               ;ERROR: CHECK ABORT CONDITION
                                                                        ;EXIT TEST IF 'DPB'+16 SET WITH ERRORS:
                                                                        ;NED+PRT+STO+MCP+PAR+OFL+UNS.
015070  002620                          DTADPB                          ;'DPB' PTR
015072  013702  002634          3$:     MOV     DTADPB+14,R2            ;FETCH AD OF SAVED REG TBL
015076  000207                          RTS     PC
```

```
                                ;THIS ROUTINE IS USED TO DETERMINE THE ABORT CONDITIONS OF
                                ;THE I/O ROUTINES
                                ;CALLING SEQ
                                ;       JSR     R5,ERRABO
                                ;       DPB                     DATA BLOCK PAR ADDRESS
                                ;       NORMAL RET
                                ERRABO: MOV     R1,-(SP)        ;SAVE R1
                                        MOV     R2,-(SP)        ;SAVE R2
                                        MOV     (R5)+,R1        ;LOAD THE DPB ADDRESS
                                        MOV     14(R1),R2       ;ADDRESS OF SAVED REGISTER TABLE
                                        MOV     36(R2),CYL.RD   ;GET CURRENT CYLINDER
                                        MOVB    6(R2),SEC.RD    ;GET CURRENT SECTOR
                                        MOVB    7(R2),TRK.RD    ;GET CURRENT TRACK
                                        MOV     16(R1),R2       ;R2 TEMP STORAGE
                                        BIT     #BIT1,R2        ;DRIVE BECOME NON-EXIST ?
                                        BEQ     1$              ;BRANCH IF NOT
                                        TRAP    C$ERDF
                                        .WORD   25
                                        .WORD   EM25
                                        .WORD   DH25
                                        BR      5$              ;EXIT
                                1$:     BIT     #BIT2,R2        ;PORT REQUEST TIMEOUT ?
                                        BEQ     2$              ;BRANCH IF NOT
                                        TRAP    C$ERDF
                                        .WORD   26
                                        .WORD   EM26
                                        .WORD   DH44
                                        BR      5$
                                2$:     BIT     #BIT9,R2        ;TIME OUT ON THIS DRIVE
                                        BEQ     3$              ;BANCH IF NOT
                                        TRAP    C$ERDF
                                        .WORD   27
                                        .WORD   EM27
                                        .WORD   DH44
                                        BR      5$              ;EXIT
                                3$:     BIT     #BIT10!BIT11,R2 ;MASSBUS PARITY ERROR ?
                                        BEQ     4$              ;BRANCH IF NOT
                                        TRAP    C$ERDF
                                        .WORD   30
                                        .WORD   EM30
                                        .WORD   DH25
                                        BR      5$
                                4$:     BIT     #BIT12!BIT14,R2 ;DRIVE UNSAFE OR OFFLINE
                                        BEQ     6$              ;BRANCH IF NOT (OTHER ERROR CATLOG)
                                        TRAP    C$ERDF
                                        .WORD   31
                                        .WORD   EM31
                                        .WORD   DH25
                                        BR      5$
                                5$:     MOV     BYPASS,R5       ;THE ABORT ADDRESS
                                6$:     MOV     (SP)+,R2        ;EXIT IF NO ABORT CONDITION
                                        MOV     (SP)+,R1
                                        RTS     R5              ;EXIT
```

```
                                ;ABORT RETURN ADDRESS FROM 'ERRABO' SUBR, VIA 'BYPASS',  ON DEV FATAL ERROR

015272                          ABOPAS:
015272  104444                          TRAP    C$DCLN


                                ;THIS ROUTINE WILL PROVIDE A STALL IN MILLISECONDS FOR A SPECIFIC
                                ;AMOUNT OF TIME IF STALRD = 0 OR A RANDOM AMOUNT OF TIME IF STALRD = 1.
                                ;STALL1 CONTAINS SPECIFIED TIME FOR TESTS 1-6, AND STALL2
                                ;CONTAINS THE TIME FOR TESTS 13-18.
                                ;CALL
                                ;       JSR     R4,STALL
                                ;       TIME POINTER            ;WHERE TO FIND THE STALL TIME

015274  013446                  STALL:  MOV     @(R4)+,-(SP)    ;PICKUP STALL TIME
015276  105737  002232                  TSTB    STALRD          ;USE A RANDOM TIME ?
015302  001406                          BEQ     1$              ;NO--BRANCH
015304  004737  011610                  JSR     PC,RAND         ;YES--FORM RANDOM NUMBER
015310  013716  011672                  MOV     $RP1,(SP)       ;AND USE IT FOR THE STALL TIME
015314  042716  177700                  BIC     #^C77,(SP)      ;BUT NEVER > 64 MILLISECONDS
015320  005046                  1$:     CLR     -(SP)           ;CLEAR TEMP. LOCATION
015322  162766  000001  000002  2$:     SUB     #1,2(SP)        ;MORE STALL REQUIRED?
015330  103407                          BLO     4$              ;NO--BRANCH
015332  012716  000144                  MOV     #100.,(SP)      ;STALL FOR ABOUT 1 MILLISECOND
015336  005704                  3$:     TST     R4              ;NOP TO KILL TIME
015340  005366  000000                  DEC     0(SP)           ;COUNT
015344  001374                          BNE     3$              ;LOOP IF MORE COUNTS NEEDED
015346  000765                          BR      2$
015350  022626                  4$:     CMP     (SP)+,(SP)+     ;CLEAN OFF THE STACK
015352  000204                          RTS     R4              ;EXIT
```

```
                                        ;ROUTINE TO SOFTWARE COMPARE HEADER ON IMPLIED SEEKS
                                        ;CALL
                                        ;       JSR     R4,VERIFY
                                        ;       ADR POINTER             ;ADDRESS OF DPB+10 (SECTOR NUMBER)
                                        ;       ERR RETURN
                                        ;       RETURN

015354  010146                  VERIFY: MOV     R1,-(SP)        ;SAVE R1
015356  012401                          MOV     (R4)+,R1        ;GET ADDRESS OF DPB+10
015360  042737  150000  042610          BIC     #150000,DBUFF   ;STRIP FORMAT AND BAD SECTOR BITS FROM CYLINDER NUMBER
015366  023761  042610  000002          CMP     DBUFF,2(R1)     ;CYLINDER NUMBER OK?
015374  001003                          BNE     1$              ;NO--BRANCH
015376  023711  042612                  CMP     DBUFF+2,(R1)    ;YES--HOW ABOUT TRACK/SECTOR?
015402  001431                          BEQ     3$              ;BRANCH IF GOOD
015404  013737  042610  002266  1$:     MOV     DBUFF,CYL.RD    ;SAVE THE EXPECTED AND THE
015412  113737  042613  002270          MOVB    DBUFF+3,TRK.RD  ;RECIEVED CYLINDER, TRACK,
015420  113737  042612  002272          MOVB    DBUFF+2,SEC.RD  ;AND SECTOR
015426  112137  002276                  MOVB    (R1)+,SEC.DS
015432  112137  002300                  MOVB    (R1)+,TRK.DS
015436  011137  002274                  MOV     (R1),CYL.DS
015442  005744                          TST     -(R4)           ;MAKE IT TEST PC+4
015444  104456                          TRAP    C$ERHRD
015446  000052                          .WORD   42
015450  007020                          .WORD   EM42
015452  010340                          .WORD   DH45
015454  012737  000107  002542  2$:     MOV     #RECAL,DPB.A+2  ;LOAD RECALIBRATE ORDER CODE
015462  004437  014260                  JSR     R4,CALL.A       ;GO EXECUTE THE COMMAND
015466  062704  000002          3$:     ADD     #2,R4           ;INCREMENT RETURN ADDRESS
015472  012601                  4$:     MOV     (SP)+,R1        ;RESTORE R1
015474  000204                          RTS     R4              ;EXIT
```

```
                                ;THIS ROUTINE WILL PERFORM A "MASSBUS" INIT. FOLLOWED BY
                                ;A "RECALIBRATE" ON THE DRIVE UNDER TEST.
                                ;NOTE: THIS ROUTINE DESTROYS R1 AND R4
                                ;CALL
                                ;       JSR     R4,SRCH00       ;DO A MASSBUS INIT. AND RECAL
                                ;       RETURN1                 ;RETURN HERE IF NO ERROR
                                ;       RETURN2                 ;RETURN HERE ON ERROR

015476  005001          SRCH00: CLR     R1                      ;INCASE OF ERROR (TYPTIM)
015500  012777  000040  165162        MOV     #CLR,@RPCS2     ;MASSBUS INIT.
015506  005037  002630              CLR     DTADPB+10       ;TRACK=0; SECTOR=0
015512  005037  002632              CLR     DTADPB+12       ;CYLINDER =0
015516  012737  000107  002622        MOV     #RECAL,DTADPB+2 ;COMMAND = RECALIBRATE
015524  004437  020750              JSR     R4,RP07         ;CALL THE DRIVER
015530  002620                      DTADPB                  ;DPB POINTER
015532  000433                      BR      4$              ;BRANCH IF QUEUE FULL,NO SPACE
015534  005737  002636        1$:   TST     DTADPB+16       ;WAIT ON DONE
015540  001775                      BEQ     1$
015542  100021                      BPL     3$              ;TAKE NORMAL EXIT IF NO ERROR
015544  013737  002632  002274        MOV     DTADPB+12,CYL.DS        ;CYLINDER
015552  113737  002631  002300        MOVB    DTADPB+11,TRK.DS        ;TRACK
015560  113737  002630  002276        MOVB    DTADPB+10,SEC.DS        ;SECTOR
015566  004537  015100              JSR     R5,ERRABO       ;CHECK ANY ABORT CONDITION
015572  002620                      DTADPB
015574  004537  012664              JSR     R5,ERRANY
015600  002620                      DTADPB
015602  005724                2$:   TST     (R4)+           ;ADJUST FOR ERROR EXIT
015604  000406                      BR      4$              ;GO TO THE EXIT
015606  012777  000000  165052  3$:   MOV     #0,@RPDA        ;TRACK AND SECTOR =0
015614  012777  000000  165072        MOV     #0,@RPDC        ;CYLINDER = 0
015622  000204                4$:   RTS     R4              ;RETURN

                                ;THIS IS AN RTI WHICH IS USED BY THE TIMING TESTS

015624                          DORTI:                          ;RETURN FROM INTERRUPT
015624                          L10011:
015624  000002                      RTI

                                ;THIS ROUTINE WILL INITIALIZE THE TIMERS USED BY THE TIMING ROUTINE
                                ;CALL
                                ;       JSR     PC,STRTMR
                                ;       RETURN

015626  004737  010646          STRTMR: JSR     PC,SAVREG       ;SAVE R0-R5
015632  012700  002302                  MOV     #TIM.UP,R0      ;START AT TIM.UP (MINIMUM)
015636  012701  002336                  MOV     #TIM.PT,R1      ;STOP AT TIM.PT
015642  005020                  1$:     CLR     (R0)+           ;CLEAR
015644  020001                          CMP     R0,R1           ;DONE?
015646  103775                          BLO     1$              ;NO--BRANCH
015650  012710  042610                  MOV     #DBUFF,(R0)     ;SETUP POINTER
015654  012737  077777  002302          MOV     #^CBIT15,TIM.UP ;SET MINIMUM TIME TO MAXIMUM
015662  012737  077777  002320          MOV     #^CBIT15,TIM.DN ;POSITIVE NUMBER
015670  004737  010700                  JSR     PC,RESREG       ;RESTORE R0-R5
015674  000207                          RTS     PC              ;RETURN

                                ;THIS ROUTINE IS USED FOR MEASURE THE AVERAGE SEEK TIME
```

```
                        ;IN THE TEST 10
                        ;THE TIME IS MEASURED AS:
                        ;
                        ;                (T1X629+T2X628+T3X627+T4X626.....)X2
                        ;          T   =-------------------------------------
                        ;                          629X629
                        ;
                        ; WHERE THE T1 IS THE SEEK TIME FROM CYL0 TO CYL1
                        ;       THE T2 IS THE SEEK TIME FROM CYL0 TO CYL2 ,ETC.
                        ;THE COUNT2: ROUTINE WILL CALCULATE THE FOLLOWING SUMMATION:
                        ;
                        ;                (T1X629+T2X628+T3X627+.....) X 2
                        ;          T   =---------------------------------
                        ;                          629

015676  012702  002302        COUNT2: MOV     #TIM.UP,R2      ;COUNT UP TABLE
015702  005705                        TST     R5              ;COUNT UP CALCULATING ?
015704  001402                        BEQ     1$              ;BRANCH IF SO
015706  012702  002320                MOV     #TIM.DN,R2      ;LOAD THE COUNT DOWN TABLE
015712  010146                1$:     MOV     R1,-(SP)        ;COEFFICIENT 629,628,627,..... ETC.
015714  017746  174204                MOV     @PKC,-(SP)      ;MEASURED TIME INTERVAL
015720  004737  011316                JSR     PC,$MULT        ;TIME INTERVAL X COEFFICIENT
015724  016666  000002  177776        MOV     2(SP),-2(SP)    ;SWAP THE LSB , MSB OF THE PRODUCTION
015732  011666  000002                MOV     (SP),2(SP)      ;
015736  016616  177776                MOV     -2(SP),(SP)     ; FOR THE CALLING SEQ OF $DIV ROUTINE
015742  013746  002206                MOV     LC,-(SP)        ;DIVIDED BY 629 (TOTOL # OF SEEKS)
015746  006216                        ASR     (SP)            ; DIVIDEC BY 629/2
015750  005216                        INC     (SP)            ;ROUND UP THE FRACTION
015752  004737  011074                JSR     PC,$DIV         ;TIME X COEFFICIENT/TOTAL # OF SEEKS
015756  006126                        ROL     (SP)+           ;REMAINDER OVER 0.5 ?
015760  100001                        BPL     2$              ;BRANCH IF NOT
015762  005216                        INC     (SP)            ;ROUND UP
015764  062662  000010          2$:   ADD     (SP)+,10(R2)    ;LSB OF THE TOTAL SUM
015770  005562  000012                ADC     12(R2)          ;HSB OF THE TOTAL SUM
015774  005262  000014                INC     14(R2)          ;TOTAL SEEK COUNT
016000  017777  174120  164330        MOV     @PKC,@TIM.PT    ;SAVE THE TIME INTERVAL
016006  062737  000002  002336        ADD     #2,TIM.PT               ;ADJUST THE POINTER
016014  027712  174104                CMP     @PKC,(R2)               ;MINIMUM TIME
016020  002002                        BGE     3$              ;BRANCH IF NOT
016022  017712  174076                MOV     @PKC,(R2)       ;LOAD THE NEW MINIMUM
016026  027763  174072  000004  3$:   CMP     @PKC,4(R3)      ;LOWER THEN THE LIMIT ?
016034  002002                        BGE     4$              ;BRANCH IF NOT
016036  005262  000002                INC     2(R2)           ;UPDATE THE COUNTER IS SO
016042  027762  174056  000004  4$:   CMP     @PKC,4(R2)      ;GREATER THAN THE MAXIMUM VALUE ?
016050  003403                        BLE     5$              ;BRANCH IF NOT
016052  017762  174046  000004        MOV     @PKC,4(R2)      ;LOAD THE NEW MAXIMUM VALUE
016060  027763  174040  000006  5$:   CMP     @PKC,6(R3)      ;OVER THE LIMIT
016066  003402                        BLE     6$              ;BRANCH IF NOT
016070  005262  000006                INC     6(R2)           ;UPDATE THE COUNT, IF SO
016074  000207                6$:     RTS     PC              ;EXIT

                        ;THIS ROUTINE WILL ADD THE ELAPSED TIME TO THE AVERAGE COUNTER AND
                        ;MAINTAIN THE MINIMUM AND MAXIMUM TIMES.
                        ;NOTE: THIS ROUTINE DESTROYS R2
                        ;CALL
                        ;       MOV     #TP,R3          ;PARAMETER POINTER
                        ;       MOV     FLAG,R5         ;FLAG=0=COUNT UP
```

```
                                        ;                               ;FLAG=-1=COUNT DOWN
                                        ;       JSR     PC,COUNT
                                        ;       RETURN
                                        COUNT:  MOV     #TIM.UP,R2      ;PICKUP THE "UP" POINTER
016076  012702  002302                  TST     R5                      ;USE IT?
016102  005705                          BEQ     1$                      ;YES--BRANCH
016104  001402                          MOV     #TIM.DN,R2              ;NO--PICKUP "DOWN" POINTER
016106  012702  002320                  CMP     @PKC,(R2)+              ;LESS THAN PREVIOUS LOW?
016112  027722  174006          1$:     BGE     2$                      ;NO--BRANCH
016116  002003                          MOV     @PKC,-2(R2)             ;YES--SAVE IT
016120  017762  174000  177776          CMP     @PKC,4(R3)              ;LESS THAN THE LOW LIMIT?
016126  027763  173772  000004  2$:     BGE     3$                      ;NO--BRANCH
016134  002001                          INC     (R2)                    ;YES--COUNT IT
016136  005212                          TST     (R2)+                   ;ADVANCE THE POINTER
016140  005722                  3$:     CMP     @PKC,(R2)+              ;GREATER THAN PREVIOUS HIGH?
016142  027722  173756                  BLE     4$                      ;NO--BRANCH
016146  003403                          MOV     @PKC,-2(R2)             ;YES--SAVE IT
016150  017762  173750  177776          CMP     @PKC,6(R3)              ;GREATER THAN THE HIGH LIMIT?
016156  027763  173742  000006  4$:     BLE     5$                      ;NO--BRANCH
016164  003401                          INC     (R2)                    ;YES--COUNT IT
016166  005212                          TST     (R2)+                   ;ADVANCE THE POINTER
016170  005722                  5$:     ADD     @PKC,(R2)+              ;ADD THIS COUNT TO THE TOTAL
016172  067722  173726                  ADC     (R2)+
016176  005522                          INC     (R2)                    ;COUNT THIS READING
016200  005212                          CMP     L$TEST,#18.             ;DO NOT SAVE COUNTS IN MEMO IN 8 TO ALLOW
016202  023727  002114  000022                                          ;A WRITE-CHECK OPERATION AFTER THE TIMED WRITE
                                                                        ;OTHERWISE WRITE DATA WILL BE DESTOYED AND A
                                                                        ;WRITE CHECK ERROR WCE WILL RESULT IN RPCS2!
016210  001412                          BEQ     6$
016212  022737  047534  002336          CMP     #DBUFF+<4*629.>,TIM.PT ;SAVE THIS COUNT?
                                                                        ;LAST CYLINDER X 4
016220  101406                          BLOS    6$                      ;NO--BRANCH
016222  017777  173676  164106          MOV     @PKC,@TIM.PT            ;YES--WELL SAVE IT THEN
016230  062737  000002  002336          ADD     #2,TIM.PT               ;ADVANCE THE POINTER
016236  000207                  6$:     RTS     PC                      ;RETURN


                                        ;THIS ROUTINE PRINTS THE SPEC OF ALL TIMING TESTS
                                        ;CALL
                                        ;       JSR     R4,SPTYP
                                        ;       TABLE ADDRESS
                                        ;
                                        ;TABLE: .WORD   MESSAGE
                                        ;       .WORD   MIN VALUE
                                        ;       .WORD   MAX VALUE


                                        SPTYP:  MOV     (R4)+,R2        ;THE TABLE ADDRESS
016240  012402                          TSTB    TIMTYP                  ;ALLOW PRINT
016242  105737  002227                  BEQ     3$                      ;EXIT IF NOT
016246  001447                                                          ;PRINT MESSAGE
                                        MOV     (R2)+,-(SP)
016250  012246                          MOV     #1,-(SP)
016252  012746  000001                  MOV     SP,R0
016256  010600                          TRAP    C$PNTF
016260  104417                          ADD     #4,SP
016262  062706  000004
```

```
166 016266  005722                    TST     (R2)+           ;LOAD MIN VALUE
167 016270  001412                    BEQ     1$              ;SKIP IF MIN VALUE IS 0
168 016272  016246  177776            MOV     -2(R2),-(SP)
    016276  012746  017110            MOV     #MSGMIN,-(SP)
    016302  012746  000002            MOV     #2,-(SP)
    016306  010600                    MOV     SP,R0
    016310  104417                    TRAP    C$PNTF
    016312  062706  000006            ADD     #6,SP
169 016316  005722              1$:   TST     (R2)+           ;THE MAXIMUM VALUE
170 016320  001412                    BEQ     2$              ;BRANCH IF NO LIMIT
171 016322  016246  177776            MOV     -2(R2),-(SP)
    016326  012746  017133            MOV     #MSGMAX,-(SP)
    016332  012746  000002            MOV     #2,-(SP)
    016336  010600                    MOV     SP,R0
    016340  104417                    TRAP    C$PNTF
    016342  062706  000006            ADD     #6,SP
172 016346              2$:                           ;CR-LF
173 016346  012746  003054            MOV     #CRLF,-(SP)
    016352  012746  000001            MOV     #1,-(SP)
    016356  010600                    MOV     SP,R0
    016360  104417                    TRAP    C$PNTF
    016362  062706  000004            ADD     #4,SP
174 016366  000204              3$:   RTS     R4
```

```
                                ;;THIS ROUTINE IS USED TO TYPE THE MINIMUM,
                                ;MAXIMUM, AND AVERAGE TIMES FOR THE TIMING TESTS
                                ;IT WILL ALSO CHECK THE TIMES TO ENSURE
                                ;THEY ARE WITHIN TOLERANCE AND IF NOT FLAG THE BAD TIMES.
                                ;NOTE: THIS ROUTINE DESTROYS R2-R5
                                ;CALL
                                ;       JSR     R4,TYPTIM       ;GO REPORT THE TIMES
                                ;       TABLE                   ;POINT TO THE PROPER TABLE
                                ;       RETURN
                                ;
                                ;TABLE: MSGADR1                 ;ADDRESS OF ASCIZ MESSAGE NUMBER 1
                                ;       MSGADR2                 ;ADDRESS OF ASCIZ MESSAGE NUMBER 2
                                ;       MIN. ALLOWED            ;MINIMUM TIME ALLOWED
                                ;       MAX. ALLOWED            ;MAXIMUM TIME ALLOWED

016370  012402                  TYPTIM: MOV     (R4)+,R2        ;PICKUP THE TABLE POINTER
016372  105737  002227                  TSTB    TIMTYP          ;INHIBIT TIME REPORTS?
016376  001001                          BNE     1$              ;NO, PROCEED
016400  000204                          RTS     R4              ;EXIT

016402  010446                  1$:     MOV     R4,-(SP)        ;SAVE RET ADR
016404  012237  017104                  MOV     (R2)+,11$       ;ADDRESS OF MESSAGE NUMBER 1
016410  012205                          MOV     (R2)+,R5        ;ADDRESS OF MESSAGE NUMBER 2
016412  012203                          MOV     (R2)+,R3        ;PICKUP THE LOW LIMIT
016414  011202                          MOV     (R2),R2         ;AND THE HIGH LIMIT
016416  012704  002302                  MOV     #TIM.UP,R4      ;PARAMETER POINTER
016422  004737  017462                  JSR     PC,CHKTIM       ;SEE IF ALL THE DATA IS TO BE TYPED
016426                          2$:
016426  013746  017104                  MOV     11$,-(SP)
016432  012746  000001                  MOV     #1,-(SP)
016436  010600                          MOV     SP,R0
016440  104417                          TRAP    C$PNTF
016442  062706  000004                  ADD     #4,SP
016446  005764  000014                  TST     14(R4)          ;DID ANY COUNTS OCCUR?
016452  001012                          BNE     3$              ;BR IF YES
016454  012746  017443                  MOV     #MSGNON,-(SP)
016460  012746  000001                  MOV     #1,-(SP)
016464  010600                          MOV     SP,R0
016466  104417                          TRAP    C$PNTF
016470  062706  000004                  ADD     #4,SP
016474  000137  017100                  JMP     10$
016500                          3$:
016500  012446                          MOV     (R4)+,-(SP)
016502  012746  017110                  MOV     #MSGMIN,-(SP)
016506  012746  000002                  MOV     #2,-(SP)
016512  010600                          MOV     SP,R0
016514  104417                          TRAP    C$PNTF
016516  062706  000006                  ADD     #6,SP
016522  005724                          TST     (R4)+           ;ANY SEEKS BELOW THE LOW LIMIT
016524  001416                          BEQ     4$              ;NO--BRANCH
016526  005737  017542                  TST     $$FLG           ;TYPE # OF SEEKS BELOW LIMIT?
016532  001413                          BEQ     4$              ;NO, SKIP IT
016534  010346                          MOV     R3,-(SP)
016536  016446  177776                  MOV     -2(R4),-(SP)
016542  012746  017202                  MOV     #MSGBEL,-(SP)
016546  012746  000003                  MOV     #3,-(SP)
```

```
                016552  010600                          MOV     SP,R0
                016554  104417                          TRAP    C$PNTF
                016556  062706  000010                  ADD     #10,SP
             40 016562                          4$:
                016562  012446                          MOV     (R4)+,-(SP)
                016564  012746  017133                  MOV     #MSGMAX,-(SP)
                016570  012746  000002                  MOV     #2,-(SP)
                016574  010600                          MOV     SP,R0
                016576  104417                          TRAP    C$PNTF
                016600  062706  000006                  ADD     #6,SP
             41 016604  005724                          TST     (R4)+           ;ANY SEEKS ABOVE THE HIGH LIMIT
             42 016606  001416                          BEQ     5$              ;NO--BRANCH
             43 016610  005737  017542                  TST     $$FLG           ;TYPE # OF SEEKS BELOW LIMIT?
             44 016614  001413                          BEQ     5$              ;NO, SKIP IT
             45 016616  010246                          MOV     R2,-(SP)
                016620  016446  177776                  MOV     -2(R4),-(SP)
                016624  012746  017257                  MOV     #MSGABV,-(SP)
                016630  012746  000003                  MOV     #3,-(SP)
                016634  010600                          MOV     SP,R0
                016636  104417                          TRAP    C$PNTF
                016640  062706  000010                  ADD     #10,SP
             46 016644                          5$:
                016644  012746  017156                  MOV     #MSGAVG,-(SP)
                016650  012746  000001                  MOV     #1,-(SP)
                016654  010600                          MOV     SP,R0
                016656  104417                          TRAP    C$PNTF
                016660  062706  000004                  ADD     #4,SP
             47 016664  012446                          MOV     (R4)+,-(SP)     ;FORM THE AVERAGE
             48 016666  012446                          MOV     (R4)+,-(SP)
             49 016670  012446                          MOV     (R4)+,-(SP)
             50 016672  004737  011074                  JSR     PC,$DIV
             51 016676  006126                          ROL     (SP)+           ;IS THE REMAINDER OVER HALF?
             52 016700  100001                          BPL     6$              ;NO--BRANCH
             53 016702  005216                          INC     (SP)            ;YES--ROUND UP
             54 016704  012637  017106          6$:     MOV     (SP)+,AVERAG    ;POP AVERAGE VALUE FOR PRINT
             55 016710  013746  017106                  MOV     AVERAG,-(SP)
                016714  012746  017167                  MOV     #AVGVAL,-(SP)
                016720  012746  000002                  MOV     #2,-(SP)
                016724  010600                          MOV     SP,R0
                016726  104417                          TRAP    C$PNTF
                016730  062706  000006                  ADD     #6,SP
             56 016734  022737  000007  002114          CMP     #7,L$TEST       ;TEST 7 ?
             57 016742  001423                          BEQ     7$              ;BRANCH IF SO
             58 016744  022737  000016  002114          CMP     #14.,L$TEST     ;TEST 14 ?
             59 016752  001432                          BEQ     8$              ;BRANCH IF SO
             60 016754  022737  000022  002114          CMP     #18.,L$TEST     ;TEST 18 ?
             61 016762  001426                          BEQ     8$              ;BRANCH IF SO
             62 016764  016446  177776                  MOV     -2(R4),-(SP)
                016770  012746  017334                  MOV     #MSGNUM,-(SP)
                016774  012746  000002                  MOV     #2,-(SP)
                017000  010600                          MOV     SP,R0
                017002  104417                          TRAP    C$PNTF
                017004  062706  000006                  ADD     #6,SP
             63 017010  000425                          BR      9$              ;SKIP
             64 017012                          7$:
                017012  016446  177776                  MOV     -2(R4),-(SP)
                017016  012746  017361                  MOV     #MSGSEA,-(SP)
```

```
                017022  012746  000002                  MOV     #2,-(SP)
                017026  010600                          MOV     SP,R0
                017030  104417                          TRAP    C$PNTF
                017032  062706  000006                  ADD     #6,SP
     65         017036  000412                          BR      9$                      ;SKIP
     66         017040                          8$:
                017040  016446  177776                  MOV     -2(R4),-(SP)
                017044  012746  017411                  MOV     #MSGOPE,-(SP)
                017050  012746  000002                  MOV     #2,-(SP)
                017054  010600                          MOV     SP,R0
                017056  104417                          TRAP    C$PNTF
                017060  062706  000006                  ADD     #6,SP
     67         017064  010537  017104          9$:     MOV     R5,11$                  ;NEXT MESSAGE POINTER
     68         017070  001403                          BEQ     10$                     ;IF NONE EXIT
     69         017072  005005                          CLR     R5                      ;NO MORE THAN 2
     70         017074  000137  016426                  JMP     2$
     71         017100  012604                  10$:    MOV     (SP)+,R4                ;FETCH RET ADR
     72         017102  000204                          RTS     R4                      ;EXIT
     73
     74         017104  000000                  11$:    .WORD   0                       ;ADRRESS OF MSG 1
     75         017106  000000                  AVERAG: .WORD   0                       ;AVERAGE VALUE
     76
     80         017110      045     116     045  MSGMIN: .ASCIZ  /%N%AMIN=%D5%A0. US/
     81         017133      045     116     045  MSGMAX: .ASCIZ  /%N%AMAX=%D5%A0. US/
     82         017156      045     116     045  MSGAVG: .ASCIZ  /%N%AAVG=/
     83         017167      045     104     065  AVGVAL: .ASCIZ  /%D5%A0. US/
     84         017202      045     101     040  MSGBEL: .ASCIZ  /%A  %D4%A. BELOW THE MINIMUM OF %D5%A0. US%N/
     85         017257      045     101     040  MSGABV: .ASCIZ  /%A  %D4%A. ABOVE THE MAXIMUM OF %D5%A0. US%N/
     86         017334      045     104     065  MSGNUM: .ASCIZ  /%D5%A. SEEKS TIMED%N/
     87         017361      045     104     065  MSGSEA: .ASCIZ  /%D5%A. SEARCHES TIMED%N/
     88         017411      045     104     065  MSGOPE:: .ASCIZ /%D5%A. OPERATIONS TIMED%N/
     89         017443      045     101     040  MSGNON: .ASCIZ  /%A NOT TIMED%N/
     90
     91                                           .EVEN
     95
     96                                   ;SUBR TO CHECK IF COMPLETE SPECS ON SEEKS SHOULD BE TYPED
     97                                   ;IF THE AVERAGE SEEK TIME IS ABOVE SPEC, THEN TYPE ABOVE AND BELOW VALUES
     98                                   ;ELSE, DO NOT TYPE THEM
     99                                   ;$$FLG IS SET TO INDICATE TYPE THEM
    100
    101         017462  005037  017542          CHKTIM: CLR     $$FLG                   ;INIT FLAG
    102         017466  122737  000011  002114          CMPB    #9.,L$TEST              ;TEST 9, AVERAGE SEEK TIMING ?
    103         017474  001017                          BNE     2$                      ;EXIT IF NOT
    104         017476  016446  000010                  MOV     10(R4),-(SP)            ;PUSH LOW DIVIDEND OF TOTAL TIME OF ALL SEEKS
    105         017502  016446  000012                  MOV     12(R4),-(SP)            ;PUSH HIGH DIVIDEND
    106         017506  016446  000014                  MOV     14(R4),-(SP)            ;PUSH DIVISOR = NUMBER OF SEEKS TIMED
    107         017512  004737  011074                  JSR     PC,$DIV                 ;CALCULATE AVERAGE
    108         017516  006116                          ROL     (SP)                    ;REM/2
    109         017520  022664  000014                  CMP     (SP)+,14(R4)            ;IS REM OVER HALF?
    110         017524  002401                          BLT     1$                      ;NO, SKIP NEXT
    111         017526  005216                          INC     (SP)                    ;YES, ROUND UP AVG TIME
    112         017530  022602                  1$:     CMP     (SP)+,R2                ;OUT OF SPEC?
    113         017532  003402                          BLE     3$                      ;EXIT IF NOT
    114         017534  005237  017542          2$:     INC     $$FLG                   ;SET FLAG TO REPORT ALL DATA
    115         017540  000207                  3$:     RTS     PC
    116
    117         017542  000000                  $$FLG:  .WORD   0                       ;TYPE ALL SPECS FLAG
```

```
                                ;THIS ROUTINE GENERATES RANDOM CYLINDER, TRACK, AND SECTOR
                                ;ADDRESSES AND SAVES THEN IN THE DPB (DTADPB+10, 11 & DTADPB+12).
                                ;NOTE: THIS ROUTINE DESTROYS R1-R3
                                ;CALL
                                ;       JSR     R4,RANADR
                                ;       RETURN

 017544  004737  011610        RANADR: JSR     PC,RAND         ;GENERATE A RANDOM NUMBER
 017550  113701  011672                MOVB    $RP1,R1         ;FORM SECTOR IN R1
 017554  042701  177700                BIC     #177700,R1      ;REDUCE SIZE TO <= 63

                                ;BINARY SEARCH FOR FS<=R1<=LS

 017560  020137  002222        1$:     CMP     R1,LS           ;WHILE R1>LS DO R1=FS+(R1-FS)/2
 017564  003407                        BLE     2$
 017566  163701  002220                SUB     FS,R1
 017572  000241                        CLC
 017574  006001                        ROR     R1
 017576  063701  002220                ADD     FS,R1
 017602  000766                        BR      1$

 017604  020137  002220        2$:     CMP     R1,FS           ;WHILE R1<FS DO R1=LS-(LS-R1)/2
 017610  002011                        BGE     3$
 017612  013702  002222                MOV     LS,R2
 017616  010203                        MOV     R2,R3
 017620  160102                        SUB     R1,R2
 017622  000241                        CLC
 017624  006002                        ROR     R2
 017626  160203                        SUB     R2,R3
 017630  010301                        MOV     R3,R1
 017632  000764                        BR      2$

 017634  110137  002630        3$:     MOVB    R1,DTADPB+10    ;SET RANDOM SECTOR IN DPB
 017640  113701  011673                MOVB    $RP1+1,R1       ;FORM TRACK IN R1
 017644  042701  177740                BIC     #177740,R1      ;REDUCE SIZE TO <= 31

                                ;BINARY SEARCH FOR FT<=R1<=LT

 017650  020137  002214        4$:     CMP     R1,LT           ;WHILE R1>LT DO R1=FT+(R1-FT)/2
 017654  003407                        BLE     5$
 017656  163701  002212                SUB     FT,R1
 017662  000241                        CLC
 017664  006001                        ROR     R1
 017666  063701  002212                ADD     FT,R1
 017672  000766                        BR      4$
 017674  020137  002212        5$:     CMP     R1,FT           ;WHILE R1<FT DO R1=LT-(LT-R1)/2
 017700  002011                        BGE     6$
 017702  013702  002214                MOV     LT,R2
 017706  010203                        MOV     R2,R3
 017710  160102                        SUB     R1,R2
 017712  000241                        CLC
 017714  006002                        ROR     R2
 017716  160203                        SUB     R2,R3
 017720  010301                        MOV     R3,R1
 017722  000764                        BR      5$

 017724  110137  002631        6$:     MOVB    R1,DTADPB+11    ;SET RANDOM TRACK IN DPB
```

```
                                                JSR     PC,RAND         ;GENERATE RANDOM NUMBERS
                                                MOV     $RP1,R1         ;PICK ONE FOR CYLINDER
                                                BIC     #176000,R1      ;REDUCE SIZE TO <=1777

                                                ;BINARY SEARCH FOR FC<=R1<=LC

                                        7$:     CMP     R1,LC           ;WHILE R1>LC DO R1=FC+(R1-FC)/2
                                                BLE     8$
                                                SUB     FC,R1
                                                CLC
                                                ROR     R1
                                                ADD     FC,R1
                                                BR      7$

                                        8$:     CMP     R1,FC           ;WHILE R1<FC DO R1=LC-(LC-R1)/2
                                                BGE     9$
                                                MOV     LC,R2
                                                MOV     R2,R3
                                                SUB     R1,R2
                                                CLC
                                                ROR     R2
                                                SUB     R2,R3
                                                MOV     R3,R1
                                                BR      8$

                                        9$:     MOV     R1,DTADPB+12    ;SAVE CYLINDER ADDRESS
                                                RTS     R4              ;RETURN
```

```
                                .SBTTL  RP07 DRIVER
                                ;STORAGE FOR RPDS, RPER1, RPER2, AND RPER3
020026  000000  000000  000000  RPSTU0: .WORD   0,0,0,0          ;DS, ER1, ER2 & ER3 STORAGE FOR DRIVE 0
020036  000000  000000  000000  RPSTU1: .WORD   0,0,0,0          ;DS, ER1, ER2 & ER3 STORAGE FOR DRIVE 1
020046  000000  000000  000000  RPSTU2: .WORD   0,0,0,0          ;DS, ER1, ER2 & ER3 STORAGE FOR DRIVE 2
020056  000000  000000  000000  RPSTU3: .WORD   0,0,0,0          ;DS, ER1, ER2 & ER3 STORAGE FOR DRIVE 3
020066  000000  000000  000000  RPSTU4: .WORD   0,0,0,0          ;DS, ER1, ER2 & ER3 STORAGE FOR DRIVE 4
020076  000000  000000  000000  RPSTU5: .WORD   0,0,0,0          ;DS, ER1, ER2 & ER3 STORAGE FOR DRIVE 5
020106  000000  000000  000000  RPSTU6: .WORD   0,0,0,0          ;DS, ER1, ER2 & ER3 STORAGE FOR DRIVE 6
020116  000000  000000  000000  RPSTU7: .WORD   0,0,0,0          ;DS, ER1, ER2 & ER3 STORAGE FOR DRIVE 7

                                ;TABLE OF DRIVE ACTIVE INDICATORS (DRVACT=8 BYTES)
                                        ;DRVACT=0 IF DRIVE IS IDLE
                                        ;DRVACT>0 IF DRIVE IS ACTIVE WITH A COMMAND
                                        ;DRVACT<0 IF DRIVE IS ACTIVE WITH AN ERROR RECOVERY OPERATION

020126      000                 DRVACT: .BYTE   0               ;DRIVE 0
020127      000                         .BYTE   0               ;DRIVE 1
020130      000                         .BYTE   0               ;DRIVE 2
020131      000                         .BYTE   0               ;DRIVE 3
020132      000                         .BYTE   0               ;DRIVE 4
020133      000                         .BYTE   0               ;DRIVE 5
020134      000                         .BYTE   0               ;DRIVE 6
020135      000                         .BYTE   0               ;DRIVE 7

                                ;TABLE OF DRIVE STATUS INDICATORS (DRVSTA=8 BYTES)
                                        ;DRVSTA=0 IF DRIVE IS OFFLINE OR NONEXSITENT
                                        ;DRVSTA>0 IF DRIVE IS ONLINE
                                        ;DRVSTA<0 IF DRIVE IS UNSAFE

020136      000                 DRVSTA: .BYTE   0               ;DRIVE 0
020137      000                         .BYTE   0               ;DRIVE 1
020140      000                         .BYTE   0               ;DRIVE 2
020141      000                         .BYTE   0               ;DRIVE 3
020142      000                         .BYTE   0               ;DRIVE 4
020143      000                         .BYTE   0               ;DRIVE 5
020144      000                         .BYTE   0               ;DRIVE 6
020145      000                         .BYTE   0               ;DRIVE 7

                                ;TABLE OF DRIVE TYPES (DRVTYP=8 BYTES)
                                        ;DRVTYP=0 IF DRIVE IS NONEXISTENT (DRVSTA=0, ALSO)
                                        ;DRVTYP=5 IF DRIVE IS RP07  MOVING HEAD OPTION
                                        ;DRVTYP=4 IF DRIVE IS RP07 FIX HEAD OPTION
                                        ;DRVTYP=-1 IF NOT RP07

020146      000                 DRVTYP: .BYTE   0               ;DRIVE 0
020147      000                         .BYTE   0               ;DRIVE 1
020150      000                         .BYTE   0               ;DRIVE 2
020151      000                         .BYTE   0               ;DRIVE 3
020152      000                         .BYTE   0               ;DRIVE 4
020153      000                         .BYTE   0               ;DRIVE 5
020154      000                         .BYTE   0               ;DRIVE 6
020155      000                         .BYTE   0               ;DRIVE 7

                                ;TABLE OF DUAL PORT INITIALIZATION INDICATORS
```

```
                                        ;DPINT=0 IF INITIALIZATION IS NOT ACTIVE ON THE DRIVE
                                        ;DPINT<0 IF INITIALIZATION IS IN PROGRESS

020156  000                     DPINT:  .BYTE   0               ;DRIVE 0
020157  000                             .BYTE   0               ;DRIVE 1
020160  000                             .BYTE   0               ;DRIVE 2
020161  000                             .BYTE   0               ;DRIVE 3
020162  000                             .BYTE   0               ;DRIVE 4
020163  000                             .BYTE   0               ;DRIVE 5
020164  000                             .BYTE   0               ;DRIVE 6
020165  000                             .BYTE   0               ;DRIVE 7

                                ;TABLE OF PENDING DUAL PORT REQUESTS
                                        ;DPRQS=0 IF THAT A DUAL PORT REQUEST IS NOT PENDING FOR THAT DRIVE
                                        ;DPRQS<0 IF THAT A DUAL PORT REQUEST IS PENDING FOR THAT DRIVE

020166  000                     DPRQS:  .BYTE   0               ;DRIVE 0
020167  000                             .BYTE   0               ;DRIVE 1
020170  000                             .BYTE   0               ;DRIVE 2
020171  000                             .BYTE   0               ;DRIVE 3
020172  000                             .BYTE   0               ;DRIVE 4
020173  000                             .BYTE   0               ;DRIVE 5
020174  000                             .BYTE   0               ;DRIVE 6
020175  000                             .BYTE   0               ;DRIVE 7

                                ;TRANSFER WAIT FLAG (TRNSWT=1 WORD)
                                        ;THIS IS A ONE WORD QUEUE. IT WILL CONTAIN THE ADDRESS OF
                                        ;"DPB" OF THE I/O OPERATION.

020176  000000                  TRNSWT: .WORD   0

                                ;SEARCH WAIT KEYS (SRCHWT=1 WORD)
                                        ;THIS IS A ONE WORD QUEUE THAT WILL CONTAIN A KEY FOR EACH OF
                                        ;THE DRIVES THAT ARE PERFORMING A SEARCH COMMAND FOR THE I/O
                                        ;REQUEST THAT IS AT THE TOP OF THEIR REQUEST QUEUE.
                                        ;EACH DRIVE IS ASSIGNED ONE BIT, STARTING AT BIT00 FOR DRIVE 0.

020200  000000                  SRCHWT: .WORD   0

                                ;RP07 DRIVER ACTIVE FLAG (ACTDRV=1 BYTE)
                                        ;ACTDRV=0 IF DRIVER IS INACTIVE
                                        ;ACTDRV>0 IF DRIVER IS ACTIVE

020202  000                     ACTDRV: .BYTE   0

                                ;SOFTWARE TIMER ROUTINE ACTIVE FLAG (ACTSTR=1 BYTE)
                                        ;ACTSTR=0 IF SOFTWARE TIMER ROUTINE IS INACTIVE
                                        ;ACTSTR>0 IF SOFTWARE TIMER ROUTINE IS ACTIVE

020203  000                     ACTSTR: .BYTE   0


                                ;TIMEOUT TABLE (TIMER=8 WORDS)
                                        ;THIS TABLE CONTAINS THE TIME ALLOWED FOR AN OPERATION

020204  177777                  TIMER:  .WORD   -1       ;DRIVE 0
020206  177777                          .WORD   -1       ;DRIVE 1
```

```
020210  177777                  .WORD   -1      ;DRIVE 2
020212  177777                  .WORD   -1      ;DRIVE 3
020214  177777                  .WORD   -1      ;DRIVE 4
020216  177777                  .WORD   -1      ;DRIVE 5
020220  177777                  .WORD   -1      ;DRIVE 6
020222  177777                  .WORD   -1      ;DRIVE 7

                        ;DATA TRANSFER UNDERWAY INDICATOR (DTUW=1 WORD)
                                ;DTUW<0 IF NO DATA TRANSFER UNDERWAY
                                ;DTUW=+N (WHERE N=0 TO 7) IMPLIES DATA TRANSFER UNDERWAY ON DRIVE N

020224  177777          DTUW:   .WORD   -1
```

```
                                ;RHXX/RP07 DRIVER INITIALIZATION CODE
                                        ;THIS ROUTINE WILL DETERMINE WHICH RP07 DRIVES ARE
                                        ;AVAILABLE FOR TESTING AND SET THE DRVSTA INDICATOR
                                        ;TO THE PROPER STATE FOR EACH DRIVE.
                                        ;NOTE: THIS ROUTINE CALLS DRVINT
                                ;
                                ;CALL
                                ;
                                ;       JSR     PC,RPINIT
                                ;       RETURN
                                ;
                                ;NOTE: THE 'P' OR 'L' CLOCK MUST BE STARTED
                                ;
020226  004737  010646  RPINIT: JSR     PC,SAVREG       ;SAVE R0 - R5
020232  004737  011676          JSR     PC,ST.CLK       ;TURN ON THE CLOCK
                                                        ;SAVE THE PRESENT PROCESSOR STATUS
020236  104440                  TRAP    C$GPRI
020240  010046                  MOV     R0,-(SP)
                                                        ;CHANGE THE PRIORITY TO 5
020242  012700  000240          MOV     #PRI05,R0
020246  104441                  TRAP    C$SPRI
020250  004737  025176          JSR     PC,CLRQUE       ;CLEAR ALL REQUEST QUEUES
020254  012701  020026          MOV     #RPSTU0,R1      ;FIRST ADDRESS TO BE CLEARED
020260  012702  020204          MOV     #TIMER,R2       ;LAST ADDRESS TO BE CLEARED
020264  005021          1$:     CLR     (R1)+           ;CLEAR
020266  020102                  CMP     R1,R2           ;ARE WE DONE?
020270  103775                  BLO     1$              ;BRANCH IF NO
020272  012702  020224          MOV     #DTUW,R2        ;LAST ADDRESS
020276  012721  177777  2$:     MOV     #-1,(R1)+       ;INITIALIZE
020302  020102                  CMP     R1,R2           ;DONE?
020304  101774                  BLOS    2$              ;LOOP IF NO
020306  005037  020136          CLR     DRVSTA          ;SET ALL DRIVES TO OFFLINE
020312  005037  020140          CLR     DRVSTA+2
020316  005037  020142          CLR     DRVSTA+4
020322  005037  020144          CLR     DRVSTA+6
                                                        ;SETUP RHXX/RP07 VECTOR
020326  013746  002646          MOV     RPVEC+2,-(SP)
020332  012746  022674          MOV     #ISRV,-(SP)
020336  013746  002644          MOV     RPVEC,-(SP)
020342  012746  000003          MOV     #3,-(SP)
020346  104437                  TRAP    C$SVEC
020350  062706  000010          ADD     #10,SP
020354  012777  000040  162306  MOV     #CLR,@RPCS2     ;MASSBUS INIT
020362  013701  002654          MOV     DRVNO,R1        ;GET SELECTED DRIVE
020366  004437  020414  3$:     JSR     R4,DRVINT       ;INIT THE DRIVE
020372  000401                  BR      4$              ;'DVA' NOT SET OR PARITY ERROR
020374  000402                  BR      5$              ;NORMAL RETURN
                                
020376  105061  020136  4$:     CLRB    DRVSTA(R1)      ;SET DRIVE STATUS TO OFFLINE
020402          5$:                                     ;RESTORE THE PROCESSOR STATUS
020402  012600                  MOV     (SP)+,R0
020404  104441                  TRAP    C$SPRI
020406  004737  010700          JSR     PC,RESREG       ;RESTORE R0 - R5
020412  000207                  RTS     PC              ;BYE-BYE
                                
                                ;DRIVE INITILIZATION ROUTINE
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```
                                        ;THIS ROUTINE DETERMINES IF A DRIVE EXIST AND IF IT IS
                                        ;AN RP07. IF IT IS, A "READ-IN PRESET" IS ISSUED AND FMT16
                                        ;IS SET TO A "1". THEN MOL, DPR, DRY, AND VV ARE CHECKED TO
                                        ;INSURE THEY ARE ALL ON A "1". AND DEPENDING ON THEIR STATE,
                                        ;DRVSTA IS SET TO THE PROPER CONDITION.
                                ;CALL
                                ;       MOV     #DRVNUM,R1      ;DRIVE NUMBER TO R1
                                ;       JSR     R4,DRVINT       ;CALLED BY A JSR
                                ;       RETURN1                 ;ERROR OCCURRED (PARITY)
                                ;       RETURN2                 ;NORPAL RETURN
                                ;

020414  010546                  DRVINT: MOV     R5,-(SP)        ;SAVE R5
020416  112761  177777  020156          MOVB    #-1,DPINT(R1)   ;SET THE INITIAL FLAG
020424  006301                          ASL     R1
020426  012761  003720  020204          MOV     #2000.,TIMER(R1)        ;SET A 2 SECOND TIMER
020434  006201                          ASR     R1              ;DRIVE ADDRESS
020436  105061  020136          10$:    CLRB    DRVSTA(R1)      ;START DRIVE STATUS AS OFFLINE
020442  105061  020146                  CLRB    DRVTYP(R1)      ;CLEAR THE DRIVE TYPE INDICATOR
020446  010177  162216                  MOV     R1,@RPCS2       ;SELECT A DRIVE
020452  112777  000111  162200          MOVB    #111,@RPCS1     ;DO A DRIVE CLEAR COMMAND (& SEIZE DRIVE)
020460  032777  010000  162202          BIT     #BIT12,@RPCS2 ;NONEXISTENT DRIVE?
020466  001403                          BEQ     1$              ;NO---BRANCH
020470  004737  024632                  JSR     PC,SET.IE       ;GO SET "IE" WITHOUT A "TRE"
020474  000513                          BR      6$              ;LEAVE THIS ROUTINE

020476  105061  020136          1$:     CLRB    DRVSTA(R1)      ;SET DRIVE STATUS TO OFFLINE
020502  032777  004000  162150          BIT     #BIT11,@RPCS1  ;SEE IF DRIVE AVAILABLE
020510  001004                          BNE     22$             ;BRANCH IF DVA SET
020512  105761  020156                  TSTB    DPINT(R1)       ;SOFTWARE TIME OUT
020516  001347                          BNE     10$             ;BRANCH IF NOT
020520  000501                          BR      6$              ;OTHERWISE EXIT

020522  004437  024254          22$:    JSR     R4,RD.RP        ;READ THE DRIVE TYPE REG.
020526                                  26
020530  020726                          8$                      ;ERROR RETURN ADDRESS
020532  012605                          MOV     (SP)+,R5        ;PUT DRIVE TYPE IN R5
020534  112761  000005  020146          MOVB    #5,DRVTYP(R1)   ;SET RP07 INDICATOR
020542  022705  020040                  CMP     #20040,R5       ;SINGLE PORT RP07
020546  001420                          BEQ     2$              ;BR IF YES
020550  022705  024040                  CMP     #24040,R5       ;DUAL PORT RP07
020554  001415                          BEQ     2$              ;BR IF YES
020556  112761  000004  020146          MOVB    #4,DRVTYP(R1)   ;SET RP07+ INDICATOR
020564  022705  020042                  CMP     #20042,R5       ;SINGLE PPRT RP07+
020570  001407                          BEQ     2$              ;BRANCH IF SO
020572  022705  024042                  CMP     #24042,R5       ;DUAL PORT RP07+
020576  001404                          BEQ     2$              ;BRANCH IF SO
020600  112761  177777  020146          MOVB    #-1,DRVTYP(R1)  ;SET INDICATOR TO 'OTHER'
020606  000446                          BR      6$              ;EXIT

020610  012746  000121          2$:     MOV     #121,-(SP)      ;DO A "READ-IN PRESET"
020614  004437  024346                  JSR     R4,WRT.RP
020620  000000                          0
020622  020726                          8$
020624  012746  010000                  MOV     #BIT12,-(SP)    ;SET FMT16=1
020630  004437  024346                  JSR     R4,WRT.RP
020634  000032                          32
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```
                                                8$
020636  020726
020640  004437  024254                        JSR     R4,RD.RP        ;READ RPDS
020644  000012                                12
020646  020726                                8$
020650  012605                                MOV     (SP)+,R5        ;AND SAVE IT IN R5
020652  100015                                BPL     4$              ;BRANCH IF ATA=0
020654  116177  002734  162014                MOVB    ATABIT(R1),@RPAS ;CLEAR ATTENTION BIT
020662  004437  024254                        JSR     R4,RD.RP        ;FIND OUT WHY ATA=1
020666  000014                                14
020670  020726                                8$
020672  006126                                ROL     (SP)+           ;IS IT UNSAFE?
020674  100004                                BPL     4$              ;BR IF NOT
020676  112761  177777  020136                MOVB    #-1,DRVSTA(R1)  ;SET UNSAFE INDICATOR
020704  000407                                BR      6$              ;EXIT
020706  005105                        4$:     COM     R5              ;CHECK MOL, DPR, DRY, AND VV
020710  042705  167077                        BIC     #^C<BIT12!BIT08!BIT07!BIT06>,R5
020714  001003                                BNE     6$              ;BRANCH IF MOL, DPR, DRY, OR VV IS CLEAR
020716  112761  000001  020136                MOVB    #1,DRVSTA(R1)   ;SET DRIVE STATUS TO ONLINE
020724  005724                        6$:     TST     (R4)+           ;STEP OVER THE ERROR RETURN
020726                                  7$:
020726  006301                        8$:     ASL     R1              ;WORD INDEX
020730  012761  177777  020204                MOV     #-1,TIMER(R1)   ;STOP THE CLOCK
020736  006201                                ASR     R1              ;DRIVE ADDRESS
020740  105061  020156                        CLRB    DPINT(R1)
020744  012605                                MOV     (SP)+,R5        ;RESTORE R5
020746  000204                                RTS     R4              ;EXIT

                                ;REQUEST PRE-PROCESSOR-HANDLES SUBSYSTEM REQUEST
                                ;
                                ;CALL
                                ;
                                ;       JSR     R4,RP07         ;CALL THE RP07 DRIVER
                                ;       PNTADR                  ;ADDRESS OF POINTER OF DRIVES PARAMETER BLOCK
                                ;       RETURN1                 ;RETURN HERE IF QUEUE IS FULL
                                ;       RETURN2                 ;RETURN HERE IF REQUEST IS IN QUEUE OR THERE
                                ;                               ;IS AN ERROR CONDITION

020750                          RP07:                           ;SAVE THE CALLING STATUS
020750  104440                        TRAP    C$GPRI
020752  010046                        MOV     R0,-(SP)
                                                                ;DON'T ALLOW ANY RP07 INTERRUPTS
020754  013700  002646                MOV     RPVEC+2,R0
020760  104441                        TRAP    C$SPRI
020762  112737  000001  020202        MOVB    #1,ACTDRV       ;SET "ACTIVE DRIVER" FLAG
020770  004737  010646                JSR     PC,SAVREG       ;SAVE R0 - R5
020774  011402                        MOV     (R4),R2         ;PICKUP THE DRIVE PARAMETER BLOCK POINTER
020776  005062  000016                CLR     16(R2)          ;CLEAR THE STATUS/ERROR INDICATOR
021002  111201                        MOVB    (R2),R1         ;PICKUP THE DRIVE NUMBER
021004  105761  020136                TSTB    DRVSTA(R1)      ;CHECK DRIVES STATUS
021010  003006                        BGT     1$              ;BRANCH IF ONLINE
021012  004437  020414                JSR     R4,DRVINT       ;GO INIT. THE DRIVE
021016  000421                        BR      4$              ;ERROR RETURN
                                                                ;NO ERROR
021020  105761  020136                TSTB    DRVSTA(R1)      ;IS DRIVE STATUS ONLINE?
021024  003436                        BLE     6$              ;BR IF NOT
021026  105761  020166          1$:   TSTB    DPRQS(R1)       ;OUTSTANDING PORT REQUEST FOR THE DRIVE ?
021032  001016                        BNE     5$              ;BR IF YES
```

```
                                        MOV     R1,@RPCS2       ;SELECT THE DRIVE
                                        JSR     R4,DRVQUE       ;PUT THIS REQUEST IN QUEUE
                                        BR      9$              ;QUEUE IS FULL

                                2$:     TSTB    DRVACT(R1)      ;IS THIS DRIVE ACTIVE?
                                        BNE     8$              ;BR IF YES
                                        JSR     PC,OPT          ;CALL THE OPTIMIZER
                                        BR      8$
                                3$:
                                4$:     JSR     PC,CI7          ;GO HANDLE THE PARITY ERROR
                                        BR      8$

                                5$:     JSR     R4,DRVQUE       ;PUT REQUEST IN QUEUE
                                        BR      9$              ;QUEUE IS FULL

                                        MOV     #0,@RPCC        ;WRITE THE CURRENT CYL REG
                                        BIT     #BIT06,@RPCS1   ;IE BIT SET ?
                                        BNE     8$              ;YES
                                        JSR     PC,SET.IE       ;SET THE INTERRUPT
                                        BR      8$              ;RETURN

                                6$:     TSTB    DRVSTA(R1)      ;SEE IF DRIVE OFFLINE OR UNSAFE
                                        BLT     7$              ;BR IF UNSAFE
                                        MOV     #BIT15!BIT14,16(R2)  ;SET OFFLINE ERROR INDICATOR
                                        TSTB    DRVTYP(R1)      ;SEE IF OFFLINE OR NONEXISTENT
                                        BNE     8$              ;BR IF OFFLINE
                                        MOV     #BIT15!BIT01,16(R2)  ;REPORT DRIVE NONEXISTENT
                                        BR      8$              ;GO TO EXIT

                                7$:     MOV     #BIT15!BIT12,16(R2)  ;DRIVE IS UNSAFE
                                8$:     JSR     PC,RESREG       ;RESTORE R0 - R5
                                        TST     (R4)+           ;SETUP FOR NORMAL RETURN
                                        BR      10$             ;FINISH UP, THEN EXIT
                                9$:     JSR     PC,RESREG       ;RESTORE R0 - R5
                                10$:    TST     (R4)+           ;CORRECT THE RETURN ADDRESS
                                        CLRB    ACTDRV          ;CLEAR "ACTIVE DRIVER" FLAG
                                                                ;RESTORE PRIORITY
                                        MOV     (SP)+,R0
                                        TRAP    C$SPRI
                                        RTS     R4              ;RETURN TO CALLER

                        ;OPTIMIZER-CALLED FOR A PARTICULAR DRIVE
                        ;
                        ;CALL
                        ;       MOV     #DRVNUM,R1      ;DRIVE NUMBER TO R1
                        ;       JSR     PC,OPT          ;SETUP A COMMAND

                        OPT:    JSR     PC,SAVREG       ;SAVE R0 - R5
                                TRAP    C$GPRI
                                MOV     R0,-(SP)
                                BICB    ATABIT(R1),SRCHWT       ;CLEAR LA SEACH FLAG
                                CLRB    DPRQS(R1)       ;RESET THE PORT REQ FLAG ****
                                JSR     PC,GETREQ       ;GET "DPB" POINTER OF REQUEST
                                TST     R2              ;IS THERE A REQUEST IN QUEUE?
                                BEQ     7$              ;NO--BRANCH TO EXIT
                                MOV     R1,@RPCS2       ;LOAD THE DRIVE ADDRESS *******
                                MOV     #111,@RPCS1     ;CLEAR THE DRIVE
```

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                                                BIT     #BIT8,@RPDS     ;DPR SET ?
                                                BEQ     5$              ;TO PROT REQUEST ,IF NOT
                                        10$:    TSTB    DRVSTA(R1)      ;IS DRIVE ONLINE?
                                                BGT     1$              ;YES--BRANCH
                                                JSR     PC,POPQUE       ;NO--REMOVE REQUEST FROM QUEUE
                                                MOV     #BIT15!BIT14,16(R2)     ;SET OFFLINE STATUS/ERROR INDICATOR
                                                TSTB    DRVSTA(R1)      ;IS DRIVE UNSAFE ?
                                                BPL     8$              ;BR TO EXIT IF NOT
                                                MOV     #BIT15!BIT12,16(R2)     ;SET UNSAFE STATUS/ERROR INDICATOR
                                                BR      8$              ;BRANCH TO EXIT

                                        1$:     CMPB    #150,2(R2)      ;IS THE REQUEST FOR I/O?
                                                BLT     2$              ;YES--BRANCH
                                                CMPB    #135,2(R2)      ;IS THE DIAGNOSTIC COMMAND ?
                                                BEQ     2$              ;BRANCH IF SO
                                                JSR     PC,CI4          ;CALL THE COMMAND INITIATOR
                                                BR      8$              ;BRANCH TO EXIT

                                        2$:     TST     DTUW            ;DATA TRANSFER UNDERWAY?
                                                BGE     4$              ;YES--GO START A SEARCH
                                        3$:     JSR     PC,CI1          ;START A DATA TRANSFER
                                                BR      8$

                                        4$:     JSR     PC,CI3          ;START A SEARCH
                                                BR      8$              ;GO TO THE EXIT

                                        5$:     MOVB    #-1,DPRQS(R1)   ;SET PORT REQUEST INDICATOR
                                                MOV     R1,R3           ;SET UP TO ADDRESS WORDS
                                                ASL     R3              ;CONVERT TO WORD INDEX
                                                MOV     #20000.,TIMER(R3)       ;SET A 20. SECOND TIMER
                                                MOV     #0,@RPCC        ;SET PORT REQUEST
                                                BR      7$              ;EXIT
                                        6$:     JSR     PC,CI7          ;PROCESS THE PARITY ERROR
                                        7$:     BIT     #BIT06,@RPCS1   ;SEE IF 'IE' ALREADY SET
                                                BNE     8$              ;BR IF SET
                                                JSR     PC,SET.IE       ;SET "IE" WITHOUT A "TRE"
                                        8$:                             ;RESTORE PROC. STATUS
                                                MOV     (SP)+,R0
                                                TRAP    C$SPRI
                                                JSR     PC,RESREG       ;RESTORE R0 - R5
                                                RTS     PC
```

```
                                        ;COMMAND INITIATOR
                                        ;
                                        ;CALL
                                        ;       MOV     #DRVNUM,R1      ;DRIVE NUMBER
                                        ;       MOV     #DPB,R2         ;ADDRESS OF DPB
                                        ;       JSR     PC,CI?          ;CI?= CI1,CI3, OR CI4
                                        ;                               ;WHERE:
                                        ;                               ;CI1=DATA TRANSFER
                                        ;                               ;CI3=SEARCH REQUESTED BY DATA XFER
                                        ;                               ;CI4=NOT DATA TRANSFER

021456  004737  025376          CI1:    JSR     PC,POPQUE       ;REMOVE REQUEST FROM "DRIVES WAIT" QUEUE
021462  010237  020176                  MOV     R2,TRNSWT       ;PUT REQ. IN TRANSFER WAIT QUEUE
021466  010203                          MOV     R2,R3           ;DPB ADDRESS TO R3
021470  013704  002660                  MOV     RPCS1,R4        ;RPCS1 ADDRESS
021474  010177  161170                  MOV     R1,@RPCS2       ;SELECT DRIVE
021500  122762  000135  000002          CMPB    #DIAG,2(R2)     ;DIAGNOSTIC COMMAND ?
021506  001011                          BNE     1$              ;BRANCH IF NOT
021510  016246  000004                  MOV     4(R2),-(SP)     ;GET THE RT NUMBER, PARAMETERS
021514  052716  100000                  BIS     #DMD,(SP)       ;SET THE GIAGNOSTIC MODE BIT
021520  004437  024346                  JSR     R4,WRT.RP       ;WRITE THE RPMR1 REG
021524  000024                          24
021526  022364                          CI7                     ;RETURN HERE ON ERROR
021530  000432                          BR      2$              ;LOAD THE COMMAND AND EXIT

021532  062703  000004          1$:     ADD     #4,R3           ;DESIRED WORD COUNT
021536  062704  000002                  ADD     #2,R4           ;RPWC ADDRESS
021542  012324                          MOV     (R3)+ (R4)+     ;LOAD WORD COUNT
021544  012324                          MOV     (R3)+,(R4)+     ;LOAD BUFFER ADDRESS
021546  012346                          MOV     (R3)+,-(SP)     ;LOAD SECTOR AND TRACK
021550  004437  024346                  JSR     R4,WRT.RP       ;CALL THE LOAD(WRITE) ROUTINE
021554  000006                          6                       ;INDEX OF REGISTER TO LOAD
021556  022364                          CI7                     ;RETURN HERE ON ERROR
021560  012346                          MOV     (R3)+,-(SP)     ;LOAD CYLINDER ADDRESS
021562  004437  024346                  JSR     R4,WRT.RP
021566  000034                          34
021570  022364                          CI7                     ;RETURN HERE ON ERROR
021572  032712  100000                  BIT     #BIT15,(R2)     ;MAINTENANCE MODE FLAG BIT SET ?
021576  001407                          BEQ     2$              ;BRANCH IF NOT
021600  005046                          CLR     -(SP)           ;SET DMD BIT IN RPMR
021602  052716  100000                  BIS     #BIT15,(SP)     ;SET DMD BIT ONLY THE REST BITS MUST BE 0
021606  004437  024346                  JSR     R4,WRT.RP       ;WRITE TO RPMR
021612  000024                          24
021614  022364                          CI7                     ;RETURN HERE ON ERROR
021616  016246  000002          2$:     MOV     2(R2),-(SP)     ;LOAD "COMMAND+GO", "A17&A16", AND "PSEL"
021622  004437  024346                  JSR     R4,WRT.RP
021626  000000                          0
021630  022364                          CI7                     ;RETURN HERE ON ERROR
021632  010137  020224                  MOV     R1,DTUW         ;SET "DATA TRANSFER UNDERWAY"
021636  000137  022300                  JMP     CI5

021642  013704  002660          CI3:    MOV     RPCS1,R4        ;RPCS1 ADDRESS
021646  010177  161016                  MOV     R1,@RPCS2       ;SELECT DRIVE
021652  016246  000012                  MOV     12(R2),-(SP)    ;DESIRED CYLINDER ADDRESS
021656  004437  024346                  JSR     R4,WRT.RP
021662  000034                          34
021664  022364                          CI7                     ;RETURN HERE ON ERROR
```

```
                                                MOV     10(R2),-(SP)    ;THE SECTOR AND TRACK ADDRESS
                                                JSR     R4,WRT.RP       ;LOAD DESIRED TRACK & SECTOR
                                                6
                                                CI7                     ;RETURN HERE ON ERROR
                                                BIT     #BIT15,0(R2)    ;MAINTENANCE MODE ?
                                                BEQ     1$              ;BRANCH IF NOT
                                                CLR     -(SP)
                                                BIS     #BIT15,(SP)     ;SET DMD BIT ONLY,THE REST BITS MUST BE 0
                                                JSR     R4,WRT.RP
                                                24
                                                CI7                     ;RETURN HERE ON ERROR
                                        1$:
                                                MOV     #SEARCH,-(SP)   ;START A SEARCH
                                                JSR     R4,WRT.RP
                                                0
                                                CI7                     ;RETURN HERE ON ERROR
                                                BISB    ATABIT(R1),SRCHWT       ;SET "SEARCH WAIT" KEY
                                                BR      CI5

                                        CI4:    MOV     RPCS1,R4        ;RPCS1 ADDRESS
                                                MOV     R1,@RPCS2       ;SELECT DRIVE
                                                MOVB    2(R2),R3        ;PICKUP THE REQUESTED COMMAND
                                                CMPB    #SEARCH,R3      ;IS IT A SEARCH COMMAND?
                                                BNE     1$              ;BRANCH IF NO
                                                MOV     10(R2),-(SP)    ;LOAD DESIRED TRACK & SECTOR
                                                JSR     R4,WRT.RP
                                                6
                                                CI7                     ;RETURN HERE ON ERROR
                                                BR      2$              ;GO LOAD CYLINDER

                                        1$:     CMPB    #SEEK,R3        ;IS IT A SEEK COMMAND
                                                BNE     3$              ;BRANCH IF NO
                                        2$:     MOV     12(R2),-(SP)    ;LOAD DESIRED CYLINDER
                                                JSR     R4,WRT.RP
                                                34
                                                CI7                     ;RETURN HERE ON ERROR
                                                BR      CI6

                                        3$:     CMPB    #OFFSET,R3      ;IS IT AN "OFFSET" REGISTER CHANGE COMMAND ?
                                                BNE     4$              ;BR IF NO
                                                JSR     R4,RD.RP        ;MERGE THE OFFSET VALUE INTO RPOF
                                                32                      ;BUT DON'T CHANGE THE UPPER
                                                CI7                     ;RETURN HERE ON ERROR
                                                MOVB    1(R2),(SP)      ;BYTE WHEN LOADING THE
                                                JSR     R4,WRT.RP       ;REGISTER (RPOF)
                                                32
                                                CI7                     ;RETURN HERE ON ERROR
                                                BR      CI6             ;GO START THE COMMAND

                                        4$:     CMPB    #RECAL,R3       ;IS IT A "RECALIBRATE" COMMAND?
                                                BEQ     CI6             ;BRANCH IF YES
                                                CMPB    #RTC,R3         ;IS IT A RETURN TO CENTER?
                                                BEQ     CI6             ;BRANCH IF YES
                                        5$:     CMPB    #SETFORM,R3     ;IS IT A "SET FORMAT" COMMAND?
                                                BNE     6$              ;BRANCH IF NO
                                                JSR     R4,RD.RP        ;READ THE OFFSET REGISTER
                                                32
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115 022124  022364                        CI7                 ;RETURN HERE ON ERROR
116 022126  116266  000001  000001        MOVB    1(R2),1(SP) ;COMBINE "FMT16","ECI", AND "HCI"
117 022134  004437  024346                JSR     R4,WRT.RP   ;LOAD "FMT16", "ECI", AND/OR "HCI".
118 022140  000032                        32
119 022142  022364                        CI7                 ;RETURN HERE ON ERROR
120 022144  000445                        BR      12$
121
122 022146  122703  000141          6$:   CMPB    #GETREG,R3  ;IS IT A "GET REGISTER" COMMAND?
123 022152  001023                        BNE     10$         ;BRANCH IF NO
124 022154  016203  000006          7$:   MOV     6(R2),R3    ;POINTS TO 1ST ADDRESS OF WHERE
125                                                           ;TO PUT THE REGISTER(S)
126 022160  116237  000010  022176        MOVB    10(R2),9$   ;INIT. THE INDEX FOR THE FIRST REG.
127 022166  116205  000011                MOVB    11(R2),R5   ;INDEX OF LAST REG. TO MOVE
128 022172  004437  024254          8$:   JSR     R4,RD.RP    ;READ RHXX/RP07 REGISTER
129 022176  000000          9$:   0                           ;INDEX OF REG. TO READ
130 022200  022364                        CI7                 ;RETURN HERE ON ERROR
131 022202  012623                        MOV     (SP)+,(R3)+ ;GET THE CONTENTS OF RHXX//RP07 REG.
132 022204  023705  022176                CMP     9$,R5       ;LAST REG. BEEN READ?
133 022210  001423                        BEQ     12$         ;GET OUT IF YES
134 022212  062737  000002  022176        ADD     #2,9$       ;INCREASE THE INDEX BY 2
135 022220  000764                        BR      8$          ;LOOP--MORE TO READ
136
137 022222  122703  000145         10$:   CMPB    #MAINT,R3   ;IS IT A "SELECT MAINTENANCE" COMMAND?
138 022226  001007                        BNE     11$         ;BRANCH IF NOT
139 022230  012746  100000                MOV     #DMD,-(SP)  ;SET DIAGNOSTIC MODE COMMAND
140 022234  004437  024346                JSR     R4,WRT.RP   ;WRITE THE MAINTENANCE REGISTER
141 022240  000024                        24
142 022242  022364                        CI7                 ;RETURN HERE ON ERROR
143 022244  000405                        BR      12$         ;EXIT
144
145 022246  010346         11$:   MOV     R3,-(SP)    ;LOAD THE COMMAND
146 022250  004437  024346                JSR     R4,WRT.RP
147 022254  000000                        0                   ;INDEX OF REG. TO WRITE
148 022256  022364                        CI7                 ;RETURN HERE ON ERROR
149 022260  004737  025376         12$:   JSR     PC,POPQUE   ;REMOVE REQ. FROM QUEUE
150 022264  052762  000200  000016        BIS     #BIT07,16(R2) ;SET THE "DONE" BIT
151 022272  004737  024472                JSR     PC,SVRHXX   ;YES--GO SAVE THE REGISTERS
152 022276  000207         13$:   RTS     PC                  ;RETURN TO USER
153
154 022300  006301         CI5:   ASL     R1
155 022302  012761  001750  020204        MOV     #1000.,TIMER(R1)        ;SET A ONE SECOND TIMER
156 022310  006201                        ASR     R1
157 022312  112761  000001  020126        MOVB    #1,DRVACT(R1)   ;SET THE DRIVE ACTIVE
158 022320  000207                        RTS     PC              ;RETURN TO THE USER
159
160 022322  032762  100000  000000  CI6:  BIT     #BIT15,0(R2)    ;MAINTENANCE MODE ?
161 022330  001407                        BEQ     1$              ;BRANCH IF NOT
162 022332  005046                        CLR     -(SP)           ;
163 022334  052716  100000                BIS     #BIT15,(SP)     ;SET DMD BIT ONLY
164 022340  004437  024346                JSR     R4,WRT.RP       ;THE REST BITS MUST BE 0
165 022344  000024                        24
166 022346  022364                        CI7                     ;RETURN HERE ON ERROR
167 022350  010346          1$:   MOV     R3,-(SP)        ;LOAD THE COMMAND
168 022352  004437  024346                JSR     R4,WRT.RP
169 022356  000000                        0                       ;INDEX OF REG. TO WRITE
170 022360  022364                        CI7                     ;RETURN HERE ON ERROR
171 022362  000746                        BR      CI5
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```
172 022364                                CI7:
173 022364  005702                    1$:     TST     R2              ;ANYTHING IN QUEUE ?
174 022366  001001                            BNE     2$              ;BRANCH IF QUEUE IS THERE
175 022370  000207                            RTS     PC              ;OTHERWISE EXIT
176 022372  012762  104000  000016    2$:     MOV     #BIT15!BIT11,16(R2)     ;SET "PARITY" ERROR INDICATOR
177
178 022400  012746  000111            CI7B:   MOV     #111,-(SP)      ;DO A "DRIVE CLEAR"
179 022404  004437  024346                    JSR     R4,WRT.RP
180 022410  000000                            0
181 022412  022452                            CI8                     ;RETURN HERE ON ERROR
182 022414  004737  025260            2$:     JSR     PC,EMPTYQ       ;EMPTY THE QUEUE
183 022420  105061  020166                    CLRB    DPRQS(R1)       ;CLEAR THE PORT REQUEST FLAG
184 022424  105061  020126                    CLRB    DRVACT(R1)      ;DRIVE IS IDLE
185 022430  020237  020176                    CMP     R2,TRNSWT       ;IF THIS DRIVE HAD AN I/O REQUEST
186 022434  001005                            BNE     1$              ;IN PROGRESS CLEAR ALL OF THE FLAGS
187 022436  005037  020176                    CLR     TRNSWT
188 022442  012737  177777  020224           MOV     #-1,DTUW
189 022450  000207                    1$:     RTS     PC
190
191 022452  004737  010646            CI8:    JSR     PC,SAVREG       ;SAVE R0 - R5
192 022456  005001                            CLR     R1
193 022460  005003                            CLR     R3
194 022462  105761  020126            1$:     TSTB    DRVACT(R1)      ;DRIVE ACTIVE?
195 022466  001003                            BNE     22$             ;BRANCH IF IN ACTIVE
196 022470  105761  020166                    TSTB    DPRQS(R1)       ;PORT REQUEST
197 022474  001443                            BEQ     5$              ;BRANCH IF NOT
198 022476  013702  020176            22$:    MOV     TRNSWT,R2       ;GET THE "TRANSFER WAIT" QUEUE
199 022502  020137  020224                    CMP     R1,DTUW         ;DID THIS DRIVE HAVE AN I/O IN PROGRESS?
200 022506  001402                            BEQ     2$              ;BRANCH IF YES
201 022510  004737  025354                    JSR     PC,GETREQ       ;GET THE DPB POINTER
202 022514  005702                    2$:     TST     R2              ;QUEUE ENTRY FOR DRIVE ?
203 022516  001413                            BEQ     4$              ;BR IF NOT
204 022520  032777  010000  160142            BIT     #BIT12,@RPCS2   ;'NED' SET ?
205 022526  001404                            BEQ     3$              ;BR IF NOT
206 022530  012762  100002  000016            MOV     #BIT15!BIT01,16(R2)  ;SET 'DRIVE NON-EXISTENT' INDICATOR
207 022536  000403                            BR      4$              ;CONTINUE
208
209 022540  012762  102000  000016    3$:     MOV     #BIT15!BIT10,16(R2) ;SET "NON-CLEARABLE PARITY" ERROR INDICATOR
210 022546  012763  177777  020204    4$:     MOV     #-1,TIMER(R3)   ;STOP THE TIMER
211 022554  105061  020126                    CLRB    DRVACT(R1)      ;SET "DRIVE ACTIVE" TO IDLE
212 022560  105061  020166                    CLRB    DPRQS(R1)       ;CLEAR PORT REQUEST FLAG
213 022564  020137  020224                    CMP     R1,DTUW         ;IS THIS DRIVE SETUP FOR A TRANSFER
214 022570  001005                            BNE     5$              ;BR IF NOT
215 022572  012737  177777  020224           MOV     #-1,DTUW        ;RESET THE INDICATOR
216 022600  005037  020176                    CLR     TRNSWT          ;CLEAR THE TRANSFER QUEUE
217 022604  005201                    5$:     INC     R1              ;MOVE TO THE NEXT DRIVE
218 022606  062703  000002                    ADD     #2,R3
219 022612  042701  177770                    BIC     #^C7,R1
220 022616  001321                            BNE     1$              ;BRANCH IF MORE DRIVES
221 022620  012737  177777  020224           MOV     #-1,DTUW        ;NO DATA TRANSFERS UNDERWAY
222 022626  005037  020176                    CLR     TRNSWT          ;CLEAR THE 'TRANSFER WAIT' QUEUE
223 022632  004737  025176                    JSR     PC,CLRQUE       ;CLEAR ALL OF THE REQUEST QUEUES
224 022636  012777  000040  160024           MOV     #CLR,@RPCS2     ;DO A MASSBUS INIT.
225 022644  000406                            BR      7$              ;CONTINUE
226
227 022646  004737  025260            6$:     JSR     PC,EMPTYQ       ;CLEAR THE DRIVE'S QUEUE
228 022652  105061  020136                    CLRB    DRVSTA(R1)      ;SET DRIVE TO OFFLINE
```

```
    229 022656  105061  020146
    230 022662  004737  024632          7$:     CLRB    DRVTYP(R1)      ;CLEAR THE DRIVE TYPE INDICATOR
    231 022666  004737  010700                  JSR     PC,SET.IE       ;SET "IE" WITHOUT "TRE"
    232 022672  000207                          JSR     PC,RESREG       ;RESTORE R0 - R5
                                                RTS     PC              ;RETURN
```

```
                                        ;INTERRUPT SERVICE ROUTINE
                                        ;
022674  112737  000001  020202  ISRV:   MOVB    #1,ACTDRV       ;SET "ACTIVE DRIVER" FLAG
022702  005237  002242            INC     ISRCNT          ;COUNT INTERRUPTS
022706  004737  010646            JSR     PC,SAVREG       ;SAVE R0 - R5
022712  013701  020224            MOV     DTUW,R1         ;GET "DATA TRANSFER UNDERWAY" INDICATOR
022716  002403                    BLT     1$              ;BRANCH IF NO DATA TRANSFER UNDERWAY
022720  004737  022744            JSR     PC,TD           ;CALL TRANSFER DONE
022724  000402                    BR      2$              ;EXIT
022726  004737  023132  1$:       JSR     PC,SC           ;CALL SPECIAL CONDITIONS
022732  004737  010700  2$:       JSR     PC,RESREG       ;RESTORE R0 - R5
022736  105037  020202            CLRB    ACTDRV          ;CLEAR "ACTIVE DRIVER" FLAG
022742                    L10012:
022742  000002                    RTI
                                        ;
                                        ;TRANSFER DONE ROUTINE
                                        ;
022744  105061  020126  TD:       CLRB    DRVACT(R1)      ;SET DRIVE ACTIVE INDICATOR TO IDLE
022750  012737  177777  020224            MOV     #-1,DTUW        ;NO DATA TRANSFERS UNDERWAY
022756  006301                    ASL     R1
022760  012761  177777  020204            MOV     #-1,TIMER(R1)   ;CANCEL TIMEOUT
022766  006201                    ASR     R1
022770  013702  020176            MOV     TRNSWT,R2       ;GET "DPB" ADDRESS FROM THE
022774  005037  020176            CLR     TRNSWT          ;TRANSFER WAIT QUEUE--CLEAR QUEUE
023000  052762  000200  000016    BIS     #BIT07,16(R2)   ;SET DONE
023006  010177  157656            MOV     R1,@RPCS2       ;SELECT THE DRIVE
023012  004437  024254            JSR     R4,RD.RP        ;TRANSFER ERROR(TRE=1)?
023016  000000                    0
023020  022364                    CI7                     ;RETURN HERE ON ERROR
023022  006126                    ROL     (SP)+
023024  100424                    BMI     3$              ;BR IF YES
023026  004737  024472            JSR     PC,SVRHXX       ;YES--SAVE THE REGISTERS
023032  122762  000135  000002    CMPB    #135,2(R2)      ;IE FROM DIAGNOSTIC COMMAND ?
023040  001003                    BNE     1$              ;BRANCH IF NOT
023042  116177  002734  157626    MOVB    ATABIT(R1),@RPAS        ;RESET THE ATA BIT
023050  004737  025354  1$:       JSR     PC,GETREQ       ;GET DPB POINTER
023054  005702                    TST     R2              ;ENTRY FOR DRIVE ?
023056  001403                    BEQ     2$              ;BR IF NOT
023060  004737  021212            JSR     PC,OPT          ;CALL OPTIMIZER
023064  000422                    BR      SC              ;CHECK OTHER DRIVES
                                        ;
023066  012777  000113  157564  2$:       MOV     #113,@RPCS1     ;RELEASE THE DRIVE
023074  000416                    BR      SC              ;CHECK FOR OTHER DRIVES
023076  052762  100100  000016  3$:       BIS     #BIT15!BIT06,16(R2) ;SET DATA ERROR FLAG
023104  004737  025260            JSR     PC,EMPTYQ       ;EMPTY THE "DRIVE'S WAIT" QUEUE
023110  004737  024472            JSR     PC,SVRHXX       ;SAVE THE RHXX/RP07 REGISTERS
023114  012777  040111  157536    MOV     #40111,@RPCS1   ;ISSUE A "DRIVE CLEAR"
023122  012777  000113  157530    MOV     #113,@RPCS1     ;ISSUE A RELEASE TO THE DRIVE
023130  000400                    BR      SC              ;CHECK FOR OTHER DRIVES
                                        ;
                                        ;SPECIAL CONDITION ROUTINE
                                        ;
023132  117703  157540  SC:       MOVB    @RPAS,R3        ;READ "RPAS"
023136  001014                    BNE     2$              ;BRANCH IF ANY 'ATA' BITS SET
023140  004437  024254            JSR     R4,RD.RP        ;READ CONTROL AND STATUS REGISTER
023144  000000                    0
```

```
023146  022452                  CI8             ;RETURN HERE ON ERROR
023150  106126                  ROLB    (SP)+   ;IS "IE"=1?
023152  100405                  BMI     1$      ;YES, NO DRIVES TO CHECK
023154  000240                  NOP
023156  000240                  NOP
023160  000240                  NOP
023162  004737  024632          JSR     PC,SET.IE       ;SET INTERRUPT ENABLE
023166  000207          1$:     RTS     PC              ;RETURN
023170  005046          2$:     CLR     -(SP)           ;PROCESS ALL DRIVES THAT HAVE
023172  110316                  MOVB    R3,(SP)         ;AN "ATA"=1
023174  012703  000001          MOV     #1,R3
023200  005001                  CLR     R1
023202  030316          SC3:    BIT     R3,(SP)         ;ATA=1?
023204  001005                  BNE     SC5             ;YES--BRANCH
023206  005201          SC4:    INC     R1              ;MOVE TO THE NEXT DRIVE
023210  106303                  ASLB    R3
023212  001373                  BNE     SC3             ;BRANCH IF MORE TO CHECK?
023214  005726                  TST     (SP)+           ;CLEAN OFF THE STACK
023216  000207                  RTS     PC              ;RETURN TO USER
023220                  SC5:
023220  105761  020166  1$:     TSTB    DPRQS(R1)       ;PORT REQUEST OUTSTANDING ?
023224  001402                  BEQ     2$              ;BR IF NOT
023226  000137  023614          JMP     SC13            ;START THE OUTSTANDING COMMAND
023232  105761  020136  2$:     TSTB    DRVSTA(R1)      ;CHECK THE DRIVE STATUS
023236  003011                  BGT     5$              ;BRANCH IF ONLINE
023240  004737  025354          JSR     PC,GETREQ       ;GET DPB POINTER
023244  004737  024472          JSR     PC,SVRHXX       ;SAVE THE RHXX/RP07 REGISTERS
023250  004737  023530          JSR     PC,SC12         ;SAVE RPDS, RPER1, RPER3, AND RPER2
                                                        ;ALSO DO A DRIVE INIT (DRVINT)
023254  105761  020136          TSTB    DRVSTA(R1)      ;DID DRIVE COME ONLINE?
023260  003405                  BLE     6$              ;NO---BRANCH
023262  105761  020126  5$:     TSTB    DRVACT(R1)      ;DRIVE ACTIVE WITH COMMAND OR ERROR RECOVERY ?
023266  001035                  BNE     SC6             ;BR IF EITHER
023270  004737  023530          JSR     PC,SC12         ;SAVE RPDS, RPER1, RPER3, AND RPER2
                                                        ;ALSO DO A DRVINT
023274  105761  020136  6$:     TSTB    DRVSTA(R1)      ;CHECK ON DRIVE'S STATUS
023300  100421                  BMI     7$              ;BR IF UNSAFE
023302  006301                  ASL     R1
023304  006301                  ASL     R1
023306  006301                  ASL     R1
023310  016105  020032          MOV     RPSTU0+4(R1),R5
023314  006201                  ASR     R1
023316  006201                  ASR     R1
023320  006201                  ASR     R1
023322  032705  020000          BIT     #BIT13,R5       ;ADDRESS PLUG CHANGED
023326  001012                  BNE     8$              ;BRANCH IF SO
023330  012746  000111          MOV     #111,-(SP)      ;DRIVE CLEAR
023334  004437  024346          JSR     R4,WRT.RP       ;WRITE THE COMMAND INTO RPCS1
023340  000000                  0                       ;REGISTER INDEX
023342  023410                  SC8                     ;PARITY EXIT ADDRESS
023344  011605          7$:     MOV     (SP),R5         ;PICKUP (RPAS) BEFORE THE ERROR CALL
023346  000240                  NOP
023350  000240                  NOP
023352  000715                  BR      SC4             ;GO CHECK FOR MORE ATA'S

023354  000240          8$:     NOP
023356  000240                  NOP
```

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115 023360  000712                          BR      SC4             ;CHECK FOR MORE DRIVES
116
117 023362  006301                  SC6:    ASL     R1              ;SETUP TO ADDRESS WORDS
118 023364  012761  177777  020204          MOV     #-1,TIMER(R1)   ;STOP THE TIMER
119 023372  006201                          ASR     R1              ;RESTORE THE DRIVE ADDRESS
120 023374  004737  025354                  JSR     PC,GETREQ       ;GET THE DPB POINTER FROM THE QUEUE
121 023400  010177  157264                  MOV     R1,@RPCS2       ;SELECT DRIVE
122 023404  000137  023440                  JMP     SC11            ;PROCESS THE SEARCH
123 023410  105761  020126          SC8:    TSTB    DRVACT(R1)      ;IS DRIVE IDLE?
124 023414  001405                          BEQ     1$              ;YES--BRANCH
125 023416  004737  025354                  JSR     PC,GETREQ       ;GET DPB POINTER
126 023422  004737  022364                  JSR     PC,CI7          ;PROCESS THE PARITY ERROR
127 023426  000402                          BR      2$              ;CONTINUE
128
129 023430  004737  022400          1$:     JSR     PC,CI7B         ;PROCESS THE UNCORRECTABLE PARITY ERROR
130 023434  000137  023206          2$:     JMP     SC4             ;CHECK MORE DRIVES
131
132 023440                          SC11:
133 023440  105061  020126          1$:     CLRB    DRVACT(R1)      ;SET DRIVE IDLE
134 023444  136137  002734  020200          BITB    ATABIT(R1),SRCHWT  ;DOING A SEARCH OPERATION FOR
135                                                                 ;AN I/O COMMAND?
136 023452  001007                          BNE     2$              ;BRANCH IF YES
137 023454  004737  025376                  JSR     PC,POPQUE       ;REMOVE REQUEST FROM QUEUE
138 023460  052762  000200  000016          BIS     #BIT07,16(R2)   ;SET "DONE" BIT
139 023466  004737  024472                  JSR     PC,SVRHXX       ;YES--SAVE ALL OF THE RHXX/RP07 REG'S
140 023472  116177  002734  157176  2$:     MOVB    ATABIT(R1),@RPAS  ;CLEAR ATTENTION BIT
141 023500  146137  002734  020200          BICB    ATABIT(R1),SRCHWT       ;CLEAR IMPLIED SEEK SET
142 023506  006301                          ASL     R1              ;WORD INDEX
143 023510  012761  177777  020204          MOV     #-1,TIMER(R1)   ;STOP CLOCK
144 023516  006201                          ASR     R1              ;RESTORE R1
145 023520  004737  021212                  JSR     PC,OPT          ;START A REQUEST
146 023524  000137  023206                  JMP     SC4             ;CHECK FOR MORE DRIVES
147
148 023530  010177  157134          SC12:   MOV     R1,@RPCS2       ;SELECT DRIVE
149 023534  006301                          ASL     R1
150 023536  006301                          ASL     R1
151 023540  006301                          ASL     R1
152 023542  017761  157124  020026          MOV     @RPDS,RPSTU0(R1)
153 023550  017761  157120  020030          MOV     @RPER1,RPSTU0+2(R1)
154 023556  017761  157136  020032          MOV     @RPER2,RPSTU0+4(R1)
155 023564  017761  157132  020034          MOV     @RPER3,RPSTU0+6(R1)
156 023572  006201                          ASR     R1
157 023574  006201                          ASR     R1
158 023576  006201                          ASR     R1
159 023600  004437  020414                  JSR     R4,DRVINT       ;INIT. THE STATE OF THE DRIVE
160 023604  000401                          BR      1$              ;TAKE ERROR EXIT
161 023606  000207                          RTS     PC              ;RETURN
162
163 023610  005726                  1$:     TST     (SP)+           ;CLEAR THE STACK
164 023612  000676                          BR      SC8             ;PROCESS THE PARITY ERROR
165
166 023614                          SC13:;  ASL     R1              ;SETUP TO ADDRESS WORDS
167                                 ;       MOV     #-1,TIMER(R1)   ;STOP THE TIMER
168                                 ;       ASR     R1              ;
169 023614  010177  157050                  MOV     R1,@RPCS2       ;SELECT THE DRIVE
170 023620  116177  002734  157050          MOVB    ATABIT(R1),@RPAS  ;CLEAR THE ATTENTION BIT
171 023626  105761  020156          1$:     TSTB    DPINT(R1)       ;INITIALIZING THE DRIVE ?
```

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023632  001424                          BEQ     2$              ;BR IF NOT
023634  105061  020156                  CLRB    DPINT(R1)       ;CLEAR THE INIT INDICATOR
023640  004437  020414                  JSR     R4,DRVINT       ;GO INIT THE DRIVE
023644  000240                          NOP                     ;DUMMY PARITY ERROR RETURN
023646  105761  020136                  TSTB    DRVSTA(R1)      ;DRIVE ONLINE ?
023652  003014                          BGT     2$              ;BR IF YES -- START ORDER
023654  005702                          TST     R2              ;QUEUE ENTRY FOR THE DRIVE
023656  001423                          BEQ     3$              ;BR IF NOT
023660  004737  025354                  JSR     PC,GETREQ       ;GET DPB ADDRESS
023664  052762  140000  000016          BIS     #BIT15!BIT14,16(R2)  ;INFORP USER THAT DRIVE OFFLINE
023672  004737  024472                  JSR     PC,SVRHXX       ;SAVE THE REGISTERS
023676  004737  025376                  JSR     PC,POPQUE       ;REMOVE THE QUEUE
023702  000411                          BR      3$

023704  032777  000400  156760  2$:     BIT     #BIT8,@RPDS     ;DVA SET ?
023712  001003                          BNE     4$              ;SET THEN CALL OPT
                                ;       ASL     R1
                                ;       MOV     #60000.,TIMER(R1);SET A 60. SECOND TIMER
                                ;       ASR     R1
023714  004737  024632                  JSR     PC,SET.IE
023720  000402                          BR      3$

023722  004737  021212          4$:     JSR     PC,OPT          ;START THE PENDING REQUEST
023726  000137  023206          3$:     JMP     SC4             ;PROCESS OTHER DRIVES

                                ;/RP07 TIMER ROUTINE
                                ;CALL
                                ;       MOV     #TIME,-(SP)     ;ELASPED TIME IN MILLISECONDS ON THE STACK
                                ;       JSR     PC,RPTMR        ;CALL RP07 TIME ROUTINE

023732  005737  020202          RPTMR:  TST     ACTDRV          ;CHECK "ACTDRV & ACTSTR"
023736  001031                          BNE     4$              ;IF NON ZERO EXIT
023740  112737  000001  020203          MOVB    #1,ACTSTR       ;SET "ACTSTR"
023746  004737  010646                  JSR     PC,SAVREG       ;SAVE R0 - R5
023752  005001                          CLR     R1              ;START WITH DRIVE 0
023754  005003                          CLR     R3
023756  005763  020204          1$:     TST     TIMER(R3)       ;IS THE TIMER RUNNING?
023762  002406                          BLT     2$              ;BRANCH IF NO
023764  166663  000002  020204          SUB     2(SP),TIMER(R3) ;COUNT THE INTERVAL
023772  003002                          BGT     2$              ;BR IF NO SOFTWARE TIMEOUT
023774  004737  024026                  JSR     PC,STO          ;CALL SOFTWARE TIMEOUT ROUTINE
024000  005201          2$:     INC     R1              ;MOVE TO NEXT DRIVE
024002  005723                          TST     (R3)+
024004  022701  000010                  CMP     #8.,R1          ;OUT OF DRIVES?
024010  003362                          BGT     1$              ;BRANCH IF NO
024012  004737  010700          3$:     JSR     PC,RESREG       ;RESTORE R0 - R5
024016  105037  020203                  CLRB    ACTSTR          ;ZERO ACTIVE SOFTWARE TIMEOUT ROUTINE FLAG
024022  012616          4$:     MOV     (SP)+,(SP)      ;ADJUST THE STACK
024024  000207                          RTS     PC              ;RETURN

                                ;SOFTWARE TIMEOUT ROUTINE
                                ;
                                ;NOTE: THIS ROUTINE MUST BE ENTERED AT PRIORITY 6
                                ;       OR GREATER
                                ;
                                ;CALL:  STO
                                ;       MOV     #DRVNUM,R1      ;DRIVE NUMBER
```

```
                                ;       JSR     PC,STO          ;CALL
                                ;       RETURN
                                ;
024026  010146                  STO:    MOV     R1,-(SP)        ;SAVE R1-R4
024030  010246                          MOV     R2,-(SP)        ;
024032  010346                          MOV     R3,-(SP)        ;
024034  010446                          MOV     R4,-(SP)        ;
024036  013702  020176                  MOV     TRNSWT,R2       ;PICKUP THE TRANSFER QUEUE
024042  020137  020224                  CMP     R1,DTUW         ;TRANSFER UNDER WAY ON THIS DRIVE
024046  001421                          BEQ     1$              ;BRANCH IF SO
024050  105761  020156                  TSTB    DPINT(R1)       ;DRIVE INITIALIZE ?
024054  001033                          BNE     2$              ;BRANCH IF SO
024056  105761  020166                  TSTB    DPRQS(R1)       ;PROT REQUEST ?
024062  001047                          BNE     3$              ;BRANCH IF SO
024064  012763  177777  020204          MOV     #-1,TIMER(R3)   ;STOP THE TIMER
024072  004737  025354                  JSR     PC,GETREQ       ;GET THE QUEUE
024076  005702                          TST     R2              ;EXIT IF NONE
024100  001460                          BEQ     5$              ;
024102  052762  101000  000016          BIS     #BIT15!BIT9,16(R2)      ;TIME OUT OR LOST INTERRUPT
                                                                ;ON HOUSE KEEPING COMMANDS
024110  000454                          BR      5$              ;EXIT
024112  052762  101000  000016  1$:     BIS     #BIT15!BIT9,16(R2)      ;TIME OUT ON DATA TRANSFER
024120  004737  024472                  JSR     PC,SVRHXX       ;READ ALL REGISTERS
024124  105061  020126                  CLRB    DRVACT(R1)      ;DRRIVE SET TO IDLE
024130  005037  020176                  CLR     TRNSWT          ;CLEAR DATA TRANSFER QUEUE
024134  012737  177777  020224          MOV     #-1,DTUW        ;CLEAR THE TRANSFER DRIVE #
024142  000437                          BR      5$              ;EXIT
024144  105061  020156          2$:     CLRB    DPINT(R1)       ;CLEAR THE INITIALIZE INDICATOR
024150  105061  020136                  CLRB    DRVSTA(R1)      ;SET UNIT TO OFFLINE
024154  012763  177777  020204          MOV     #-1,TIMER(R3)   ;STOP THE TIMER
024162  004737  025354                  JSR     PC,GETREQ       ;GET THE DPB ADDRESS
024166  005702                          TST     R2              ;ANYTHING IN QUEUE
024170  001424                          BEQ     5$              ;BRANCH IF NOT
024172  052762  140000  000016          BIS     #BIT15!BIT14,16(R2) ;INFORM THE USER DRIVE NOT AVAILABLE
024200  000420                          BR      5$              ;FINISH
024202  012763  177777, 020204  3$:     MOV     #-1,TIMER(R3)   ;STOP THE TIMER
024210  105061  020166                  CLRB    DPRQS(R1)       ;CLEAR THE PORT REQUEST INDICATOR
024214  004737  025354                  JSR     PC,GETREQ       ;GET DPB ADDRESS
024220  005702                          TST     R2              ;ANYTHING IN QUEUE ?
024222  001407                          BEQ     5$              ;BRANCH IF NONE
024224  012762  100004  000016          MOV     #BIT15!BIT2,16(R2) ;INFORM USER OF PROT REQUEST TIMEOUT
024232  004737  024472          4$:     JSR     PC,SVRHXX       ;READ ALL REGISTERS
024236  004737  025260                  JSR     PC,EMPTYQ       ;CANCEL ALL QUEUE REQ
024242  012604                  5$:     MOV     (SP)+,R4        ;RESTORE R4-R1
024244  012603                          MOV     (SP)+,R3
024246  012602                          MOV     (SP)+,R2
024250  012601                          MOV     (SP)+,R1
024252  000207                          RTS     PC              ;EXIT

                                ;ROUTINE TO READ A RHXX/RP07 REGISTER
                                ;
                                ;CALL
                                ;       JSR     R4,RD.RP        ;GO READ A REGISTER
                                ;       INDEX                   ;REG. INDEX FROM BASE
                                ;       ERRADR                  ;ERROR ADDRESS--PROCESS ERROR STARTING
                                ;                               ;AT THIS ADDRESS
                                ;       RETURN                  ;CONTENTS OF REG. IS ON THE STACK
```

```
                                ;
024254                          ;RD.RP:
024254  011646                         MOV     (SP),-(SP)      ;SAVE R4
024256  013746  002660                  MOV     RPCS1,-(SP)     ;ADDRESS OF THE
024262  062416                          ADD     (R4)+,(SP)      ;REG
024264  017666  000000  000004          MOV     @(SP),4(SP)     ;READ THE CONTENTS OF THE REG
024272  013716  002660                  MOV     RPCS1,(SP)      ;CHECK IF NON-EXIST DRIVE
024276  062716  000010                  ADD     #10,(SP)        ;
024302  032776  010000  000000          BIT     #BIT12,@(SP)    ;NED BIT SET ?
024310  001004                          BNE     1$              ;ERROR EXIT
024312  032777  020000  156340          BIT     #BIT13,@RPCS1   ;MCPE SET ?
024320  001406                          BEQ     2$              ;EXIT
024322  016666  000002  000004  1$:     MOV     2(SP),4(SP)     ;MOVE THE R4 TO TOP OF STACK
024330  022626                          CMP     (SP)+,(SP)+     ;CLEAR OFF THE STACK
024332  011404                          MOV     (R4),R4 ;ERROR EXIT ADDRESS
024334  000403                          BR      3$              ;EXIT
024336  062704  000002          2$:     ADD     #2,R4           ;NORMAL EXIT
024342  005726                          TST     (SP)+           ;CLEAR OFF STACK
024344  000204                  3$:     RTS     R4              ;EXIT

                                ;ROUTINE TO WRITE A REGISTER
                                ;
                                ;CALL
                                ;       MOV     DATA,-(SP)      ;DATA TO BE LOADED ON THE STACK
                                ;       JSR     R4,WRT.RP       ;CALL THE ROUTINE TO LOAD(WRITE) THE REG.
                                ;       INDEX                   ;INDEX OF THE REGISTER TO BE LOADED
                                ;       ERRADR                  ;ADDRESS TO RETURN TO ON AN ERROR
                                ;       RETURN                  ;ERROR FREE RETURN

024346                          WRT.RP:
024346  012446                         MOV     (R4)+,-(SP)     ;FORMING THE REG ADDRESS
024350  001014                          BNE     1$              ;BRANCH IF NOT RPCS1
024352  122766  000150  000004          CMPB    #150,4(SP)      ;DATA XTRNS COMMAND ?
024360  002410                          BLT     1$              ;BRANCH IF NOT
024362  017746  156272                  MOV     @RPCS1,-(SP)    ;READ RPCS1
024366  000316                          SWAB    (SP)            ;MERG THE A17,A18,PSEL BITS
024370  042716  177770                  BIC     #^C7,(SP)       ;CHOP OFF THE REST BITS FROM RPCS1
024374  111666  000007                  MOVB    (SP),7(SP)      ;ATTACH A17,A18,PSEL TO COMMAND
024400  005726                          TST     (SP)+           ;RESTORE STACK LEVEL
024402  063716  002660          1$:     ADD     RPCS1,(SP)      ;THE DEST REG ADDRESS
024406  016676  000004  000000          MOV     4(SP),@(SP)     ;WRITE THE REGISTER
024414  013716  002660                  MOV     RPCS1,(SP)      ;CHECK NED,PAR BITS
024420  062716  000010                  ADD     #10,(SP)        ;
024424  032776  010000  000000          BIT     #BIT12,@(SP)    ;NONE EXIST DRIVE ?
024432  001013                          BNE     2$              ;BRANCH IF IT IS
024434  013716  002660                  MOV     RPCS1,(SP)      ;ADDRESS RPER1
024440  062716  000014                  ADD     #14,(SP)        ;
024444  032776  000010  000000          BIT     #BIT3,@(SP)     ;PAR SET ?
024452  001003                          BNE     2$              ;BRANCH IF SO
024454  062704  000002                  ADD     #2,R4           ;NORMAL RETURN
024460  000401                          BR      3$              ;EXIT
024462  011404                  2$:     MOV     (R4),R4         ;ERROR EXIT
024464  005726                  3$:     TST     (SP)+           ;CLEAR OFF THE STACK
024466  012616                          MOV     (SP)+,(SP)      ;MOVE R4 TO TOP OF STACK
024470  000204                          RTS     R4              ;EXIT

                                ;ROUTINE TO SAVE THE RHXX/RP07 REGISTERS AS PER DPB+14
```

```
                                        ;
                                        ;CALL
                                        ;       MOV     #DPBNUM,R2      ;DPB POINTER TO R2
                                        ;       JSR     PC,SVRHXX       ;SAVE THE DRIVES REG'S (RHXX= RH11 OR RH70)
                                        SVRHXX:
024472  004737  010646                          JSR     PC,SAVREG       ;;SAVE R0-R5
024476  005702                                  TST     R2              ;QUEUE ENTRY FOR THE DRIVE ?
024500  001451                                  BEQ     7$              ;BR IF NONE
024502  111277  156162                          MOVB    (R2),@RPCS2     ;SELECT DRIVE
024506  016203  000014                          MOV     14(R2),R3       ;GET THE ERROR TABLE POINTER
024512  001444                                  BEQ     7$              ;EXIT IF NO ADDRESS
024514  005037  024550                          CLR     3$              ;COUNTER & POINTER
024520  023727  024550  000022    1$:           CMP     3$,#22          ;REACHED THE BUFFER REGISTER ?
024526  001006                                  BNE     2$              ;BR IF NOT
024530  032777  000200  156132                  BIT     #BIT07,@RPCS2   ;'OR' SET ?
024536  001002                                  BNE     2$              ;BR IF SET
024540  005023                                  CLR     (R3)+           ;STORE RPDB AS ZEROES
024542  000405                                  BR      4$              ;CONTINUE

024544  004437  024254            2$:           JSR     R4,RD.RP        ;READ THE SELECTED REGISTER
024550  000000                    3$:           .WORD   0               ;REGISTER INDEX
024552  024576                                  5$                      ;ERROR RETURN ADDRESS
024554  012623                                  MOV     (SP)+,(R3)+     ;STORE THE REGISTER CONTENTS
024556  023727  024550  000046    4$:           CMP     3$,#46          ;REACHED THE END ?
024564  001406                                  BEQ     6$              ;BR IF YES
024566  062737  000002  024550                  ADD     #2,3$           ;INCREMENT THE REGISTER INDEX
024574  000751                                  BR      1$              ;CONTINUE READING THE REGISTERS

024576  004737  022364            5$:           JSR     PC,CI7          ;PROCESS THE UNCORRECTABLE PARITY ERROR
024602  005737  002652            6$:           TST     RHTYPE          ;IS IT RH70 ?
024606  001406                                  BEQ     7$              ;IF EQ, NO
024610  013704  002642                          MOV     RPADR,R4        ;GET RPCS1 BASE ADDRESS
024614  063704  002650                          ADD     RHEXT,R4        ;POINT TO RPBAE
024620  012423                                  MOV     (R4)+,(R3)+     ;STORE THE CONTENTS
024622  011413                                  MOV     (R4),(R3)       ;GET RPCS3
024624                            7$:
024624  004737  010700                          JSR     PC,RESREG       ;;RESTORE R0-R5
024630  000207                                  RTS     PC              ;RETURN

                                        ;ROUTINE TO SET THE INTERRUPT WITHOUT GETTING A "TRE"
                                        ;CALL
                                        ;       MOV     #DRVNUM,R1      ;DRIVE NUMBER TO R1
                                        ;       JSR     PC,SET.IE       ;SET "IE"
                                        ;       RETURN

024632  010446                          SET.IE: MOV     R4,-(SP)        ;SAVE R4
024634  013704  002660                          MOV     RPCS1,R4        ;PICKUP ADR OF RPCS1
024640  010177  156024                          MOV     R1,@RPCS2       ;SELECT DRIVE
024644  011446                                  MOV     (R4),-(SP)      ;READ RPCS1
024646  052716  040000                          BIS     #BIT14,(SP)     ;SET THE "TRE" BIT OF THE WORD READ
024652  000316                                  SWAB    (SP)            ;ADJUST FOR DATO
024654  112714  000100                          MOVB    #BIT06,(R4)     ;SET "IE"
024660  032777  010000  156002                  BIT     #BIT12,@RPCS2 ;IS "NED"=1?
024666  001002                                  BNE     1$              ;YES--CLEAR "TRE"
024670  005726                                  TST     (SP)+           ;CLEAN OFF THE STACK
024672  000402                                  BR      2$
```

```
    398 024674  112664  000001          1$:     MOVB    (SP)+,1(R4)     ;CLEAR "TRE"
    399 024700  012604                  2$:     MOV     (SP)+,R4        ;RESTORE R4
    400 024702  000207                          RTS     PC              ;RETURN TO CALLER
```

```
                                ;QUEUE COUNT
024704  000                     QCNT:   .BYTE   0               ;DRIVE 0
024705  000                             .BYTE   0               ;DRIVE 1
024706  000                             .BYTE   0               ;DRIVE 2
024707  000                             .BYTE   0               ;DRIVE 3
024710  000                             .BYTE   0               ;DRIVE 4
024711  000                             .BYTE   0               ;DRIVE 5
024712  000                             .BYTE   0               ;DRIVE 6
024713  000                             .BYTE   0               ;DRIVE 7

                                ;QUEUE INPUT POINTERS

024714  024776                  QINPT:  .WORD   QDRV0            ;DRIVE 0
024716  025016                          .WORD   QDRV1           ;DRIVE 1
024720  025036                          .WORD   QDRV2           ;DRIVE 2
024722  025056                          .WORD   QDRV3           ;DRIVE 3
024724  025076                          .WORD   QDRV4           ;DRIVE 4
024726  025116                          .WORD   QDRV5           ;DRIVE 5
024730  025136                          .WORD   QDRV6           ;DRIVE 6
024732  025156                          .WORD   QDRV7           ;DRIVE 7

                                ;QUEUE OUTPUT POINTERS

024734  024776                  QOUTPT: .WORD   QDRV0            ;DRIVE 0
024736  025016                          .WORD   QDRV1           ;DRIVE 1
024740  025036                          .WORD   QDRV2           ;DRIVE 2
024742  025056                          .WORD   QDRV3           ;DRIVE 3
024744  025076                          .WORD   QDRV4           ;DRIVE 4
024746  025116                          .WORD   QDRV5           ;DRIVE 5
024750  025136                          .WORD   QDRV6           ;DRIVE 6
024752  025156                          .WORD   QDRV7           ;DRIVE 7

024754  024776                  QSTART: .WORD   QDRV0           ;DRIVE 0 START ADDRESS
024756  025016                  QSTOP:  .WORD   QDRV1           ;DRIVE 0 STOP ADDRESS & DRIVE 1 START ADDRESS
024760  025036                          .WORD   QDRV2           ;STOP DRIVE 1--START DRIVE 2
024762  025056                          .WORD   QDRV3           ;STOP DRIVE 2--START DRIVE 3
024764  025076                          .WORD   QDRV4           ;STOP DRIVE 3--START DRIVE 4
024766  025116                          .WORD   QDRV5           ;STOP DRIVE 4--START DRIVE 5
024770  025136                          .WORD   QDRV6           ;STOP DRIVE 5--START DRIVE 6
024772  025156                          .WORD   QDRV7           ;STOP DRIVE 6--START DRIVE 7
024774  025176                          .WORD   QTERP           ;STOP DRIVE 7

                                ;DRIVE REQUEST QUEUES

024776                          QDRV0:  .BLKW   10
025016                          QDRV1:  .BLKW   10
025036                          QDRV2:  .BLKW   10
025056                          QDRV3:  .BLKW   10
025076                          QDRV4:  .BLKW   10
025116                          QDRV5:  .BLKW   10
025136                          QDRV6:  .BLKW   10
025156                          QDRV7:  .BLKW   10
        025176                  QTERP=.
```

```
                                        ;ROUTINE TO CLEAR ALL OF THE REQUEST QUEUES
                                        ;
                                        ;CALL
                                        ;       JSR     PC,CLRQUE
                                        ;
025176  004737  010646          CLRQUE: JSR     PC,SAVREG       ;SAVE R0 - R5
025202  012702  024704                  MOV     #QCNT,R2        ;ZERO THE QUEUE COUNTS
025206  005022                          CLR     (R2)+           ;DRIVES 0 & 1
025210  005022                          CLR     (R2)+           ;DRIVES 2 & 3
025212  005022                          CLR     (R2)+           ;DRIVES 4 & 5
025214  005022                          CLR     (R2)+           ;DRIVES 6 & 7
025216  012703  000010                  MOV     #8.,R3          ;MOVE THE STARTING
025222  012701  024754                  MOV     #QSTART,R1      ;ADDRESS OF THE QUEUE INTO
025226  012122                  1$:     MOV     (R1)+,(R2)+     ;THE QUEUE INPUT POINTER
025230  005303                          DEC     R3
025232  001375                          BNE     1$
025234  012703  000010                  MOV     #8.,R3          ;MOVE THE STARTING ADDRESS
025240  012701  024754                  MOV     #QSTART,R1      ;OF THE QUEUE INTO THE
025244  012122                  2$:     MOV     (R1)+,(R2)+     ;QUEUE OUTPUT POINTER
025246  005303                          DEC     R3
025250  001375                          BNE     2$
025252  004737  010700                  JSR     PC,RESREG       ;RESTORE R0 - R5
025256  000207                          RTS     PC

                                        ;EMPTY THE QUEUE SPECIFIED BY R1
                                        ;
                                        ;CALL
                                        ;       MOV     DRVNUM,R1       ;DRIVE NUMBER TO R1
                                        ;       JSR     PC,EMPTYQ
                                        ;
025260  105061  024704          EMPTYQ: CLRB    QCNT(R1)        ;CLEAR NUMBER OF ITEMS IN QUEUE
025264  006301                          ASL     R1
025266  016161  024714  024734          MOV     QINPT(R1),QOUTPT(R1) ;SET OUTPUT QUEUE POINTER=INPUT POINTER
025274  006201                          ASR     R1
025276  000207                          RTS     PC

                                        ;ROUTINE TO PUT A REQUEST IN QUEUE
                                        ;
                                        ;CALL
                                        ;       MOV     #DRVNUM,R1      ;DRIVE NUMBER
                                        ;       MOV     #DPB,R2         ;ADDRESS OF PARAMETER BLOCK
                                        ;       JSR     R4,DRVQUE       ;GO PUT REQUEST IN QUEUE
                                        ;       RETURN1                 ;RETURN HERE IF QUEUE IS FULL
                                        ;       RETURN2                 ;RETURN HERE IF REQUEST IS IN QUEUE
                                        ;
122761  000010  024704  DRVQUE: CMPB    #10,QCNT(R1)    ;IS QUEUE FULL?
001421                          BEQ     2$              ;BR IF YES-TAKE RETURN1
105261  024704                  INCB    QCNT(R1)        ;INCREMENT QUEUE COUNT
006301                          ASL     R1
010271  024714                  MOV     R2,@QINPT(R1)   ;PUT THIS REQUEST IN QUEUE
062761  000002  024714          ADD     #2,QINPT(R1)    ;UPDATE THE QUEUE POINTER
026161  024714  024756          CMP     QINPT(R1),QSTOP(R1) ;TIME TO RESET THE POINTER
001003                          BNE     1$              ;BRANCH IF NO
016161  024754  024714          MOV     QSTART(R1),QINPT(R1) ;YES--RESET POINTER
006201                  1$:     ASR     R1
005724                          TST     (R4)+           ;TAKE RETURN 2
```

```
                                2$:     RTS     R4              ;RETURN TO USER
                                ;ROUTINE TO GET THE "DPB" ADDRESS OF NEXT REQUEST IN QUEUE
                                ;
                                ;CALL
                                ;       MOV     #DRVNUM,R1      ;DRIVE NUMBER TO R1
                                ;       JSR     PC,GETREQ       ;GO GET THE REQUEST
                                ;       RETURN                  ;R2="DPB" ADDRESS OF THE REQUEST
                                ;                               ;R2=0 IF NO REQUEST IN QUEUE
                                GETREQ: CLR     R2
025354  005002
025356  105761  024704                  TSTB    QCNT(R1)        ;IS THERE ANY REQUEST IN QUEUE?
025362  001404                          BEQ     2$              ;NO---BRANCH
025364  006301                1$:       ASL     R1
025366  017102  024734                  MOV     @QOUTPT(R1),R2  ;PICKUP "DPB" POINTER FOR THIS DRIVE
025372  006201                          ASR     R1
025374  000207                2$:       RTS     PC              ;RETURN TO USER
                                ;ROUTINE TO "POP" THE REQUEST FROM QUEUE
                                ;
                                ;CALL
                                ;       MOV     #DRVNUM,R1      ;DRIVE NUMBER TO R1
                                ;       JSR     PC,POPQUE       ;CALL TO REMOVE REQUEST
                                ;       RETURN                  ;R2=ADDRESS OF DPB REMOVED
025376  105361  024704           POPQUE: DECB    QCNT(R1)        ;DECREMENT QUEUE COUNT
025402  006301                          ASL     R1
025404  017102  024734                  MOV     @QOUTPT(R1),R2  ;GET THE "DPB" POINTER
025410  005071  024734                  CLR     @QOUTPT(R1)     ;REMOVE DPB ADDRESS FROM THE QUEUE
025414  062761  000002  024734          ADD     #2,QOUTPT(R1)   ;UPDATE THE QUEUE POINTER
025422  026161  024734  024756          CMP     QOUTPT(R1),QSTOP(R1) ;TIME TO RESET THE POINTER?
025430  001003                          BNE     1$              ;NO--BRANCH TO EXIT
025432  016161  024754  024734          MOV     QSTART(R1),QOUTPT(R1) ;YES--RESET THE POINTER
025440  006201                1$:       ASR     R1
025442  000207                          RTS     PC              ;RETURN TO USER
```

```
                                .SBTTL  REPORT CODING SECTION

                                ;++
                                ; THE REPORT CODING SECTION CONTAINS THE
                                ; "PRINTS" CALLS THAT GENERATE STATISTICAL REPORTS.
                                ;--

025444                          L$RPT::

025444  000167                          .WORD   J$JMP
025446  000000                          .WORD   L10013-2-.

                                        .EVEN

025450                          L10013:
025450  104425                          TRAP    C$RPT
```

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

025452                          L$PROT::
025452  000000                            0               ;P-TABLE OFFSET OF CSR
025454  177777                            -1              ;NOT A MASSBUS DEVICE
025456  000006                            6               ;P-TABLE OFFSET DRIVE #
```

```
                                .SBTTL  INITIALIZE SECTION

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

025460                          L$INIT::
                                                                ;RESET THE WORLD
025460  104433                          TRAP    C$RESET
025462  012737  015272  002252          MOV     #ABOPAS,BYPASS  ;ABORT PASS ON DEV FATAL ERROR DETECTED IN 'ERRABO',
                                                                ;CALLED BY SFTW DRVRS
025470  012737  000001  002240          MOV     #1,ITCNT        ;RESET ITERATION COUNT
025476  005037  002242                  CLR     ISRCNT          ;CLEAR INTERRUPT COUNTER
                                                                ;POWER UP SEQUENCE ?
025502  012700  000034                  MOV     #EF.PWR,R0
025506  104447                          TRAP    C$REFG
                                                                ;GO TO 4$ IF YES
025510  103432                          BCS     4$
                                                                ;CONTINUE COMMAND ?
025512  012700  000036                  MOV     #EF.CON,R0
025516  104447                          TRAP    C$REFG
                                                                ;GO TO 1$ IF NO
025520  103002                          BCC     1$
025522  000137  026124                  JMP     CONTIN          ;GO TO 'CONTIN' IF YES
025526                          1$:             ;'STA', 'RES' OR 'NEW PASS' ?
025526  012700  000035                  MOV     #EF.NEW,R0
025532  104447                          TRAP    C$REFG
                                                                ;GO TO 3$ IF NO, MUST BE NEW 'SUB-PASS'
025534  103016                          BCC     3$
                                                                ;CR-LF
025536  012746  003054                  MOV     #CRLF,-(SP)
025542  012746  000001                  MOV     #1,-(SP)
025546  010600                          MOV     SP,R0
025550  104417                          TRAP    C$PNTF
025552  062706  000004                  ADD     #4,SP
025556  012737  177777  002640          MOV     #-1,UNIT        ;RESET UNIT COUNT
025564  012727  177777                  MOV     #-1,(PC)+       ;RESET CLOCK MESSAGE FLAG
025570  000000                  2$:     .WORD   0               ;CLOCK MESSAGE FLAG GOES HERE
025572  005237  002640          3$:     INC     UNIT            ;GET NEXT UNIT NUMBER FOR TESTING
025576  023737  002640  002012  4$:     CMP     UNIT,L$UNIT     ;OUT OF UNITS TO TEST ?
025604  002166                          BGE     ABORT           ;BR IF YES
025606  012702  000024                  MOV     #20.,R2         ;RHXX/RP07 REGISTER COUNT
025612  012703  002660                  MOV     #RPCS1,R3       ;DATA SINK
                                                                ;GET UNIT FROM HARDWARE P-TABLE
025616  013700  002640                  MOV     UNIT,R0
025622  104442                          TRAP    C$GPHRD
025624  010005                          MOV     R0,R5
025626  103361                          BCC     3$
025630  011346                          MOV     (R3),-(SP)      ;SAVE R3
025632  011546                          MOV     (R5),-(SP)      ;AND THE BASE ADDRESS
025634  166616  000002                  SUB     2(SP),(SP)      ;DERIVE NEW ADDRESS
025640  061623                  5$:     ADD     (SP),(R3)+      ;LOG IT IN NEW TABLE
025642  005302                          DEC     R2              ;COUNT LOGGING
025644  001375                          BNE     5$              ;R2 NOT ZERO, CONTINUE LOGGING
025646  004737  010732                  JSR     PC,SIZE70       ;SEE IF RH70 IS PRESENT
025652  005737  002652                  TST     RHTYPE          ;IS IT AN RH70 ?
```

```
 49 025656  001406                    BEQ     6$              ;BR IF NO
 50 025660  017702  002650             MOV     RHEXT,R2        ;GET RPBAE OFFSET
 51 025664  061502                    ADD     (R5),R2         ;ADD BASE ADDRESS TO OFFSET
 52 025666  010223                    MOV     R2,(R3)+        ;SAVE NEW RPBAE
 53 025670  005722                    TST     (R2)+           ;ADD 2
 54 025672  010213                    MOV     R2,(R3)         ;SAVE NEW RPCS3
 55
 56 025674  022626              6$:   CMP     (SP)+,(SP)+     ;RESTORE STACK
 57 025676  012537  002642             MOV     (R5)+,RPADR     ;SAVE RPCS1 BASE ADDRESS
 58 025702  012537  002644             MOV     (R5)+,RPVEC     ;SAVE INTERUPT VECTOR ADDRESS
 59 025706  012537  002646             MOV     (R5)+,RPVEC+2   ;SAVE INTERUPT PRIORITY
 60 025712  011537  002654             MOV     (R5),DRVNO      ;SETUP DRIVE NUMBER FOR UNIT N
 61
 62 025716  004737  020226             JSR     PC,RPINIT       ;INITIALIZE THE SUB-SYSTEM
 63 025722  013705  002654             MOV     DRVNO,R5        ;PICKUP DRIVE # AS AN INDEX
 64 025726  105765  020136             TSTB    DRVSTA(R5)      ;CHECK DRIVE STATUS: IF NOT AVAILABLE, TRY ANOTHER DRIVE
 65 025732  100443                    BMI     9$              ;UNSAFE BRANCH
 66 025734  001054                    BNE     10$             ;DRIVE OK
 67 025736  105765  020146             TSTB    DRVTYP(R5)      ;NED + OFL ?
 68 025742  001425                    BEQ     8$              ;NED BRANCH: NON-EXISTENT DRV
 69 025744  100012                    BPL     7$              ;OFL BRANCH: OFF-LINE
 70
 71 025746  010546                    MOV     R5,-(SP)
    025750  012746  005273             MOV     #NOTMSG,-(SP)
    025754  012746  000002             MOV     #2,-(SP)
    025760  010600                    MOV     SP,R0
    025762  104417                    TRAP    C$PNTF
    025764  062706  000006             ADD     #6,SP
 72 025770  000700                    BR      3$              ;EXIT BLOCK
 73 025772                      7$:
    025772  010546                    MOV     R5,-(SP)
    025774  012746  005240             MOV     #OFLMSG,-(SP)
    026000  012746  000002             MOV     #2,-(SP)
    026004  010600                    MOV     SP,R0
    026006  104417                    TRAP    C$PNTF
    026010  062706  000006             ADD     #6,SP
 74 026014  000666                    BR      3$              ;EXIT BLOCK
 75 026016                      8$:
    026016  010546                    MOV     R5,-(SP)
    026020  012746  005201             MOV     #NEDMSG,-(SP)
    026024  012746  000002             MOV     #2,-(SP)
    026030  010600                    MOV     SP,R0
    026032  104417                    TRAP    C$PNTF
    026034  062706  000006             ADD     #6,SP
 76 026040  000654                    BR      3$              ;EXIT BLOCK
 77 026042                      9$:
    026042  010546                    MOV     R5,-(SP)
    026044  012746  005150             MOV     #UNSMSG,-(SP)
    026050  012746  000002             MOV     #2,-(SP)
    026054  010600                    MOV     SP,R0
    026056  104417                    TRAP    C$PNTF
    026060  062706  000006             ADD     #6,SP
 78 026064  000642                    BR      3$              ;DRV NOT AVAILABLE: TRY ANOTHER
 79
 80 026066  005737  002250       10$:  TST     CLKSTA          ;DRV IS OK! WHAT CLOCK TYPE?
 81 026072  100061                    BPL     EXINIT          ;P TYPE, OK!
 82 026074  005237  025570             INC     2$              ;UPDATE, CAN CLOCK MESSAGE BE TYPED ?
```

```
 83 026100  001056                          BNE     EXINIT          ;BR IF NO
 84                                                                 ;PRINT 'NO P-CLOCK, TIMING TESTS WILL NOT BE EXECUTED'
 85 026102  012746  004232                   MOV     #NOCLK,-(SP)
    026106  012746  000001                   MOV     #1,-(SP)
    026112  010600                           MOV     SP,R0
    026114  104417                           TRAP    C$PNTF
    026116  062706  000004                   ADD     #4,SP
 86 026122  000445                          BR      EXINIT          ;SKIP NEXT INTERMEDIATE BRANCHING
 87
 88 026124                          CONTIN:                         ;SETUP RHXX/RP07 VECTOR
 89 026124  013746  002646                   MOV     RPVEC+2,-(SP)
    026130  012746  022674                   MOV     #ISRV,-(SP)
    026134  013746  002644                   MOV     RPVEC,-(SP)
    026140  012746  000003                   MOV     #3,-(SP)
    026144  104437                           TRAP    C$SVEC
    026146  062706  000010                   ADD     #10,SP
 90 026152  004737  011676                   JSR     PC,ST.CLK       ;START CLOCK
 91 026156  104432                           TRAP    C$EXIT
    026160  000320                           .WORD   L10015-.
 92
 93 026162  004737  012262          ABORT:   JSR     PC,STOPCK       ;STOP THE CLOCK
 94 026166  012777  000040  154474           MOV     #CLR,@RPCS2     ;MASSBUS INIT TO CLEAR IMPENDING INTERRUPTS
 95 026174  005737  002250                   TST     CLKSTA          ;RELEASE APPROPRIATE CLOCK VECTOR
 96 026200  001410                           BEQ     2$              ;NO CLOCK, SKIP
 97 026202  100404                           BMI     1$              ;L-CLK
 98 026204  013700  012126                   MOV     PKV,R0
    026210  104436                           TRAP    C$CVEC
 99 026212  000403                          BR      2$              ;SKIP
100 026214                          1$:
    026214  013700  012136                   MOV     LKV,R0
    026220  104436                           TRAP    C$CVEC
101 026222                          2$:
    026222  013700  002644                   MOV     RPVEC,R0
    026226  104436                           TRAP    C$CVEC
102 026230  104444                           TRAP    C$DCLN
103 026232  104432                           TRAP    C$EXIT
    026234  000244                           .WORD   L10015-.
104
105 026236  013737  002654  002540  EXINIT: MOV     DRVNO,DPB.A     ;STUFF DRIVE NUMBER IN DPB TABLES
106 026244  013737  002654  002560          MOV     DRVNO,DPB.B
107 026252  013737  002654  002600          MOV     DRVNO,DPB.C
108 026260  013737  002654  002620          MOV     DRVNO,DTADPB
109
110                                         ;PRINT DRIVE SERIAL NUMBER
111
112 026266  012701  000004                   MOV     #4,R1           ;4 DIGITS
113 026272  013777  002654  154370           MOV     DRVNO,@RPCS2    ;SELECT DRIVE
114 026300  013746  002654                   MOV     DRVNO,-(SP)
    026304  012746  004316                   MOV     #DSNMSG,-(SP)
    026310  012746  000002                   MOV     #2,-(SP)
    026314  010600                           MOV     SP,R0
    026316  104417                           TRAP    C$PNTF
    026320  062706  000006                   ADD     #6,SP
115 026324  017746  154360                   MOV     @RPSN,-(SP)     ;FETCH S/N
116 026330  005002                  3$:      CLR     R2              ;ZERO OUTPUT
117 026332  006116                           ROL     (SP)            ;PUT NEXT DIGIT INTO R2
118 026334  006102                           ROL     R2
```

```
119 026336  006116                        ROL     (SP)
120 026340  006102                        ROL     R2
121 026342  006116                        ROL     (SP)
122 026344  006102                        ROL     R2
123 026346  006116                        ROL     (SP)
124 026350  006102                        ROL     R2
125 026352  062702  000060                ADD     #'0,R2          ;MAKE RESULT ASCII
126 026356  010237  002656                MOV     R2,DRVSN        ;SAVE R2 FOR PRINT
127 026362  012746  002656                MOV     #DRVSN,-(SP)
    026366  012746  004342                MOV     #SNDIGT,-(SP)
    026372  012746  000002                MOV     #2,-(SP)
    026376  010600                        MOV     SP,R0
    026400  104417                        TRAP    C$PNTF
    026402  062706  000006                ADD     #6,SP
128 026406  005301                        DEC     R1              ;COUNT DOWN DIGIT
129 026410  003347                        BGT     3$              ;NEXT DIGIT
130 026412  005726                        TST     (SP)+           ;RESTORE STACK
131                                                               ;CR LF
132 026414  012746  003054                MOV     #CRLF,-(SP)
    026420  012746  000001                MOV     #1,-(SP)
    026424  010600                        MOV     SP,R0
    026426  104417                        TRAP    C$PNTF
    026430  062706  000004                ADD     #4,SP
133
134 026434  004737  012622                JSR     PC,LDCMD        ;LOAD COMMAND IN DPB.B, DPB.C FOR SEEK TESTS
135 026440  012737  026162  002252        MOV     #ABORT,BYPASS   ;BYPASS ROUTE ON RP DRIVER FATAL ERROR
136 026446  112737  000020  002541        MOVB    #20,DPB.A+1     ;SET 16 BIT FORMAT
137 026454  112737  000147  002542        MOVB    #SETFORM,DPB.A+2        ;SET FORMAT MODE (16 BIT)
138 026462  004437  014260                JSR     R4,CALL.A       ;GO EXECUTE THE COMMAND
139 026466  012737  015272  002252        MOV     #ABOPAS,BYPASS  ;RESTORE ABORT ADDRESS FOR 'ERRABO' DEV FATAL ERROR
140
164
165 026474  104432                        TRAP    C$EXIT
    026476  000002                        .WORD   L10015-.
166
178                                       .EVEN
179
180 026500                          L10015:
    026500  104411                        TRAP    C$INIT
```

```
                        .SBTTL  AUTODROP SECTION

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

026502                  L$AUTO::
026502                  L10016:
026502  104461                  TRAP    C$AUTO
```

```
                                .SBTTL  CLEANUP CODING SECTION

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

026504                          L$CLEAN::
                                                                ;SET PRIORITY TO 7
026504  012700  000340                  MOV     #PRI07,R0
026510  104441                          TRAP    C$SPRI
026512  012777  000040  154150          MOV     #CLR,@RPCS2     ;MASSBUS INIT TO CLEAR IMPENDING INTERRUPTS
026520  013777  002654  154142          MOV     DRVNO,@RPCS2    ;GET DRIVE NUMBER
026526  004737  012262                  JSR     PC,STOPCK       ;STOP THE CLOCK
026532  005737  002250                  TST     CLKSTA          ;RELEASE APPROPRIATE CLOCK VECTOR
026536  001410                          BEQ     2$              ;NO CLOCK, SKIP
026540  100404                          BMI     1$              ;L-CLK
                                                                ;P-CLK VECTOR RELEASE
026542  013700  012126                  MOV     PKV,R0
026546  104436                          TRAP    C$CVEC
026550  000403                          BR      2$
                                                                ;L-CLK VECTOR RELEASE
026552                          1$:
026552  013700  012136                  MOV     LKV,R0
026556  104436                          TRAP    C$CVEC
026560                          2$:                             ;RP07 VECTOR RELEASE
026560  013700  002644                  MOV     RPVEC,R0
026564  104436                          TRAP    C$CVEC
026566  104432                          TRAP    C$EXIT
026570  000002                          .WORD   L10017-.

026572                          L10017:
026572  104412                          TRAP    C$CLEAN
```

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

026574                          L$DU::

026574  000167                          .WORD   J$JMP
026576  000000                          .WORD   L10020-2-.

                                        .EVEN

026660                          L10020:
026660  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.
                                ;--

026602                          L$AU::

026602  000167                          .WORD   J$JMP
026604  000000                          .WORD   L10021-2-.

                                        .EVEN

026606                          L10021:
026606  104452                          TRAP    C$AU
```

```
                        .SBTTL  HARDWARE TESTS

                        ;*IN THE DESCRIPTIONS OF THE BELOW TESTS THE VARIABLES USED
                        ;*AND THEIR DEFAULT VALUES (UNLESS SPECIFIED OTHERWISE) ARE:
                        ;*
                        ;*MNEMONIC      VALUE           VARIABLE
                        ;*--------      -----           --------
                        ;*
                        ;*ITCNT         1               ITERATIONS
                        ;*FC            0               FIRST CYLINDER ADDRESS
                        ;*LC            629             LAST CYLINDER ADDRESS
                        ;*IC            1               INCREMENT VALUE
                        ;*NC OF NC1     FC+IC           NEW OR MODIFIED CYLINDER
                        ;*                              ADDRRESS
                        ;*NC2           LC-IC           NEW OR MODIFIED CYLINDER
                        ;*                              ADDRESS
                        ;*
                        ;*FT            0               FIRST TRACK ADDRESS
                        ;*LT            31.             LAST TRACK ADDRESS
                        ;*IT            1               INCREMENT VALUE
                        ;*NT            FT+IT           NEW OR MODIFIED TRACK ADDRESS
                        ;*
                        ;*FS            0               FIRST SECTOR ADDRESS
                        ;*LS            49.             LAST SECTOR ADDRESS

                        .SBTTL  SEEK TESTS

                        ;*THE SEEK TESTS WILL BE EXCUTED USING IMPLIED SEEKS. THESE
                        ;*IMPLIED SEEKS WILL BE PERFORMED BY "READ HEADER AND
                        ;*DATA" COMMANDS TO TRACK "FT" SECTOR "FS" OF THE DESIRED CYLINDER.
                        ;*THE WORD COUNT WILL BE SET SUCH THAT ONLY THE CYLINDER AND
                        ;*TRACK/SECTOR WORDS OF THE HEADER ARE READ.
                        ;*HOWEVER, THESE IMPLIED SEEKS CAN BE SUPERSEDED BY EXPLICIT SEEKS
                        ;*VIA OPERATOR DIALOGUE, IN WHICH CASE HEADER INFORMATION IS NOT VERIFIED.
```

```
                                .SBTTL  TEST 1: RECALIBRATE TEST
                                
                                
                                ;;*************************************************************************
                                ;*      THIS TEST WILL CAUSE THE DRIVE TO EXECUTE A RECALIBRATE
                                ;*      COMMAND CYCLE AND THEN DO A READ HEADER AND DATA COMMAND
                                ;*      TO VERIFY POSITION.
                                ;;*************************************************************************
                                
                                T1::
026610  012737  000012  002240          MOV     #10.,ITCNT      ;SET ITERATION COUNT
                                TEST1:
026616  112737  000107  002542          MOVB    #RECAL,DPB.A+2  ;RECAL=COMMAND
026624  005037  002570                  CLR     DPB.B+10        ;SEC/TRK 0
026630  005037  002572                  CLR     DPB.B+12        ;CYL 0
                                T1.1:
026634  104402                          TRAP    C$BSUB
026636  004437  014260                  JSR     R4,CALL.A       ;GO EXECUTE THE COMMAND
026642  004437  014376                  JSR     R4,CALL.B       ;GO EXECUTE THE COMMAND
026646  005337  002240                  DEC     ITCNT           ;DONE ITERATIONS ?
026652  001361                          BNE     TEST1           ;BR IF NO
                                EXIT1:
                                L10023:
026654  104403                          TRAP    C$ESUB
                                L10022:
026656  104401                          TRAP    C$ETST
```

```
                                .SBTTL  TEST 2: INCREMENT SEEK TEST
                                ;
                                ;;*************************************************************************
                                ;*      THIS TEST WILL COMMAND FORWARD SEEK CYCLES TO ADVANCE THE
                                ;*      CYLINDER ADDRESS FROM "FC" TO "LC" BY THE INCREMENT "IC".
                                ;*      WHEN THE RESULTANT CYLINDER ADDRESS (NC) EXCEEDS
                                ;*      "LC" REVERSE SEEK CYCLES ARE INITIATED; STARTING
                                ;*      AT THE LAST LEGAL "NC" AND DECREMENTING BY "IC"
                                ;*      UNTIL "NC" IS LESS THAN "FC". AT THE COMPLETION OF EACH
                                ;*      SEEK COMMAND THE PROPER INDICATORS ARE EXAMINED TO
                                ;*      ENSURE PROPER OPERATION.
                                ;;*************************************************************************
                                ;
 026660                         T2::
 026660  113737  002220  002570 1$:     MOVB    FS,DPB.B+10     ;FS
 026666  113737  002212  002571         MOVB    FT,DPB.B+11     ;FT
 026674  013737  002204  002572         MOV     FC,DPB.B+12     ;FC
 026702                         T2.11:
 026702                         T2.1:
 026702  104402                         TRAP    C$BSUB
 026704  004437  014376                 JSR     R4,CALL.B       ;GO EXECUTE THE COMMAND
 026710                         L10025:
 026710  104403                         TRAP    C$ESUB
 026712  063737  002210  002572         ADD     IC,DPB.B+12     ;MOVE TO NEXT CYLINDER
 026720  023737  002206  002572         CMP     LC,DPB.B+12     ;OUT OF CYLINDERS?
 026726  002365                         BGE     T2.11           ;NO--BRANCH
 026730  013737  002206  002572         MOV     LC,DPB.B+12
 026736                         T2.21:
 026736                         T2.2:
 026736  104402                         TRAP    C$BSUB
 026740  004437  014376                 JSR     R4,CALL.B       ;GO EXECUTE THE COMMAND
 026744                         L10026:
 026744  104403                         TRAP    C$ESUB
 026746  163737  002210  002572         SUB     IC,DPB.B+12
 026754  023737  002204  002572         CMP     FC,DPB.B+12
 026762  003765                         BLE     T2.21
 026764                         EXIT2:
 026764                         L10024:
 026764  104401                         TRAP    C$ETST
```

```
                                .SBTTL  TEST 3: RANDOM SEEK TEST
                                ;
                                ;*******************************************************************************
                                ;*      THIS TEST PERFORMS RANDOM SEEK OPERATIONS BETWEEN CYLINDERS 'FC'
                                ;*      'LC'.  AFTER EACH SEEK, THE POSITION OF THE DRIVE IS VERIFIED BY
                                ;*      READING A SECTOR FROM THE CURRENTLY ADDRESSED CYLINDER AND TRACK.
                                ;*      THE TRACK ADDRESS IS INCREMENTED FOR EACH SEEK SO THAT VERIFICATION
                                ;*      OF POSITIONING OCCURS USING EACH HEAD.  TRACK ADDRESSES ARE INCREMENTED
                                ;*      BETWEEN PARAMTERS 'FT' AND 'LT'.
                                ;*      THE RANDOM CYLINDER IS GENERATED BY USING THE 'MOD' FUNCTION:
                                ;*              X MOD Y = X - (X DIV Y) * Y
                                ;*      IF X,Y ARE INTEGERS WITH Y <> 0 THEN:
                                ;*              X MOD Y = REMAINDER OF X DIV Y
                                ;*      THE ACTUAL OPERATION PERFORMED IS:
                                ;*              FC + $RP1 MOD (LC+1)-FC
                                ;*      BY DOING:
                                ;*              CYL = FC + R
                                ;*      WHERE R IS OBTAINED BY:
                                ;*              $RP1 DIV (LC+1)-FC = Q + R
                                ;*      WHERE Q = QUOTIENT,  R = REMAINDER,  $RP1 = A RANDOM NUMBER FROM RAND CALL.
                                ;*******************************************************************************
                                T3::
026766                                  MOV     #10.,ITCNT      ;SET ITERATION COUNT
026766  012737  000012  002240          MOVB    FT,DPB.B+11     ;LOAD STARTING TRACK ADDRESS
026774  113737  002212  002571          MOVB    #SEEK,DPB.A+2   ;SEEK=COMMAND
027002  112737  000105  002542  TEST3:  MOV     FC,DPB.B+12     ;INITIAL CYLINDER ADDRESS
027010  013737  002204  002572          CMP     FC,LC           ;CYLINDER LIMITS THE SAME ?
027016  023737  002204  002206          BEQ     T3.11           ;BR IF THEY ARE
027024  001423
                                ;GENERATE A RANDOM CYLINDER
                                ;
027026  004737  011610                  JSR     PC,RAND         ;CYCLE THE RANDOM NUMBER GENERATOR
027032  013746  011672                  MOV     $RP1,-(SP)      ;USE THE HIGH RANDOM NUMBER
027036  005046                          CLR     -(SP)           ;UPPER DIVIDEND
027040  013746  002206                  MOV     LC,-(SP)        ;FORM THE DIVISOR
027044  005216                          INC     (SP)            ;INCREMENT
027046  163716  002204                  SUB     FC,(SP)         ;SUBTRACT THE LOWER LIMIT
027052  004737  011074                  JSR     PC,$DIV         ;DIVIDE
027056  062637  002572                  ADD     (SP)+,DPB.B+12  ;ADD THE REMAINDER TO THE INITIAL CYLINDER
027062  005726                          TST     (SP)+           ;DISCARD THE QUOTENT
                                ;
                                ;END OF RANDOM CYL GEN.
                                ;
027064  013737  002572  002552          MOV     DPB.B+12,DPB.A+12       ;COPY NEW CYLINDER ADDRESS
027072                          T3.1:
027072  104402                          TRAP    C$BSUB
027074                          T3.11:
027074  004437  014260                  JSR     R4,CALL.A       ;GO EXECUTE THE COMMAND
027100                          L10030:
027100  104403                          TRAP    C$ESUB
027102                          T3.2:
027102  104402                          TRAP    C$BSUB
027104  113777  002540  153556          MOVB    DPB.A,@RPCS2    ;SELECT THE DRIVE
027112  017746  153562                  MOV     @RPLA,-(SP)     ;GET THE LOOK AHEAD REGISTER
027116  006316                          ASL     (SP)            ;ALIGN THE SECTOR ADDRESS
027120  006316                          ASL     (SP)            ;ALIGN THE SECTOR ADDRESS
```

TEST 3: RANDOM SEEK TEST

```
     027122  000316                          SWAB    (SP)                ;PUT ADDRESS IN LOWER BYTE
     027124  112637  002570                  MOVB    (SP)+,DPB.B+10      ;LOAD THE DPB
     027130  013746  002264                  MOV     NS1,-(SP)           ;PUT LAST SECTOR ADDRESS ON THE STACK
     027134  122637  002570                  CMPB    (SP)+,DPB.B+10      ;NEW SECTOR ADDRESS TOO LARGE ?
     027140  103007                          BHIS    2$                  ;BR IF NOT
     027142  103403                          BLO     1$                  ;BR IF ADDRESS IS 2 GREATER
     027144  105037  002570                  CLRB    DPB.B+10            ;RESET TO SECTOR ADDRESS 0
     027150  000403                          BR      2$                  ;CONTINUE
     027152  112737  000001  002570  1$:     MOVB    #1,DPB.B+10         ;RESET ADDRESS TO SECTOR 1
     027160                          2$:
     027160  004437  014376                  JSR     R4,CALL.B           ;GO EXECUTE THE COMMAND
     027164                          L10031:
     027164  104403                          TRAP    C$ESUB
     027166  105237  002571                  INCB    DPB.B+11            ;INCREMENT THE TRACK ADDRESS
     027172  123737  002571  002214          CMPB    DPB.B+11,LT         ;MAXIMUM ?
     027200  101703                          BLOS    TEST3               ;BR IF NOT
     027202  113737  002212  002571          MOVB    FT,DPB.B+11         ;RELOAD STARTING TRACK ADDRESS
     027210  005337  002240          EXIT3:  DEC     ITCNT               ;DONE ITERATIONS ?
     027214  001275                          BNE     TEST3               ;BR IF NO
     027216                          L10027:
     027216  104401                          TRAP    C$ETST
```

```
                                .SBTTL  TEST 4: RECAL, RANDOM SEEK TEST
                                ;
                                ;;*************************************************************************
                                ;*      THIS TEST EXECUTES A RECAL COMMAND, THEN A SEEK IMPLIED IN A READ HEADER
                                ;*      AND DATA COMMAND, TO A RANDOMLY SELECTED CYLINDER.
                                ;*      THIS SEQUENCE IS REPEATED 10 TIMES.
                                ;*      THE TRACK AD OF THE RANDOMLY SELECTED CYLINDER IS INCREMENTED BY ONE,
                                ;*      STARING FROM FC, AT EACH TEST ITERATION.
                                ;*      THE RANDOM CYLINDER IS GENERATED BY USING THE 'MOD' FUNCTION:
                                ;*              X MOD Y = X - (X DIV Y) * Y
                                ;*      IF X,Y ARE INTEGERS WITH Y <> 0 THEN:
                                ;*              X MOD Y = REMAINDER OF X DIV Y
                                ;*      THE ACTUAL OPERATION PERFORMED IS:
                                ;*              FC + $RP1 MOD (LC+1)-FC
                                ;*      BY DOING:
                                ;*              CYL = FC + R
                                ;*      WHERE R IS OBTAINED BY:
                                ;*              $RP1 DIV (LC+1)-FC = Q + R
                                ;*      WHERE Q = QUOTIENT,  R = REMAINDER,  $RP1 = A RANDOM NUMBER FROM RAND CALL.
                                ;;*************************************************************************
                                ;
027220                          T4::
027220  012737  000012  002240          MOV     #10.,ITCNT      ;SET ITERATION COUNT
027226  113737  002212  002571          MOVB    FT,DPB.B+11     ;LOAD STARTING TRACK ADDRESS
027234  112737  000107  002542          MOVB    #RECAL,DPB.A+2  ;RECAL=COMMAND
027242  013737  002204  002572  TEST4:  MOV     FC,DPB.B+12     ;INITIAL CYLINDER ADDRESS
                                ;
                                ;GENERATE A RANDOM CYLINDER
                                ;
027250  004737  011610                  JSR     PC,RAND         ;CYCLE THE RANDOM NUMBER GENERATOR
027254  013746  011672                  MOV     $RP1,-(SP)      ;USE THE HIGH RANDOM NUMBER
027260  005046                          CLR     -(SP)           ;UPPER DIVIDEND
027262  013746  002206                  MOV     LC,-(SP)        ;FORM THE DIVISOR
027266  005216                          INC     (SP)            ;INCREMENT
027270  163716  002204                  SUB     FC,(SP)         ;SUBTRACT THE LOWER LIMIT
027274  004737  011074                  JSR     PC,$DIV         ;DIVIDE
027300  062637  002572                  ADD     (SP)+,DPB.B+12  ;ADD THE REMAINDER TO THE INITIAL CYLINDER
027304  005726                          TST     (SP)+           ;DISCARD THE QUOTENT
                                ;
                                ;END OF RANDOM CYL GEN.
027306                          T4.1:
027306  104402                          TRAP    C$BSUB
027310  004437  014260                  JSR     R4,CALL.A       ;GO EXECUTE THE COMMAND
027314                          L10033:
027314  104403                          TRAP    C$ESUB
027316                          T4.2:
027316  104402                          TRAP    C$BSUB
027320  113777  002540  153342          MOVB    DPB.A,@RPCS2    ;SELECT THE DRIVE
027326  017746  153346                  MOV     @RPLA,-(SP)     ;GET THE LOOK AHEAD REGISTER
027332  006316                          ASL     (SP)            ;ALIGN THE SECTOR ADDRESS
027334  006316                          ASL     (SP)            ;ALIGN THE SECTOR ADDRESS
027336  000316                          SWAB    (SP)            ;PUT ADDRESS IN LOWER BYTE
027340  112637  002570          1$:     MOVB    (SP)+,DPB.B+10  ;LOAD THE DPB
027344  013746  002264                  MOV     NS1,-(SP)       ;PUT LAST SECTOR ADDRESS ON THE STACK
027350  122637  002570                  CMPB    (SP)+,DPB.B+10  ;NEW SECTOR ADDRESS TOO LARGE ?
027354  103007                          BHIS    3$              ;BR IF NOT
027356  103403                          BLO     2$              ;BR IF ADDRESS IS 2 GREATER
```

```
     027360  105037  002570                  CLRB    DPB.B+10        ;RESET TO SECTOR ADDRESS 0
     027364  000403                          BR      3$              ;CONTINUE
                                     2$:     MOVB    #1,DPB.B+10     ;RESET ADDRESS TO SECTOR 1
                                     3$:
     027374  004437  014376                  JSR     R4,CALL.B       ;GO EXECUTE THE COMMAND
                                     L10034:
     027400  104403                          TRAP    C$ESUB
     027402  105237  002571                  INCB    DPB.B+11        ;INCREMENT THE TRACK ADDRESS
     027406  123737  002571  002214          CMPB    DPB.B+11,LT     ;MAXIMUM ?
     027414  101712                          BLOS    TEST4           ;BR IF NOT
     027416  113737  002212  002571          MOVB    FT,DPB.B+11     ;RELOAD STARTING TRACK ADDRESS
     027424  005337  002240          EXIT4:  DEC     ITCNT           ;DONE ITERATIONS ?
     027430  001304                          BNE     TEST4           ;BR IF NO
                                     L10032:
     027432  104401                          TRAP    C$ETST
```

```
                                .SBTTL  TEST 5: DIFFERENTIAL SEEK TEST
                                ;;*************************************************************************
                                ;*      THIS TEST CONSISTS OF 3 SUBTESTS TO TEST THE HEAD POSITIONER AND SERVO
                                ;*      SYSTEM RESPONSE TO 3 UNIQUE DIFFERENTIAL SEEK PROFILES:
                                ;*      1. 6 CYL DIF SEEK:  FORCES A SLEW RATE CHANGE BY SEEKING FROM CYL 0 TO 5,
                                ;*      2 TO 7, ... 624 TO 629, TO TEST THE POSITIONAL LOGIC.
                                ;*
                                ;*      2. 33 CYL DIF SEEK:  WORST CASE SEEK OVERSHOOT TEST, FORCED BY SEEKING
                                ;*      FROM CYL 0 TO 32, 1 TO 33, 2 TO 34, ... 597 TO 629.
                                ;*
                                ;*      3. 400 CYL DIF SEEK:  FORCES MAX ACCELERATION AND DECELERATION OF CARRIAGE
                                ;*      ASSEMBLY, FORCED BY SEEKING FROM CYL 0 TO 399, 1 TO 400, 2 TO 401, ...
                                ;*      230 TO 629.
                                ;;*************************************************************************

027434                          T5::
027434  113737  002220  002570          MOVB    FS,DPB.B+10     ;FIRST SEEK OF THE PAIR OF SEEKS READS FS, FT
027442  113737  002212  002571          MOVB    FT,DPB.B+11
027450  113737  002222  002610          MOVB    LS,DPB.C+10     ;SECOND SEEK OF THE PAIR OF SEEKS READS LS, LT
027456  113737  002214  002611          MOVB    LT,DPB.C+11

                                        ;6 CYL DIFF SEEK

027464  005037  002572          TEST5:  CLR     DPB.B+12        ;FIRST SEEK STARTS AT 0
027470  012737  000005  002612          MOV     #5,DPB.C+12     ;SECOND SEEK IS TO FIRST CYL + 5
027476                          T5.1:
027476  104402                          TRAP    C$BSUB
027500                          T5.11:
027500  004437  014376                  JSR     R4,CALL.B       ;GO EXECUTE THE COMMAND
027504                          L10036:
027504  104403                          TRAP    C$ESUB
027506                          T5.2:
027506  104402                          TRAP    C$BSUB
027510  004437  014560                  JSR     R4,CALL.C       ;GO EXECUTE THE COMMAND
027514                          L10037:
027514  104403                          TRAP    C$ESUB
027516  005237  002572                  INC     DPB.B+12        ;NEXT CYL OF FIRST SEEK
027522  005237  002612                  INC     DPB.C+12        ;NEXT CYL OF SECOND SEEK
027526  023737  002256  002612          CMP     NC1,DPB.C+12    ;REACHED LAST USER CYL ON SECOND(LAST?) SEEK?
027534  002361                          BGE     T5.11           ;NOT YET, REPEAT ABOVE SEQ UNTIL OUT OF CYL

                                        ;33 CYL DIFF SEEK

027536  005037  002572                  CLR     DPB.B+12        ;FIRST SEEK STARTS AT 0
027542  012737  000040  002612          MOV     #32.,DPB.C+12   ;SECOND SEEK IS TO FIRST CYL + 32.
027550                          T5.3:
027550  104402                          TRAP    C$BSUB
027552                          T5.31:
027552  004437  014376                  JSR     R4,CALL.B       ;GO EXECUTE THE COMMAND
027556                          L10040:
027556  104403                          TRAP    C$ESUB
027560                          T5.4:
027560  104402                          TRAP    C$BSUB
027562  004437  014560                  JSR     R4,CALL.C       ;GO EXECUTE THE COMMAND
027566                          L10041:
027566  104403                          TRAP    C$ESUB
```

```
                                                ;NEXT CYL OF FIRST SEEK
                                                ;NEXT CYL OF SECOND SEEK
                                                ;REACHED LAST USER CYL ON SECOND(LAST?) SEEK?
                                                ;NOT YET, REPEAT ABOVE SEQ UNTIL OUT OF CYL

                                                ;400 CYL DIFF SEEK

                                                ;FIRST SEEK STARTS AT 0
                                                ;SECOND SEEK IS TO FIRST CYL + 399.
T5.5:
                                                
T5.51:
                                                ;GO EXECUTE THE COMMAND
L10042:
                                                
T5.6:
                                                
                                                ;GO EXECUTE THE COMMAND
L10043:
                                                
                                                ;NEXT CYL OF FIRST SEEK
                                                ;NEXT CYL OF SECOND SEEK
                                                ;REACHED LAST USER CYL ON SECOND(LAST?) SEEK?
                                                ;NOT YET, REPEAT ABOVE SEQ UNTIL OUT OF CYL
EXIT5:
L10035:
                                                
```

```
                                        .SBTTL  TEST 6: OSCILLATING SEEK TEST
                                        ;;*************************************************************************
                                        ;*      THIS TEST PERFORMS A SERIES OF SEEK OPERATIONS TO CAUSE AN OSCILLATING
                                        ;*      MOVEMENT OF THE HEAD POSITIONER.
                                        ;;*************************************************************************
027664                                  T6::
027664  113737  002220  002570                MOVB    FS,DPB.B+10     ;FS
027672  113737  002212  002571                MOVB    FT,DPB.B+11     ;FT
027700  113737  002222  002610                MOVB    LS,DPB.C+10     ;LS
027706  113737  002214  002611                MOVB    LT,DPB.C+11     ;LT
027714  013737  002204  002572  TEST6:        MOV     FC,DPB.B+12     ;FC
027722  013737  002206  002612                MOV     LC,DPB.C+12     ;LC
027730                                  T6.1:
027730  104402                                TRAP    C$BSUB
027732                                  T6.11:
027732  004437  014376                        JSR     R4,CALL.B       ;GO EXECUTE THE COMMAND
027736                                  L10045:
027736  104403                                TRAP    C$ESUB
027740                                  T6.2:
027740  104402                                TRAP    C$BSUB
027742  004437  014560                        JSR     R4,CALL.C       ;GO EXECUTE THE COMMAND
027746                                  L10046:
027746  104403                                TRAP    C$ESUB
027750  005237  002572                        INC     DPB.B+12
027754  005337  002612                        DEC     DPB.C+12
027760  023737  002612  002204                CMP     DPB.C+12,FC     ;UNTIL
027766  002361                                BGE     T6.11
027770                                  EXIT6:
027770                                  L10044:
027770  104401                                TRAP    C$ETST
```

```
                                .SBTTL  TIMING TESTS

                                ;;*******************************************************************************
                                ;*THE TIMING TESTS WILL ENSURE THAT THOSE FUNCTIONS BEING
                                ;*TIMED ARE WITHIN THE TOLERANCES SPECIFIED IN THE "RP07
                                ;*ENGINEERING SPECIFICATIONS".
                                ;*THE SEEK TIMING WILL BE PERFORMED USING EXPLICIT SEEK
                                ;*OPERATIONS. AT THE COMPLETION OF EACH OF THE TIMING
                                ;*TESTS THE MINIMUM, MAXIMUM AND AVERAGE TIMES WILL BE
                                ;*TYPED, IF TIMTYP=1.

                                .SBTTL  TEST 7: ROTATIONAL SPEED TIMING TEST

                                ;;*******************************************************************************
                                ;*      THIS TEST WILL START A SEARCH TO CYLINDER FC, TRACK FT, SECTOR
                                ;*      FS.  AS SOON AS THE INTERRUPT OCCURS, THE GO BIT IS SET AGAIN
                                ;*      AND THE OPERATION IS TIMED.  THIS PROCEDURE IS REPEATED 10
                                ;*      TIMES THEN THE AVERAGE TIME IS CALCULATED AND CHECKED TO
                                ;*      ENSURE IT IS WITHIN TOLERANCE:
                                ;*              16.515 MS/REV + OR - 3%
                                ;;*******************************************************************************

 027772                         T7::
 027772  005737  002250                 TST     CLKSTA          ;KW11-P CLOCK?
 027776  003002                         BGT     1$              ;YES--START TEST
 030000  104432                         TRAP    C$EXIT
 030002  001044                         .WORD   L10047-.
 030004  004437  015476         1$:     JSR     R4,SRCH00       ;DO A MASSBUS INIT & RECAL
 030010  000402                         BR      2$              ;RETURN HERE IF NO ERROR
 030012  000137  031020                 JMP     EXIT7           ;RETURN HERE IF ERROR

 030016  005005                 2$:     CLR     R5              ;COUNT UP
 030020  012703  002432                 MOV     #T7A,R3         ;TIMING LIMITS
 030024  012701  000012         TEST7:  MOV     #10.,R1         ;TIME 10 SEARCHES
 030030  004737  015626                 JSR     PC,STRTMR       ;INITIALIZE THE TIMERS
 030034  004737  012262                 JSR     PC,STOPCK       ;STOP THE CLOCK
                                                                 ;SETUP VECTOR IN CASE OF CLOCK OVERFLOW
 030040  012746  000300                 MOV     #PR106,-(SP)
 030044  012746  030660                 MOV     #T7.7$,-(SP)
 030050  013746  012126                 MOV     PKV,-(SP)
 030054  012746  000003                 MOV     #3,-(SP)
 030060  104437                         TRAP    C$SVEC
 030062  062706  000010                 ADD     #10,SP
                                                                 ;SETUP RHXX/RP07 VECTOR
 030066  012746  000000                 MOV     #PRI00,-(SP)
 030072  012746  015624                 MOV     #DORTI,-(SP)
 030076  013746  002644                 MOV     RPVEC,-(SP)
 030102  012746  000003                 MOV     #3,-(SP)
 030106  104437                         TRAP    C$SVEC
 030110  062706  000010                 ADD     #10,SP
 030114  013777  002204  152572         MOV     FC,@RPDC        ;FC
 030122  013746  002220                 MOV     FS,-(SP)        ;FS
 030126  113766  002212  000001         MOVB    FT,1(SP)        ;FT
 030134  012677  152526                 MOV     (SP)+,@RPDA     ;LOAD FT/FS
 030140                         T7.1:
 030140  104402                         TRAP    C$BSUB
 030142  005077  161754         T7.1$:  CLR     @PKB            ;START COUNTING AT ZERO
```

```
030146  012777  000131  161744          MOV     #131,@PKCS      ;INT.EN., COUNT UP AT 100KHZ
030154  012777  000131  152476          MOV     #SEARCH,@RPCS1  ;START A SEARCH
030162  000001                          WAIT                    ;WAIT ON INTERRUPT
030164  017746  161734                  MOV     @PKC,-(SP)      ;SAVE THE CLOCK
030170  042777  000101  161722          BIC     #101,@PKCS      ;STOP THE CLOCK
030176  012677  161720                  MOV     (SP)+,@PKB      ;AND RESTORE THE COUNTED VALUE
030202  032777  040000  152462          BIT     #BIT14,@RPDS    ;ERROR?
030210  001516                          BEQ     T7.2$           ;NO--BRANCH
030212  004737  010646                  JSR     PC,SAVREG       ;;SAVE R0-R5
030216  012702  002620                  MOV     #DTADPB,R2      ;DTB POINTER
030222  004737  024472                  JSR     PC,SVRHXX       ;SAVE ALL THE RHXX/RP07 REGISTERS
030226  012777  000040  152434          MOV     #CLR,@RPCS2     ;MASSBUS CLEAR
030234  013777  002620  152426          MOV     DTADPB,@RPCS2   ;SELECT DRIVE
030242  004737  010700                  JSR     PC,RESREG       ;;RESTORE R0-R5
030246  004537  012664                  JSR     R5,ERRANY
030252  002620                          DTADPB                  ;FIND OUT WHAT ERROR
030254                          L10050:
030254  104403                          TRAP    C$ESUB
030256  032737  000210  002254          BIT     #BIT3!BIT7,SVSTAT       ;RETRY ALLOWED ?
030264  001022                          BNE     T7.44$          ;BRANCH IS SO
030266                          T7.10$:
030266  012746  004422                  MOV     #SEAERR,-(SP)
030272  012746  000001                  MOV     #1,-(SP)
030276  010600                          MOV     SP,R0
030300  104417                          TRAP    C$PNTF
030302  062706  000004                  ADD     #4,SP
030306  012746  004525                  MOV     #ABOTST,-(SP)
030312  012746  000001                  MOV     #1,-(SP)
030316  010600                          MOV     SP,R0
030320  104417                          TRAP    C$PNTF
030322  062706  000004                  ADD     #4,SP
030326  000137  030764                  JMP     T7.8$

030332  012737  000020  002340  T7.44$: MOV     #16.,WCEFLG     ;RETRY 16 TIMES
030340  012777  000131  152312  1$:     MOV     #SEARCH,@RPCS1
030346  000001                          WAIT                    ;WAIT FOR INTERRUPT
030350  032777  040000  152314          BIT     #BIT14,@RPDS    ;ANY ERROR ?
030356  001433                          BEQ     T7.2$           ;EXIT IF NONE
030360  012777  000040  152302          MOV     #CLR,@RPCS2     ;MASSBUS CLEAR
030366  013777  002620  152274          MOV     DTADPB,@RPCS2   ;DRIVE ADDRESS
030374  005337  002340                  DEC     WCEFLG          ;OVER RETRY LIMIT ?
030400  001357                          BNE     1$              ;BRANCH IF NOT
030402                          T7.20$:
030402  012746  004461                  MOV     #SEABAD,-(SP)
030406  012746  000001                  MOV     #1,-(SP)
030412  010600                          MOV     SP,R0
030414  104417                          TRAP    C$PNTF
030416  062706  000004                  ADD     #4,SP
030422  012746  004525                  MOV     #ABOTST,-(SP)
030426  012746  000001                  MOV     #1,-(SP)
030432  010600                          MOV     SP,R0
030434  104417                          TRAP    C$PNTF
030436  062706  000004                  ADD     #4,SP
030442  000550                          BR      T7.8$           ;EXIT
030444                          T7.2:
030444  104402                          TRAP    C$BSUB
030446  005077  161450          T7.2$:  CLR     @PKB            ;START THE COUNT AT ZERO
```

```
     030452  012777  000131  152200          MOV     #SEARCH,@RPCS1  ;START A SEARCH
     030460  012777  000131  161432          MOV     #131,@PKCS      ;START THE CLOCK
     030466  000001                          WAIT                    ;WAIT ON INTERRUPT
     030470  017746  161430                  MOV     @PKC,-(SP)      ;SAVE THE CLOCK
     030474  042777  000101  161416          BIC     #101,@PKCS      ;STOP THE CLOCK
     030502  012677  161414                  MOV     (SP)+,@PKB      ;AND RESTORE THE COUNTED VALUE
     030506  032777  040000  152156          BIT     #BIT14,@RPDS    ;IS "ERR=1"?
     030514  001453                          BEQ     T7.3$           ;NO--BRANCH
     030516  004737  010646                  JSR     PC,SAVREG       ;;SAVE R0-R5
     030522  012702  002620                  MOV     #DTADPB,R2      ;DPB POINTER
     030526  004737  024472                  JSR     PC,SVRHXX       ;SAVE ALL THE RHXX/RP07 REGISTERS
     030532  012777  000040  152130          MOV     #CLR,@RPCS2     ;MASSBUS CLEAR
     030540  013777  002620  152122          MOV     DTADPB,@RPCS2   ;SELECT DRIVE
     030546  004737  010700                  JSR     PC,RESREG       ;;RESTORE R0-R5
     030552  004537  012664                  JSR     R5,ERRANY       ;FIND OUT WHAT ERROR
     030556  002620                          DTADPB
     030560                          L10051:
     030560  104403                          TRAP    C$ESUB
     030562  032737  000210  002254          BIT     #BIT3!BIT7,SVSTAT       ;RETRY ALLOWED ?
     030570  001636                          BEQ     T7.10$          ;BRANCH IF NOT, ABORT TEST
     030572  012737  000020  002340          MOV     #16.,WCEFLG     ;RETRY 16 TIMES
     030600  012777  000131  152052  1$:     MOV     #SEARCH,@RPCS1  ;START TO SEARCH
     030606  000001                          WAIT
     030610  032777  040000  152054          BIT     #BIT14,@RPDS    ;ANY ERROR
     030616  001412                          BEQ     T7.3$           ;BRANCH IF NONE
     030620  012777  000040  152042          MOV     #CLR,@RPCS2     ;MASS BUS CLEAR
     030626  013777  002620  152034          MOV     DTADPB,@RPCS2   ;LOAD THE DRIVE ADDRESS
     030634  005337  002340                  DEC     WCEFLG          ;DECREMENT THE RETRY COUNT
     030640  001357                          BNE     1$              ;BRANCH IF NOT OVER THE LIMIT
     030642  000657                          BR      T7.20$          ;EXIT

     030644  004737  016076          T7.3$:  JSR     PC,COUNT        ;UPDATE THE COUNT
     030650  005301                          DEC     R1              ;DONE?
     030652  003444                          BLE     T7.8$           ;YES--GO TO THE EXIT
     030654  000137  030142                  JMP     T7.1$           ;NO, LOOP

     030660  004737  012324          T7.7$:  JSR     PC,FORSEC       ;RESET TIMER TO 4 SEC, CHANGE CLK SERVICE AD
                                             ;DROP THE PRIORITY
     030664  012700  000000                  MOV     #PRI00,R0
     030670  104441                          TRAP    C$SPRI
     030672  004737  010646                  JSR     PC,SAVREG       ;;SAVE R0-R5
     030676  012702  002620                  MOV     #DTADPB,R2      ;DPB POINTER
     030702  004737  024472                  JSR     PC,SVRHXX       ;SAVE ALL THE RHXX/RP07 REGISTERS
     030706  012777  000040  151754          MOV     #CLR,@RPCS2     ;MASSBUS CLEAR
     030714  013777  002620  151746          MOV     DTADPB,@RPCS2   ;SELECT DRIVE
     030722  016102  000014                  MOV     14(R1),R2       ;ADDRESS OF SAVED REGISTER TABLE
     030726  016237  000036  002266          MOV     36(R2),CYL.RD   ;GET CURRENT CYLINDER
     030734  116237  000006  002272          MOVB    6(R2),SEC.RD    ;GET CURRENT SECTOR
     030742  116237  000007  002270          MOVB    7(R2),TRK.RD    ;GET CURRENT TRACK
     030750  004737  010700                  JSR     PC,RESREG       ;;RESTORE R0-R5
     030754  104456                          TRAP    C$ERHRD
     030756  000024                          .WORD   20
     030760  006112                          .WORD   EM20
     030762  007604                          .WORD   DH44
     030764                          T7.8$:
     030764  012777  000040  151676          MOV     #CLR,@RPCS2     ;CLEAR THE MASSBUS
     030772  013777  002620  151670          MOV     DTADPB,@RPCS2   ;& SELECT DRIVE
```

```
    114 031000  004737  011676                JSR     PC,ST.CLK       ;INITIALIZE THE CLOCK
    115 031004  004437  016370                JSR     R4,TYPTIM       ;GO TYPE THE TIMES
        031010  002432                        T7A                     ;POINTER
    116 031012  004437  016240                JSR     R4,SPTYP        ;TYPE THE SPECIFICATION VALUE
    117 031016  002502                        SP7
    118 031020                          EXIT7:                        ;SETUP RHXX/RP07 VECTOR
    119 031020  013746  002646                MOV     RPVEC+2,-(SP)
        031024  012746  022674                MOV     #ISRV,-(SP)
        031030  013746  002644                MOV     RPVEC,-(SP)
        031034  012746  000003                MOV     #3,-(SP)
        031040  104437                        TRAP    C$SVEC
        031042  062706  000010                ADD     #10,SP
    120 031046                          L10047:
        031046  104401                        TRAP    C$ETST
```

```
                                .SBTTL  TEST 8: ONE CYLINDER SEEK TIMING TEST
                                ;
                                ;;*************************************************************************
                                ;*      THIS TEST WILL COMMAND FORWARD SEEK CYCLES TO ADVANCE THE
                                ;*      CYLINDER BY ONE FROM FC  UNTIL THE INCREMENT IS GREATER THAN THE
                                ;*      CYLINDER 'LC', THEN REVERSE SEEK TO CYLINDER 'FC'. DO IT TWICE.
                                ;*      THE TIME TO PERFORM EACH SEEK IS CHECKED TO ENSURE IT DOES NOT
                                ;*      EXCEED THE MAXIMUM TIME PERMITTED FOR A ONE CYLINDER SEEK.
                                ;*      THE TIME MUST BE LESS THAN 4MS.
                                ;;*************************************************************************
                                ;
031050                          T8::
031050  005737  002250                TST     CLKSTA          ;KW11-P CLOCK?
031054  003002                        BGT     1$              ;YES--START TEST
031056  104432                        TRAP    C$EXIT
031060  000756                        .WORD   L10052-.
031062  004437  015476        1$:     JSR     R4,SRCH00       ;DO A MASSBUS INIT. AND RECAL
031066  000402                        BR      2$              ;NO ERROR RETURN
031070  104432                        TRAP    C$EXIT
031072  000744                        .WORD   L10052-.
031074  012703  002442        2$:     MOV     #TIMT10,R3      ;PARAMETER POINTER
031100  005037  002246        TEST8:  CLR     DOTWO           ;SET-UP FOR TWO ITERATIONS
031104  013737  002204  002632        MOV     FC,DTADPB+12    ;START WITH BEGINNING CYLINDER
031112  005737  002204                TST     FC              ;IF FC <> 0
031116  001407                        BEQ     T8.5$           ;ELSE SKIP
031120  012737  000105  002622        MOV     #SEEK,DTADPB+2  ;THEN SEEK TO FC BEFORE TIMING PORTION OF TEST
031126                          T8.1:
031126  104402                        TRAP    C$BSUB
031130  004437  014742                JSR     R4,DRVCAL       ;SEEK TO FC
031134                          L10053:
031134  104403                        TRAP    C$ESUB
031136  005005                T8.5$:  CLR     R5              ;SET THE UP/DOWN SWITCH TO UP
031140  004737  015626                JSR     PC,STRTMR       ;INITIALIZE THE TIMERS
031144  004737  012262                JSR     PC,STOPCK       ;STOP THE CLOCK
                                                            ;SETUP VECTOR IN CASE OF CLOCK OVERFLOW
031150  012746  000300                MOV     #PRI06,-(SP)
031154  012746  031650                MOV     #T8.7$,-(SP)
031160  013746  012126                MOV     PKV,-(SP)
031164  012746  000003                MOV     #3,-(SP)
031170  104437                        TRAP    C$SVEC
031172  062706  000010                ADD     #10,SP
                                                            ;SETUP RHXX/RP07 VECTOR
031176  012746  000000                MOV     #PRI00,-(SP)
031202  012746  015624                MOV     #DORTI,-(SP)
031206  013746  002644                MOV     RPVEC,-(SP)
031212  012746  000003                MOV     #3,-(SP)
031216  104437                        TRAP    C$SVEC
031220  062706  000010                ADD     #10,SP
                                ;
                                ;SEEK FORWARD:  FC --> LC
                                ;
031224  005237  002632        T8.1$:  INC     DTADPB+12       ;MOVE TO NEXT CYLINDER UP
031230  023737  002632  002206        CMP     DTADPB+12,LC    ;OUT OF CYLINDERS?
031236  003063                        BGT     T8.3$           ;YES, GO SEEK REVERSE
031240                          T8.2:
031240  104402                        TRAP    C$BSUB
031242  005077  160654                CLR     @PKB            ;START THE COUNTER AT ZERO
```

```
 43 031246  013777  002632  151440          MOV     DTADPB+12,@RPDC ;LOAD DESIRED CYLINDER
 44 031254  012777  000105  151376          MOV     #SEEK,@RPCS1    ;START A SEEK
 45 031262  012777  000131  160630          MOV     #131,@PKCS      ;START THE CLOCK
 46 031270  000001                          WAIT                    ;WAIT ON INTERRUPT
 47 031272  017746  160626                  MOV     @PKC,-(SP)      ;GET THE CURRENT COUNT
 48 031276  042777  000101  160614          BIC     #101,@PKCS      ;STOP THE CLOCK
 49 031304  012677  160612                  MOV     (SP)+,@PKB      ;AND RESTORE THE VALUE
 50 031310  032777  040000  151354          BIT     #BIT14,@RPDS    ;ANY DISK ERRORS?
 51 031316  001426                          BEQ     T8.2$           ;NO--BRANCH
 52 031320  004737  010646                  JSR     PC,SAVREG       ;;SAVE R0-R5
    031324  012702  002620                  MOV     #DTADPB,R2      ;DPB POINTER
    031330  004737  024472                  JSR     PC,SVRHXX       ;SAVE ALL THE RHXX/RP07 REGISTERS
    031334  012777  000040  151326          MOV     #CLR,@RPCS2     ;MASSBUS CLEAR
    031342  013777  002620  151320          MOV     DTADPB,@RPCS2   ;SELECT DRIVE
    031350  004737  010700                  JSR     PC,RESREG       ;;RESTORE R0-R5
 53 031354  004537  012664                  JSR     R5,ERRANY       ;FIND OUT WHAT ERROR
 54 031360  002620                          DTADPB
 55 031362                          L10054:
    031362  104403                          TRAP    C$ESUB
 56 031364  032737  000040  002254          BIT     #BIT5,SVSTAT    ;POSITION ERROR?
 57 031372  001075                          BNE     T8.9$           ;YES, ABORT TEST
 58 031374  004737  016076          T8.2$:  JSR     PC,COUNT        ;COUNT THIS SEEKS TIME
 59 031400  004737  012450                  JSR     PC,TWOMS        ;STALL TWO MILLISECONDS
 60 031404  000707                          BR      T8.1$           ;LOOP, SEEK FORWARD
 61 031406  005337  002632          T8.3$:  DEC     DTADPB+12       ;MOVE TO NEXT CYLINDER DOWN
 62 031412  012705  177777                  MOV     #-1,R5          ;SET UP/DOWN SWITCH TO DOWN
 63
 64                                         ;SEEK REVERSE:  FC <-- LC
 65
 66 031416  005337  002632          T8.4$:  DEC     DTADPB+12       ;MOVE TO NEXT CYLINDER DOWN
 67 031422  023737  002632  002204          CMP     DTADPB+12,FC    ;OUT OF CYLINDERS?
 68 031430  002474                          BLT     T8.6$           ;YES, EXIT LOOP
 69 031432                          T8.3:
    031432  104402                          TRAP    C$BSUB
 70 031434  005077  160462                  CLR     @PKB            ;START THE COUNTER AT ZERO
 71 031440  013777  002632  151246          MOV     DTADPB+12,@RPDC ;LOAD DESIRED CYLINDER
 72 031446  012777  000105  151204          MOV     #SEEK,@RPCS1    ;START A SEEK
 73 031454  012777  000131  160436          MOV     #131,@PKCS      ;START THE CLOCK
 74 031462  000001                          WAIT                    ;WAIT ON INTERRUPT
 75 031464  017746  160434                  MOV     @PKC,-(SP)      ;GET THE CURRENT COUNT
 76 031470  042777  000101  160422          BIC     #101,@PKCS      ;STOP THE CLOCK
 77 031476  012677  160420                  MOV     (SP)+,@PKB      ;AND RESTORE THE VALUE
 78 031502  032777  040000  151162          BIT     #BIT14,@RPDS    ;ANY DISK ERRORS?
 79 031510  001437                          BEQ     T8.10$          ;NO--BRANCH
 80 031512  004737  010646                  JSR     PC,SAVREG       ;;SAVE R0-R5
    031516  012702  002620                  MOV     #DTADPB,R2      ;DPB POINTER
    031522  004737  024472                  JSR     PC,SVRHXX       ;SAVE ALL THE RHXX/RP07 REGISTERS
    031526  012777  000040  151134          MOV     #CLR,@RPCS2     ;MASSBUS CLEAR
    031534  013777  002620  151126          MOV     DTADPB,@RPCS2   ;SELECT DRIVE
    031542  004737  010700                  JSR     PC,RESREG       ;;RESTORE R0-R5
 81 031546  004537  012664                  JSR     R5,ERRANY       ;FIND OUT WHAT ERROR
 82 031552  002620                          DTADPB
 83 031554                          L10055:
    031554  104403                          TRAP    C$ESUB
 84 031556  032737  000040  002254          BIT     #BIT5,SVSTAT    ;POSITION ERROR?
 85 031564  001411                          BEQ     T8.10$          ;NO, CONTINUE
 86 031566                          T8.9$:
```

```
                031566  012746  004544                  MOV     #POSERR,-(SP)
                031572  012746  000001                  MOV     #1,-(SP)
                031576  010600                          MOV     SP,R0
                031600  104417                          TRAP    C$PNTF
                031602  062706  000004                  ADD     #4,SP
     87         031606  000462                          BR      T8.8$
     88         031610  004737  016076          T8.10$: JSR     PC,COUNT        ;COUNT THIS SEEKS TIME
     89         031614  004737  012450                  JSR     PC,TWOMS        ;STALL TWO MILLISECONDS
     90         031620  000676                          BR      T8.4$           ;LOOP, SEEK REVERSE
     91         031622  005237  002632          T8.6$:  INC     DTADPB+12       ;MOVE TO NEXT CYLINDER
     92         031626  005737  002246                  TST     DOTWO           ;DONE TWICE?
     93         031632  100450                          BMI     T8.8$           ;IF MINUS, YES...
     94         031634  012737  177777  002246          MOV     #-1,DOTWO       ;MARK THE FIRST ITERATION
     95         031642  005005                          CLR     R5              ;SEEK FORWARD AGAIN
     96         031644  000137  031224                  JMP     T8.1$           ;NOW!!!
     97
     98         031650  004737  012324          T8.7$:  JSR     PC,FORSEC       ;RESET TIMER TO 4 SEC, CHANGE CLK SERVICE AD
     99                                                                          ;DROP THE PRIORITY
    100         031654  012700  000000                  MOV     #PRI00,R0
                031660  104441                          TRAP    C$SPRI
    101         031662  004737  010646                  JSR     PC,SAVREG       ;;SAVE R0-R5
                031666  012702  002620                  MOV     #DTADPB,R2      ;DPB POINTER
                031672  004737  024472                  JSR     PC,SVRHXX       ;SAVE ALL THE RHXX/RP07 REGISTERS
                031676  012777  000040  150764          MOV     #CLR,@RPCS2     ;MASSBUS CLEAR
                031704  013777  002620  150756          MOV     DTADPB,@RPCS2   ;SELECT DRIVE
                031712  016102  000014                  MOV     14(R1),R2       ;ADDRESS OF SAVED REGISTER TABLE
                031716  016237  000036  002266          MOV     36(R2),CYL.RD   ;GET CURRENT CYLINDER
                031724  116237  000006  002272          MOVB    6(R2),SEC.RD    ;GET CURRENT SECTOR
                031732  116237  000007  002270          MOVB    7(R2),TRK.RD    ;GET CURRENT TRACK
                031740  004737  010700                  JSR     PC,RESREG       ;;RESTORE R0-R5
    102         031744  104456                          TRAP    C$ERHRD
                031746  000024                          .WORD   20
                031750  006112                          .WORD   EM20
                031752  007604                          .WORD   DH44
    103         031754                  T8.8$:
                031754  012777  000040  150706          MOV     #CLR,@RPCS2     ;CLEAR THE MASSBUS
                031762  013777  002620  150700          MOV     DTADPB,@RPCS2   ;& SELECT DRIVE
    104         031770  004737  011676                  JSR     PC,ST.CLK       ;INITIALIZE THE CLOCK
    105         031774  004437  016370                  JSR     R4,TYPTIM       ;GO TYPE THE TIMES
                032000  002442                          TIMT10                  ;POINTER
    106         032002  004437  016240                  JSR     R4,SPTYP
    107         032006  002510                          SP10
    108                                                                         ;SETUP RHXX/RP07 VECTOR
    109         032010  013746  002646                  MOV     RPVEC+2,-(SP)
                032014  012746  022674                  MOV     #ISRV,-(SP)
                032020  013746  002644                  MOV     RPVEC,-(SP)
                032024  012746  000003                  MOV     #3,-(SP)
                032030  104437                          TRAP    C$SVEC
                032032  062706  000010                  ADD     #10,SP
    110         032036                  L10052:
                032036  104401                          TRAP    C$ETST
```

```
                        .SBTTL  TEST 9: AVERAGE SEEK TIME MEASUREMENT TEST
                        ;
                        ;;*************************************************************************
                        ;       THIS TEST WILL MEASURE THE AVERAGE SEEK TIME AS FOLLOWS:
                        ;
                        ;                 2 X [ (T1 X 629) + (T2 X 628) + (T3 X 627) +....+ (T629 X 1)]
                        ;       T (AVG)=-------------------------------------------------------------
                        ;                                   629 X 629
                        ;
                        ;       WHERE:  THE TN IS THE MEASURED TIME INTERVAL FOR SEEKING FROM
                        ;                 CYLINDER 0 TO CYLINDER N OR FROM CYL N TO CYL 0.
                        ;               2X629 IS THE TOTAL NUMBER OF SEEKS.
                        ;;*************************************************************************
                        ;
032040                  T9::
032040  005737  002250          TST     CLKSTA          ;KW11-P CLOCK?
032044  003002                  BGT     1$              ;YES--START TEST
032046  104432                  TRAP    C$EXIT
032050  000702                  .WORD   L10056-.
032052  004437  015476  1$:     JSR     R4,SRCH00       ;DO A MASSBUS INIT & RECAL
032056  000402                  BR      2$              ;RETURN HERE IF NO ERROR
032060  104432                  TRAP    C$EXIT
032062  000670                  .WORD   L10056-.
032064  012703  002452  2$:     MOV     #TIMT11,R3      ;PARAMETER POINTER
032070  013701  002256  TEST9:  MOV     NC1,R1          ;COUNT AND COEFFICIENT
032074  004737  015626          JSR     PC,STRTMR       ;INIT. THE COUNTERS
032100  004737  012262          JSR     PC,STOPCK       ;STOP THE CLOCK
                                                        ;SETUP VECTOR IN CASE OF CLOCK OVERFLOW
032104  012746  000300          MOV     #PRI06,-(SP)
032110  012746  032536          MOV     #T9.7$,-(SP)
032114  013746  012126          MOV     PKV,-(SP)
032120  012746  000003          MOV     #3,-(SP)
032124  104437                  TRAP    C$SVEC
032126  062706  000010          ADD     #10,SP
                                                        ;SETUP RHXX/RP07 VECTOR
032132  012746  000000          MOV     #PRI00,-(SP)
032136  012746  015624          MOV     #DORTI,-(SP)
032142  013746  002644          MOV     RPVEC,-(SP)
032146  012746  000003          MOV     #3,-(SP)
032152  104437                  TRAP    C$SVEC
032154  062706  000010          ADD     #10,SP
032160  005037  032754          CLR     INCCYL          ;INITIALIZE THE SEEK CYLINDER ADDRESS
032164  005237  032754  T9.1$:  INC     INCCYL          ;INCREMENT THE SEEK CYLINDER ADDRESS
032170  013777  032754  150516  MOV     INCCYL,@RPDC    ;SEEK ADDRESS
032176  005077  157720          CLR     @PKB            ;START COUNT AT ZERO
032202                  T9.1:
032202  104402                  TRAP    C$BSUB
032204  012777  000105  150446  MOV     #SEEK,@RPCS1    ;START A SEEK
032212  012777  000131  157700  MOV     #131,@PKCS      ;START THE CLOCK
032220  000001                  WAIT                    ;WAIT ON INTERRUPT
032222  017746  157676          MOV     @PKC,-(SP)      ;STORE THE COUNTED VALUE
032226  042777  000101  157664  BIC     #101,@PKCS      ;STOP CLOCK
032234  012677  157662          MOV     (SP)+,@PKB      ;AND RESTORE THE COUNT
032240  032777  040000  150424  BIT     #BIT14,@RPDS    ;ERR=1?
032246  001426                  BEQ     T9.2$           ;NO--BRANCH
032250  004737  010646          JSR     PC,SAVREG       ;;SAVE R0-R5
032254  012702  002620          MOV     #DIADPB,R2      ;DPB POINTER
```

TEST 9: AVERAGE SEEK TIME MEASUREMENT TEST

```
                032260  004737  024472                  JSR     PC,SVRHXX       ;SAVE ALL THE RHXX/RP07 REGISTERS
                032264  012777  000040  150376          MOV     #CLR,@RPCS2     ;MASSBUS CLEAR
                032272  013777  002620  150370          MOV     DTADPB,@RPCS2   ;SELECT DRIVE
                032300  004737  010700                  JSR     PC,RESREG       ;;RESTORE R0-R5
            44  032304  004537  012664                  JSR     R5,ERRANY       ;FINDOUT WHAT ERROR
            45  032310  002620                          DTADPB
            46  032312                          L10057:
                032312  104403                          TRAP    C$ESUB
            47  032314  032737  000040  002254          BIT     #BIT5,SVSTAT    ;POSITION ERROR?
            48  032322  001063                          BNE     T9.4$           ;YES, ABORT TEST
            49  032324  005005                  T9.2$:  CLR     R5              ;SET UP/DOWN SWITCH TO UP
            50  032326  004737  015676                  JSR     PC,COUNT2       ;UPDATE THE COUNT
            51  032332  004737  012450                  JSR     PC,TWOMS        ;STALL 2 MSEC
            52  032336                          T9.2:
                032336  104402                          TRAP    C$BSUB
            53  032340  005077  157556                  CLR     @PKB            ;START THE COUNT AT ZERO
            54  032344  012777  000000  150342          MOV     #0,@RPDC        ;ALWAYS SEEK BACK TO THE FIRST CYLINDER
            55  032352  012777  000105  150300          MOV     #SEEK,@RPCS1    ;START A SEEK
            56  032360  012777  000131  157532          MOV     #131,@PKCS      ;START THE CLOCK
            57  032366  000001                          WAIT                    ;WAIT ON INTERRUPT
            58  032370  017746  157530                  MOV     @PKC,-(SP)      ;SAVE THE CLOCK VALUE
            59  032374  042777  000101  157516          BIC     #101,@PKCS      ;STOP THE CLOCK
            60  032402  012677  157514                  MOV     (SP)+,@PKB      ;NOW RESTORE THE VALUE
            61  032406  032777  040000  150256          BIT     #BIT14,@RPDS    ;ERR=1?
            62  032414  001437                          BEQ     T9.3$           ;NO--BRANCH
            63  032416  004737  010646                  JSR     PC,SAVREG       ;;SAVE R0-R5
                032422  012702  002620                  MOV     #DTADPB,R2      ;DPB POINTER
                032426  004737  024472                  JSR     PC,SVRHXX       ;SAVE ALL THE RHXX/RP07 REGISTERS
                032432  012777  000040  150230          MOV     #CLR,@RPCS2     ;MASSBUS CLEAR
                032440  013777  002620  150222          MOV     DTADPB,@RPCS2   ;SELECT DRIVE
                032446  004737  010700                  JSR     PC,RESREG       ;;RESTORE R0-R5
            64  032452  004537  012664                  JSR     R5,ERRANY       ;FIND OUT WHAT ERROR
            65  032456  002620                          DTADPB
            66  032460                          L10060:
                032460  104403                          TRAP    C$ESUB
            67  032462  032737  000040  002254          BIT     #BIT5,SVSTAT    ;POSITION ERROR?
            68  032470  001411                          BEQ     T9.3$           ;NO, CONTINUE
            69  032472                          T9.4$:
                032472  012746  004544                  MOV     #POSERR,-(SP)
                032476  012746  000001                  MOV     #1,-(SP)
                032502  010600                          MOV     SP,R0
                032504  104417                          TRAP    C$PNTF
                032506  062706  000004                  ADD     #4,SP
            70  032512  000466                          BR      T9.8$
            71  032514  012705  177777          T9.3$:  MOV     #-1,R5          ;SET UP/DOWN SWITCH TO DOWN
            72  032520  004737  015676                  JSR     PC,COUNT2       ;UPDATE THE COUNT
            73  032524  004737  012450                  JSR     PC,TWOMS        ;STALL 2 MSEC
            74  032530  005301                          DEC     R1              ;DONE?
            75  032532  003214                          BGT     T9.1$           ;NO--BRANCH
            76  032534  000455                          BR      T9.8$           ;YES--EXIT
            77
            78  032536  004737  012324          T9.7$:  JSR     PC,FORSEC       ;RESET TIMER TO 4 SEC, CHANGE CLK SERVICE AD
            79                                                                  ;DROP THE PRIORITY
            80  032542  012700  000000                  MOV     #PRI00,R0
                032546  104441                          TRAP    C$SPRI
            81  032550  004737  010646                  JSR     PC,SAVREG       ;;SAVE R0-R5
                032554  012702  002620                  MOV     #DTADPB,R2      ;DPB POINTER
```

```
        032560  004737  024472                  JSR     PC,SVRHXX       ;SAVE ALL THE RHXX/RP07 REGISTERS
        032564  012777  000040  150076          MOV     #CLR,@RPCS2     ;MASSBUS CLEAR
        032572  013777  002620  150070          MOV     DTADPB,@RPCS2   ;SELECT DRIVE
        032600  016102  000014                  MOV     14(R1),R2       ;ADDRESS OF SAVED REGISTER TABLE
        032604  016237  000036  002266          MOV     36(R2),CYL.RD   ;GET CURRENT CYLINDER
        032612  116237  000006  002272          MOVB    6(R2),SEC.RD    ;GET CURRENT SECTOR
        032620  116237  000007  002270          MOVB    7(R2),TRK.RD    ;GET CURRENT TRACK
        032626  004737  010700                  JSR     PC,RESREG       ;;RESTORE R0-R5
    82                                                                  ;SETUP RHXX/RP07 VECTOR
    83  032632  013746  002646                  MOV     RPVEC+2,-(SP)
        032636  012746  022674                  MOV     #ISRV,-(SP)
        032642  013746  002644                  MOV     RPVEC,-(SP)
        032646  012746  000003                  MOV     #3,-(SP)
        032652  104437                          TRAP    C$SVEC
        032654  062706  000010                  ADD     #10,SP
    84  032660  104456                          TRAP    C$ERHRD
        032662  000024                          .WORD   20
        032664  006112                          .WORD   EM20
        032666  007604                          .WORD   DH44
    85  032670                          T9.8$:
        032670  012777  000040  147772          MOV     #CLR,@RPCS2     ;CLEAR THE MASSBUS
        032676  013777  002620  147764          MOV     DTADPB,@RPCS2   ;& SELECT DRIVE
    86  032704  004737  011676                  JSR     PC,ST.CLK       ;INITIALIZE THE CLOCK
    87  032710  004437  016370                  JSR     R4,TYPTIM       ;GO TYPE THE TIMES
        032714  002452                          TIMT11                  ;POINTER
    88  032716  004437  016240                  JSR     R4,SPTYP
    89  032722  002516                          SP11
    90                                                                  ;SETUP RHXX/RP07 VECTOR
    91  032724  013746  002646                  MOV     RPVEC+2,-(SP)
        032730  012746  022674                  MOV     #ISRV,-(SP)
        032734  013746  002644                  MOV     RPVEC,-(SP)
        032740  012746  000003                  MOV     #3,-(SP)
        032744  104437                          TRAP    C$SVEC
        032746  062706  000010                  ADD     #10,SP
    92  032752                          L10056:
        032752  104401                          TRAP    C$ETST
    93
    94  032754  000000                  INCCYL: .WORD   0               ;CYL ADR COUNTER
```

```
                        .SBTTL  TEST 10: MAXIMUM SEEK TIMING TEST
                        ;
                        ;;*************************************************************************
                        ;*      THIS TEST WILL COMMAND A FORWARD SEEK FROM CYLINDER 0 TO
                        ;*      CYLINDER 'LC', THEN A REVERSE SEEK FROM CYLINDER 'LC' TO
                        ;*      CYLINDER 0.  BOTH SEEKS ARE TIMED AND CHECKED TO ENSURE
                        ;*      THEY ARE WITHIN THE TOLERANCE ALLOWED FOR THE MAXIMUM SEEK
                        ;*      TIME.  THIS SEQUENCE IS REPEATED 512 TIMES (FOR
                        ;*      A TOTAL OF 1024 SEEKS).  THE MAXIMUM SEEK TIME MUST BE LESS THAN
                        ;*      46 MS.  'LC' DEFAULTS TO 629 (10)
                        ;*      FOR RP07'S.
                        ;;*************************************************************************
                        ;
032756                  T10::
032756  005737  002250          TST     CLKSTA          ;KW11-P CLOCK
032762  003002                  BGT     1$              ;YES--START TEST
032764  104432                  TRAP    C$EXIT
032766  000642                  .WORD   L10061-.
032770  004437  015476  1$:     JSR     R4,SRCH00       ;DO A MASSBUS INIT & RECAL
032774  000402                  BR      2$              ;RETURN HERE IF NO ERROR
032776  104432                  TRAP    C$EXIT
033000  000630                  .WORD   L10061-.
033002  012703  002462  2$:     MOV     #TIMT12,R3      ;PARAMETER POINTER
033006  012701  001000  TEST10: MOV     #512.,R1        ;REPEAT "0-'LC'-0" 512 TIMES
033012  004737  015626          JSR     PC,STRTMR       ;INIT. THE TIMERS
033016  004737  012262          JSR     PC,STOPCK       ;STOP THE CLOCK
                                                        ;SETUP VECTOR IN CASE OF CLOCK OVERFLOW
033022  012746  000300          MOV     #PRI06,-(SP)
033026  012746  033442          MOV     #T10.7$,-(SP)
033032  013746  012126          MOV     PKV,-(SP)
033036  012746  000003          MOV     #3,-(SP)
033042  104437                  TRAP    C$SVEC
033044  062706  000010          ADD     #10,SP
                                                        ;SETUP RHXX/RP07 VECTOR
033050  012746  000000          MOV     #PRI00,-(SP)
033054  012746  015624          MOV     #DORTI,-(SP)
033060  013746  002644          MOV     RPVEC,-(SP)
033064  012746  000003          MOV     #3,-(SP)
033070  104437                  TRAP    C$SVEC
033072  062706  000010          ADD     #10,SP
033076                  T10.1:
033076  104402                  TRAP    C$BSUB
033100  005077  157016  T10.1$: CLR     @PKB            ;START COUNTING FROM ZERO
033104  013777  002206  147602  MOV     LC,@RPDC        ;MAXIMUM CYLINDER
033112  012777  000105  147540  MOV     #SEEK,@RPCS1    ;START A SEEK
033120  012777  000131  156772  MOV     #131,@PKCS      ;START THE CLOCK
033126  000001                  WAIT                    ;WAIT ON INTERRUPT
033130  017746  156770          MOV     @PKC,-(SP)      ;SAVE THE CLOCK
033134  042777  000101  156756  BIC     #101,@PKCS      ;STOP THE CLOCK
033142  012677  156754          MOV     (SP)+,@PKB      ;AND RESTORE THE COUNTED VALUE
033146  032777  040000  147516  BIT     #BIT14,@RPDS    ;ERR=1?
033154  001426                  BEQ     T10.2$          ;NO--BRANCH
033156  004737  010646          JSR     PC,SAVREG       ;;SAVE R0-R5
033162  012702  002620          MOV     #DTADPB,R2      ;DPB POINTER
033166  004737  024472          JSR     PC,SVRHXX       ;SAVE ALL THE RHXX/RP07 REGISTERS
033172  012777  000040  147470  MOV     #CLR,@RPCS2     ;MASSBUS CLEAR
033200  013777  002620  147462  MOV     DTADPB,@RPCS2   ;SELECT DRIVE
```

```
                033206  004737  010700                  JSR     PC,RESREG       ;;RESTORE R0-R5
     41         033212  004537  012664                  JSR     R5,ERRANY       ;FIND OUT WHAT ERROR
     42         033216  002620                          DTADPB
     43         033220                          L10062:
                033220  104403                          TRAP    C$ESUB
     44         033222  032737  000040  002254          BIT     #BIT5,SVSTAT    ;POSITION ERROR?
     45         033230  001062                          BNE     T10.4$          ;YES, ABORT TEST
     46         033232  005005                  T10.2$: CLR     R5              ;SET THE UP/DOWN SWITCH TO UP
     47         033234  004737  016076                  JSR     PC,COUNT        ;UP THE COUNT
     48         033240  004737  012450                  JSR     PC,TWOMS        ;STALL FOR TWO MILLISEC
     49         033244                          T10.2:
                033244  104402                          TRAP    C$BSUB
     50         033246  005077  156650                  CLR     @PKB            ;START COUNT AT ZERO
     51         033252  005077  147436                  CLR     @RPDC           ;BEGINNING CYLINDER IS 0
     52         033256  012777  000105  147374          MOV     #SEEK,@RPCS1    ;START A SEEK
     53         033264  012777  000131  156626          MOV     #131,@PKCS      ;START THE CLOCK
     54         033272  000001                          WAIT                    ;WAIT ON INTERRUPT
     55         033274  017746  156624                  MOV     @PKC,-(SP)      ;SAVE THE CLOCK
     56         033300  042777  000101  156612          BIC     #101,@PKCS      ;STOP THE CLOCK
     57         033306  012677  156610                  MOV     (SP)+,@PKB      ;NOW RESTORE CLOCK
     58         033312  032777  040000  147352          BIT     #BIT14,@RPDS    ;"ERR"=1?
     59         033320  001437                          BEQ     T10.3$          ;NO--BRANCH
     60         033322  004737  010646                  JSR     PC,SAVREG       ;;SAVE R0-R5
                033326  012702  002620                  MOV     #DTADPB,R2      ;DPB POINTER
                033332  004737  024472                  JSR     PC,SVRHXX       ;SAVE ALL THE RHXX/RP07 REGISTERS
                033336  012777  000040  147324          MOV     #CLR,@RPCS2     ;MASSBUS CLEAR
                033344  013777  002620  147316          MOV     DTADPB,@RPCS2   ;SELECT DRIVE
                033352  004737  010700                  JSR     PC,RESREG       ;;RESTORE R0-R5
     61         033356  004537  012664                  JSR     R5,ERRANY       ;FIND OUT WHAT ERROR
     62         033362  002620                          DTADPB
     63         033364                          L10063:
                033364  104403                          TRAP    C$ESUB
     64         033366  032737  000040  002254          BIT     #BIT5,SVSTAT    ;POSITION ERROR?
     65         033374  001411                          BEQ     T10.3$          ;NO, CONTINUE
     66         033376                          T10.4$:
                033376  012746  004544                  MOV     #POSERR,-(SP)
                033402  012746  000001                  MOV     #1,-(SP)
                033406  010600                          MOV     SP,R0
                033410  104417                          TRAP    C$PNTF
                033412  062706  000004                  ADD     #4,SP
     67         033416  000453                          BR      T10.8$
     68         033420  012705  177777          T10.3$: MOV     #-1,R5          ;SET THE UP/DOWN SWITCH TO DOWN
     69         033424  004737  016076                  JSR     PC,COUNT        ;UPDATE THE COUNT
     70         033430  004737  012450                  JSR     PC,TWOMS        ;STALL FOR TWO MILLISEC
     71         033434  005301                          DEC     R1              ;DONE?
     72         033436  003220                          BGT     T10.1$          ;NO--BRANCH
     73         033440  000442                          BR      T10.8$          ;YES--EXIT
     74
     75         033442  004737  012324          T10.7$: JSR     PC,FORSEC       ;RESET TIMER TO 4 SEC, CHANGE CLK SERVICE AD
     76                                                                          ;DROP THE PRIORITY
     77         033446  012700  000000                  MOV     #PRI00,R0
                033452  104441                          TRAP    C$SPRI
     78         033454  004737  010646                  JSR     PC,SAVREG       ;;SAVE R0-R5
                033460  012702  002620                  MOV     #DTADPB,R2      ;DPB POINTER
                033464  004737  024472                  JSR     PC,SVRHXX       ;SAVE ALL THE RHXX/RP07 REGISTERS
                033470  012777  000040  147172          MOV     #CLR,@RPCS2     ;MASSBUS CLEAR
                033476  013777  002620  147164          MOV     DTADPB,@RPCS2   ;SELECT DRIVE
```

```
033504  016102  000014                  MOV     14(R1),R2       ;ADDRESS OF SAVED REGISTER TABLE
033510  016237  000036  002266          MOV     36(R2),CYL.RD   ;GET CURRENT CYLINDER
033516  116237  000006  002272          MOVB    6(R2),SEC.RD    ;GET CURRENT SECTOR
033524  116237  000007  002270          MOVB    7(R2),TRK.RD    ;GET CURRENT TRACK
033532  004737  010700                  JSR     PC,RESREG       ;;RESTORE R0-R5
 79 033536  104456                      TRAP    C$ERHRD
033540  000024                          .WORD   20
033542  006112                          .WORD   EM20
033544  007604                          .WORD   DH44
 80 033546                      T10.8$:
033546  012777  000040  147114          MOV     #CLR,@RPCS2     ;CLEAR THE MASSBUS
033554  013777  002620  147106          MOV     DTADPB,@RPCS2   ;& SELECT DRIVE
 81 033562  004737  011676              JSR     PC,ST.CLK       ;INITIALIZE THE CLOCK
 82 033566  004437  016370              JSR     R4,TYPTIM       ;GO TYPE THE TIMES
033572  002462                          TIMT12                  ;POINTER
 83 033574  004437  016240              JSR     R4,SPTYP
 84 033600  002524                      SP12
 85                                                             ;SETUP RHXX/RP07 VECTOR
 86 033602  013746  002646              MOV     RPVEC+2,-(SP)
033606  012746  022674                  MOV     #ISRV,-(SP)
033612  013746  002644                  MOV     RPVEC,-(SP)
033616  012746  000003                  MOV     #3,-(SP)
033622  104437                          TRAP    C$SVEC
033624  062706  000010                  ADD     #10,SP
 87 033630                      L10061:
033630  104401                          TRAP    C$ETST
```

```
                                .SBTTL  TEST 11: MID-TRANSFER SEEK TEST
                                ;
                                ;*************************************************************************
                                ;THIS TEST EXECUTES READ-DATA COMMMANDS TO EVERY TRACK IN THE
                                ;FIRST(STARTING) CYLINDER.
                                ;
                                ;THE FULL TRACK TRANSFER IS MADE IN 2 PASSES:
                                ;       1ST PASS, SECTORS:  00. THRU 24.
                                ;       2ND PASS, SECTORS:  25. THRU (49. +1)
                                ;
                                ;THE PARAMETERS:
                                ;       STARTING CYLINDER       = FC
                                ;       STARTING TRACK          = FT
                                ;       ENDING TRACK            = LT
                                ;       INCREMENT TRACK         = 1
                                ;       STARTING SECTOR         = 0
                                ;
                                ;*************************************************************************
                                T11::
033632  004737  020226                  JSR     PC,RPINIT       ;INITIALIZE THE SUB-SYSTEM
033636  004737  012262                  JSR     PC,STOPCK       ;STOP THE CLOCK
033642  113737  002654  002620          MOVB    DRVNO,DTADPB    ;DRIVE ADDRESS
033650  112737  000171  002622          MOVB    #RDDAT,DTADPB+2 ;READ-DATA COMMAND
033656  013737  002344  002624          MOV     TRKWC,DTADPB+4  ;ASSUME HALF FULL TRACK
033664  012737  042610  002626          MOV     #DBUFF,DTADPB+6 ;BUFFER ADDRESS
033672  112737  000000  002630          MOVB    #0,DTADPB+10    ;SECTOR ADDR
033700  113737  002212  002631          MOVB    FT,DTADPB+11    ;TRACK ADDR
033706  013737  002204  002632          MOV     FC,DTADPB+12    ;CYLINDER ADDRESS
033714  012737  002744  002634          MOV     #REG,DTADPB+14  ;RHXX/RP07 REGISTER
033722  005037  002246                  CLR     DOTWO           ;RESET 2 ITERATIONS CONTROL
033726                          T11.1:
033726  104402                  TRAP    C$BSUB
033730                          T11.2$:
033730  004437  014742                  JSR     R4,DRVCAL       ;START A DATA TRANSFER
033734  005737  002246                  TST     DOTWO           ;DONE HALF TRACK TWICE?
033740  100411                          BMI     2$              ;YES, EXIT 2 ITERATIONS LOOP
033742  005337  002246                  DEC     DOTWO           ;NO, MARK 2ND ITERATION
033746  112737  000031  002630          MOVB    #25.,DTADPB+10  ;TFR 2ND HALF OF TRACK
033754  062737  177400  002624          ADD     #-256.,DTADPB+4 ;YES, SET WC FOR 2ND HALF TRACK + 1 SECTOR
033762  000762                  1$:     BR      T11.2$          ;LOOP TO TFR 2ND HALF TTRACK

033764  005037  002246          2$:     CLR     DOTWO           ;RESET PARAMETERS FOR 1ST LOOP
033770  105037  002630                  CLRB    DTADPB+10       ;RESTART AT SECTOR 0
033774  162737  177400  002624          SUB     #-256.,DTADPB+4 ;WC FOR 1ST HALF TRACK
034002                          L10065:
034002  104403                  TRAP    C$ESUB
034004  113702  002631          T11.5$: MOVB    DTADPB+11,R2    ;UPDATE THE TRACK ADDRESS
034010  063702  002216                  ADD     IT,R2           ;ADD THE DESIRED TRACK NUMBER
034014  023702  002214                  CMP     LT,R2           ;OVER THE TRACK LIMIT?
034020  101403                          BLOS    EXIT11          ;BRANCH IF SO
034022  110237  002631                  MOVB    R2,DTADPB+11    ;TO NEXT TRACK
034026  000740                          BR      T11.2$          ;LOOP BACK
034030  004737  020226          EXIT11: JSR     PC,RPINIT
034034                          L10064:
034034  104401                  TRAP    C$ETST
```

```
                                .SBTTL  TEST 12: ERROR REGISTER BIT TEST

                                ;;*************************************************************************
                                ;*      THIS TEST FORCES LBT & AOE ERROR BITS THAT ARE NOT FULLY CHECKED BY THE
                                ;*        MICRO DIAGNOSTICS
                                ;*      LBT,AOE:  READ THE LAST USER SECTOR WITH A WORD COUNT >256.
                                ;;*************************************************************************

 034036                         T12::
 034036  004737  020226                 JSR     PC,RPINIT       ;INITIALIZE THE SUB-SYSTEM
 034042  004737  012262                 JSR     PC,STOPCK       ;STOP THE CLOCK
 034046  113737  002654  002620         MOVB    DRVNO,DTADPB    ;DRIVE AD
 034054  112737  000171  002622         MOVB    #RDDAT,DTADPB+2 ;SET READ CMD IN DPB
 034062  012737  177400  002624         MOV     #SCTRWC,DTADPB+4        ;SET WORD COUNT TO READ ONE SECTOR
 034070  012737  042610  002626         MOV     #DBUFF,DTADPB+6 ;DATA BUFFER
 034076  113737  002264  002630         MOVB    NS1,DTADPB+10   ;SET LAST USER SECTOR IN DPB
 034104  113737  002262  002631         MOVB    NT1,DTADPB+11   ;I.E., CYL 629, TRK 31, SEC 49
 034112  013737  002256  002632         MOV     NC1,DTADPB+12
 034120  012737  002744  002634         MOV     #REG,DTADPB+14  ;POINT TO RHXX/RP07 REG TABLE SAVED ON CMD DONE
 034126                         T12.1:
 034126  104402                 TRAP    C$BSUB
 034130  004737  015044                 JSR     PC,EXECMD       ;EXEC CMD
 034134  032762  002000  000012         BIT     #LST,12(R2)     ;LBT=1?
 034142  001005                         BNE     TST12           ;OK, SKIP
 034144  104456                 TRAP    C$ERHRD
 034146  000062                 .WORD   50
 034150  007246                 .WORD   EM50
 034152  000000                 .WORD   0
 034154                         L10067:
 034154  104403                 TRAP    C$ESUB
 034156  032762  040000  000012 TST12:  BIT     #ERR,12(R2)     ;OTHER ERRORS?
 034164  001403                         BEQ     1$              ;NO, SKIP
 034166  004537  012664                 JSR     R5,ERRANY       ;YES, FLAG THEM
 034172  002620                         DTADPB
 034174  062737  177400  002624 1$:     ADD     #SCTRWC,DTADPB+4        ;SET DPB TO READ BEYOND LAST SECTOR
 034202                         T12.2:
 034202  104402                 TRAP    C$BSUB
 034204  004737  015044                 JSR     PC,EXECMD       ;ATTEMPT TO READ PAST LAST SECTOR
 034210  032762  001000  000014         BIT     #AOE,14(R2)     ;AOE=1?
 034216  001005                         BNE     TST12A          ;OK, SKIP
 034220  104456                 TRAP    C$ERHRD
 034222  000063                 .WORD   51
 034224  007340                 .WORD   EM51
 034226  000000                 .WORD   0
 034230                         L10070:
 034230  104403                 TRAP    C$ESUB
 034232  042762  001000  000014 TST12A: BIC     #AOE,14(R2)     ;CLEAR ERROR IN ERROR TABLE
 034240  001005                         BNE     1$              ;FLAG OTHER ERROR, IF ANY
 034242  032762  000200  000042         BIT     #DVC,42(R2)     ;(ER2)(ER3) = 0 ?
 034250  001001                         BNE     1$              ;NO, FLAG OTHER ERRORS
 034252  000403                         BR      2$              ;SKIP ON (ER1)(ER2)(ER3) = 0
 034254  004537  012664         1$:     JSR     R5,ERRANY       ;FLAG ERRORS
 034260  002620                         DTADPB
 034262                         2$:
 034262                         EXIT12:
 034262                         L10066:
 034262  104401                 TRAP    C$ETST
```

```
                                .SBTTL  TEST 13: OFFSET/RETURN-TO-CENTER-LINE TEST
                                ;
                                ;;*************************************************************************
                                ;*      ISSUE AN OFFSET COMMAND, PROCESS THE ATTENTION INTERRUPT AND CHECK FOR
                                ;*      ERRORS,VERIFY THE ASSERTION OF OM OF RPDS.
                                ;*      ISSUE THE RETURN TO CENTER LINE COMMAND, PROCESS THE ATTENTION INTERRUPT
                                ;*      AND CHECK FOR ERRORS, VERIFY THE RESETTING OF OM.
                                ;;*************************************************************************
                                ;
034264                          T13::
034264  004737  020226          T13.1:  JSR     PC,RPINIT       ;INITIALIZE THE SUB-SYSTEM
034270  012737  000012  002240          MOV     #10.,ITCNT      ;SET ITERATION COUNT
034276  013737  002654  002620  TEST13: MOV     DRVNO,DTADPB    ;GET DRIVE NUMBER
034304  113737  002220  002630          MOVB    FS,DTADPB+10    ;OPERATE ON FS,FT,FC
034312  113737  002212  002631          MOVB    FT,DTADPB+11
034320  013737  002204  002632          MOV     FC,DTADPB+12
034326  012737  002744  002634          MOV     #REG,DTADPB+14  ;POINTER TO RHXX/RP07 REG TABLE SAVED ON CMD DONE
034334  012737  000115  002622          MOV     #OFFSET,DTADPB+2        ;LOAD OFFSET CMD
034342                          T13.1:
034342  104402                  T13.1:  TRAP    C$BSUB
034344  004437  014742                  JSR     R4,DRVCAL       ;START A DATA TRANSFER
034350  013702  002634                  MOV     DTADPB+14,R2    ;POINTER TO RHXX/RP07 REG TBL SAVED ON CMD DONE
034354  032762  000001  000012          BIT     #OM,12(R2)      ;OM = 1?
034362  001005                          BNE     TST13           ;OK
034364  104456                          TRAP    C$ERHRD
034366  000066                          .WORD   54
034370  007460                          .WORD   EM54
034372  000000                          .WORD   0
034374                          L10072:
034374  104403                  L10072: TRAP    C$ESUB
                                ;
034376  012737  000117  002622  TST13:  MOV     #RTC,DTADPB+2   ;LOAD RETURN TO CENTER LINE CMD
034404                          T13.2:
034404  104402                  T13.2:  TRAP    C$BSUB
034406  004437  014742                  JSR     R4,DRVCAL       ;START A DATA TRANSFER
034412  013702  002634                  MOV     DTADPB+14,R2    ;POINTER TO RHXX/RP07 REG TBL SAVED ON CMD DONE
034416  032762  000001  000012          BIT     #OM,12(R2)      ;OM = 0?
034424  001407                          BEQ     T13.1$          ;OK
034426  104456                          TRAP    C$ERHRD
034430  000067                          .WORD   55
034432  007521                          .WORD   EM55
034434  000000                          .WORD   0
034436                          L10073:
034436  104403                  L10073: TRAP    C$ESUB
034440  104432                          TRAP    C$EXIT
034442  000010                          .WORD   L10071-.
034444  005337  002240          T13.1$: DEC     ITCNT           ;DONE ITERATIONS ?
034450  001312                          BNE     TEST13          ;BR IF NO
034452                          EXIT13:
034452                          L10071:
034452  104401                  L10071: TRAP    C$ETST
```

```
                                .SBTTL  TEST 14: RANDOM READ TEST
                                ;
                                ;;*************************************************************************
                                ;THIS TEST RANDOMLY SELECTS A SECTOR ADDRESS: CYL BETWEEN FC AND LC,
                                ;                                             TRK BETWEEN FT AND LT,
                                ;                                             SEC BETWEEN FS AND LS.
                                ;IF THERE IS NO P-CLOCK, IT THEN EXECUTES A READ DATA COMMAND  TO 1 SECTOR
                                ;AFTER EACH READ-DATA COMMAND, THE PROGRAM VERIFIES THE
                                ;BUS, DATA  AND VERIOUS RHXX/RP07 REGISTERS.
                                ;IF THERE IS A P-CLOCK,THE PROGRAM PERFORMS AN ADDRESS MARK DETECTION TEST:
                                ;IT VERIFIES THAT DATA CAN BE READ CORRECTLY WITHIN THE SAME DISC REVOLUTION
                                ;AS A SECTOR DETECTION. SEARCH FOR THE LOGICAL SECTOR PRECEDING THE SELECTED
                                ;SECTOR TO READ, THEN READ THE SELECTED SECTOR. TIME THE SEARCH DONE-READ DONE
                                ;TO BE WITHIN A DISC REVOLUTION. FLAG LOST REVOLUTIONS.
                                ;;*************************************************************************
                                ;
034454                          T14::
034454  013737  002244  002240         MOV     XTIMES,ITCNT    ;SET ITERATION COUNT
034462  005737  002250                 TST     CLKSTA          ;P-CLK PRESENT?
034466  003036                         BGT     TST14A          ;YES, EXEC RAND READ TEST + AD MARK DET
034470  004737  020226                 JSR     PC,RPINIT       ;INITIALIZE THE SUB-SYSTEM
034474  004737  012262                 JSR     PC,STOPCK       ;STOP THE CLOCK
034500  113737  002654  002620         MOVB    DRVNO,DTADPB    ;LOAD THE DRIVE ADDRESS
034506  112737  000171  002622         MOVB    #RDDAT,DTADPB+2 ;EXECUTE READ COMMAND
034514  012737  177400  002624         MOV     #-256.,DTADPB+4 ;WORD COUNT = 1 SECTOR
034522  012737  042610  002626         MOV     #DBUFF,DTADPB+6 ;BUFFER ADDRESS
034530  012737  002744  002634         MOV     #REG,DTADPB+14  ;RHXX/RP07 REGISTER TABLE
                                ;
034536  004437  017544         TEST14: JSR     R4,RANADR       ;GENERATE A STARTING ADDRESS
034542                          T14.1:
034542  104402                         TRAP    C$BSUB
034544  004437  014742                 JSR     R4,DRVCAL       ;START A DATA TRANSFER
034550                          L10075:
034550  104403                         TRAP    C$ESUB
034552  005337  002240         EXIT14: DEC     ITCNT           ;DONE ITERATIONS ?
034556  001367                         BNE     TEST14          ;BR IF NO
034560  104432                         TRAP    C$EXIT
034562  001206                         .WORD   L10074-.
                                ;
034564  004437  015476         TST14A: JSR     R4,SRCH00       ;MASS BUS INIT & RECAL
034570  000402                         BR      1$              ;NO RECAL ERROR, CONTINUE
034572  000137  035742                 JMP     XIT14           ;EXIT ON RECAL ERROR
                                ;
034576  004737  015626         1$:     JSR     PC,STRTMR       ;INIT THE TIMERS
034602  042777  000101  155310         BIC     #101,@PKCS      ;STOP THE P-CLOCK
                                                                ;SETUP VECTOR IN CASE OF CLOCK OVERFLOW
034610  012746  000300                 MOV     #PR106,-(SP)
034614  012746  035542                 MOV     #T14.7$,-(SP)
034620  013746  012126                 MOV     PKV,-(SP)
034624  012746  000003                 MOV     #3,-(SP)
034630  104437                         TRAP    C$SVEC
034632  062706  000010                 ADD     #10,SP
                                                                ;SETUP RHXX/RP07 VECTOR
034636  012746  000000                 MOV     #PR100,-(SP)
034642  012746  015624                 MOV     #DORTI,-(SP)
034646  013746  002644                 MOV     RPVEC,-(SP)
034652  012746  000003                 MOV     #3,-(SP)
```

TEST 14: RANDOM READ TEST

```
                034656  104437                          TRAP    C$SVEC
                034660  062706  000010                  ADD     #10,SP
     47         034664  005005                          CLR     R5              ;SET COUNT-UP FLAG FOR COUNT SUBR
     48
     49                                                 ;REDUCE THE TARGET SECTOR BY 2, TO COMPUTE THE VALUE OF THE 2ND LOGICAL
     50                                                 ;SECTOR.
     51
     52         034666  004437  017544          T14.1$: JSR     R4,RANADR       ;GEN A RAND ADR: CYL, TRK, SEC
     53         034672  113701  002630                  MOVB    DTADPB+10,R1    ;GET TARGET SECTOR ADDRESS TO READ
     54         034676  032777  000004  145766          BIT     #ILV,@RPDS      ;IS INTERLEAVED SECTOR ENABLED ?
     55         034704  001006                          BNE     2$              ;BR IF YES
     56         034706  162701  000002                  SUB     #2,R1           ;BACKUP THE SECTOR ADDRESS FOR THE SEARCH
     57         034712  002002                          BGE     1$              ;BR IF < SECTOR 0
     58         034714  062701  000062                  ADD     #50.,R1         ;ADJUST FOR ADDRESS BEFORE SECTOR 0
     59         034720  000411                  1$:     BR      4$              ;EXIT
     60
     61         034722  005701                  2$:     TST     R1              ;IS IT SECTOR ADDR 0 ?
     62         034724  001405                          BEQ     3$              ;BR IF YES
     63         034726  162701  000031                  SUB     #25.,R1         ;IS IT SECTOR ADDR 25 ?
     64         034732  001002                          BNE     3$              ;BR IF NO
     65         034734  062701  000031                  ADD     #25.,R1         ;ADJUST FOR THE ADDRESS BEFORE SECTOR 0
     66         034740  062701  000030          3$:     ADD     #24.,R1         ;REDUCE THE TARGET SECTOR BY 2
     67         034744                          4$:
     68                                                 ;PREPARE TO SEARCH
     69         034744                          T1410$:
                034744                          T14.2:
                034744  104402                          TRAP    C$BSUB
     70         034746  013777  002632  145740          MOV     DTADPB+12,@RPDC ;CYL
     71         034754  110146                          MOVB    R1,-(SP)        ;MERGE SECTOR
     72         034756  113766  002631  000001          MOVB    DTADPB+11,1(SP) ;AND TRK
     73         034764  012677  145676                  MOV     (SP)+,@RPDA     ;LOAD TRK/SEC
     74         034770  012777  177400  145664          MOV     #-256.,@RPWC    ;READ 1 SECTOR
     75         034776  012777  042610  145660          MOV     #DBUFF,@RPBA    ;SET DATA BUFFER ADR
     76         035004  012703  002472                  MOV     #T1420,R3       ;TIMING LIMITS FOR COUNT SUBR
     77         035010  012777  000006  155104          MOV     #6,@PKB         ;ALLOW > 6 REVOLUTIONS PER SEARCH:
     78
     79                                                 ;3 FOR IMPLIED MAX SEEK (46 MSEC OR ABOUT 3 REVOLUTIONS)
     80                                                 ;3 FOR WORST CASE SEARCH(SECT CMP ERR OR HDR CRC ERR)
     81
     82         035016  012777  000105  155074          MOV     #105,@PKCS      ;START P-CLOCK:IE,COUNT DOWN,LINE FREQ
     83         035024  012777  000131  145626          MOV     #SEARCH,@RPCS1  ;START A SEARCH
     84         035032  000001                          WAIT                    ;WAIT ON INTERRUPT
     85         035034  017746  155064                  MOV     @PKC,-(SP)      ;SAVE THE CLOCK
     86         035040  042777  000101  155052          BIC     #101,@PKCS      ;STOP THE CLOCK
     87         035046  012677  155050                  MOV     (SP)+,@PKB      ;AND RESTORE THE COUNTED VALUE
     88         035052  032777  040000  145612          BIT     #BIT14,@RPDS    ;ERROR?
     89         035060  001533                          BEQ     T1411$          ;NO--BRANCH
     90         035062  004737  010646                  JSR     PC,SAVREG       ;;SAVE R0-R5
                035066  012702  002620                  MOV     #DTADPB,R2      ;DPB POINTER
                035072  004737  024472                  JSR     PC,SVRHXX       ;SAVE ALL THE RHXX/RP07 REGISTERS
                035076  012777  000040  145564          MOV     #CLR,@RPCS2     ;MASSBUS CLEAR
                035104  013777  002620  145556          MOV     DTADPB,@RPCS2   ;SELECT DRIVE
                035112  004737  010700                  JSR     PC,RESREG       ;;RESTORE R0-R5
     91         035116  004537  012664                  JSR     R5,ERRANY
     92         035122  002620                          DTADPB                  ;FIND OUT WHAT ERROR
     93         035124                          L10076:
                035124  104403                          TRAP    C$ESUB
```

```
 94 035126  032737  000210  002254          BIT     #BIT3!BIT7,SVSTAT       ;RETRY ALLOWED ?
 95 035134  001022                          BNE     1$                      ;BRANCH IS SO
 96 035136  012746  004422                  MOV     #SEAERR,-(SP)
    035142  012746  000001                  MOV     #1,-(SP)
    035146  010600                          MOV     SP,R0
    035150  104417                          TRAP    C$PNTF
    035152  062706  000004                  ADD     #4,SP
 97 035156  012746  004525                  MOV     #ABOTST,-(SP)
    035162  012746  000001                  MOV     #1,-(SP)
    035166  010600                          MOV     SP,R0
    035170  104417                          TRAP    C$PNTF
    035172  062706  000004                  ADD     #4,SP
 98 035176  000137  035646                  JMP     T14.8$
 99 035202                          1$:
100 035202  012737  000020  002340          MOV     #16.,WCEFLG     ;RETRY 16 TIMES
101 035210  012777  000006  154704  2$:     MOV     #6,@PKB         ;ALLOW > 6 REVOLUTIONS PER SEARCH:
102
103                                         ;3 FOR IMPLIED MAX SEEK (46 MSEC OR ABOUT 3 REVOLUTIONS)
104                                         ;3 FOR WORST CASE SEARCH(SECT CMP ERR OR HDR CRC ERR)
105
106 035216  012777  000105  154674          MOV     #105,@PKCS      ;START P-CLOCK:IE,COUNT DOWN,LINE FREQ
107 035224  012777  000131  145426          MOV     #SEARCH,@RPCS1  ;START A SEARCH
108 035232  000001                          WAIT                    ;WAIT ON INTERRUPT
109 035234  017746  154664                  MOV     @PKC,-(SP)      ;SAVE THE CLOCK
110 035240  042777  000101  154652          BIC     #101,@PKCS      ;STOP THE CLOCK
111 035246  012677  154650                  MOV     (SP)+,@PKB      ;AND RESTORE THE COUNTED VALUE
112 035252  032777  040000  145412          BIT     #BIT14,@RPDS    ;ERROR?
113 035260  001433                          BEQ     T1411$          ;EXIT IF NONE
114 035262  012777  000040  145400          MOV     #CLR,@RPCS2     ;MASSBUS CLEAR
115 035270  013777  002620  145372          MOV     DTADPB,@RPCS2   ;DRIVE ADDRESS
116 035276  005337  002340                  DEC     WCEFLG          ;OVER RETRY LIMIT ?
117 035302  001342                          BNE     2$              ;BRANCH IF NOT
118 035304  012746  004461                  MOV     #SEABAD,-(SP)
    035310  012746  000001                  MOV     #1,-(SP)
    035314  010600                          MOV     SP,R0
    035316  104417                          TRAP    C$PNTF
    035320  062706  000004                  ADD     #4,SP
119 035324  012746  004525                  MOV     #ABOTST,-(SP)
    035330  012746  000001                  MOV     #1,-(SP)
    035334  010600                          MOV     SP,R0
    035336  104417                          TRAP    C$PNTF
    035340  062706  000004                  ADD     #4,SP
120 035344  000540                          BR      T14.8$          ;EXIT
121 035346                          T14.3:
    035346  104402                          TRAP    C$BSUB
122 035350  013777  002630  145310  T1411$: MOV     DTADPB+10,@RPDA ;SET TRK/SECT TO READ
123 035356  005077  154540                  CLR     @PKB            ;CLEAR P-CLK BUFFER COUNT
124 035362  012777  000171  145270          MOV     #RDDAT,@RPCS1   ;START A READ
125 035370  012777  000121  154522          MOV     #121,@PKCS      ;START THE CLOCK:IE=1,UP,SINGLE,10US
126 035376  000001                          WAIT                    ;WAIT ON INTERRUPT
127 035400  017746  154520                  MOV     @PKC,-(SP)      ;SAVE THE CLOCK
128 035404  042777  000101  154506          BIC     #101,@PKCS      ;STOP THE CLOCK
129 035412  012677  154504                  MOV     (SP)+,@PKB      ;AND RESTORE THE COUNTED VALUE
130 035416  032777  040000  145246          BIT     #BIT14,@RPDS    ;ERR=1?
131 035424  001437                          BEQ     T1412$          ;NO--BRANCH
132 035426  004737  010646                  JSR     PC,SAVREG       ;;SAVE R0-R5
    035432  012702  002620                  MOV     #DTADPB,R2      ;DPB POINTER
```

```
                035436  004737  024472                  JSR     PC,SVRHXX       ;SAVE ALL THE RHXX/RP07 REGISTERS
                035442  012777  000040  145220          MOV     #CLR,@RPCS2     ;MASSBUS CLEAR
                035450  013777  002620  145212          MOV     DTADPB,@RPCS2   ;SELECT DRIVE
                035456  004737  010700                  JSR     PC,RESREG       ;;RESTORE R0-R5
133             035462  004537  012664                  JSR     R5,ERRANY       ;FIND OUT WHAT ERROR
134             035466  002620                          DTADPB
135             035470                          L10077:
                035470  104403                          TRAP    C$ESUB
136             035472  032737  000040  002254          BIT     #BIT5,SVSTAT    ;POSITION ERROR?
137             035500  001411                          BEQ     T1412$          ;NO, CONTINUE
138             035502  012746  004544                  MOV     #POSERR,-(SP)
                035506  012746  000001                  MOV     #1,-(SP)
                035512  010600                          MOV     SP,R0
                035514  104417                          TRAP    C$PNTF
                035516  062706  000004                  ADD     #4,SP
139             035522  000451                          BR      T14.8$
140
141             035524  004737  016076          T1412$: JSR     PC,COUNT        ;COUNT TIME SEARCH DONE-READ DONE
142             035530  021237  002244                  CMP     (R2),XTIMES     ;REPEATED 1024 TIMES?
143             035534  002044                          BGE     T14.8$          ;YES, CONCLUDE TEST
144             035536  000137  034666                  JMP     T14.1$          ;NO, CONTINUE
145
146             035542  004737  012324          T14.7$: JSR     PC,FORSEC       ;RESET TIMER TO 4 SEC, CHANGE CLK SERVICE AD
147                                                                             ;DROP THE PRIORITY
148             035546  012700  000000                  MOV     #PRI00,R0
                035552  104441                          TRAP    C$SPRI
149             035554  004737  010646                  JSR     PC,SAVREG       ;;SAVE R0-R5
                035560  012702  002620                  MOV     #DTADPB,R2      ;DPB POINTER
                035564  004737  024472                  JSR     PC,SVRHXX       ;SAVE ALL THE RHXX/RP07 REGISTERS
                035570  012777  000040  145072          MOV     #CLR,@RPCS2     ;MASSBUS CLEAR
                035576  013777  002620  145064          MOV     DTADPB,@RPCS2   ;SELECT DRIVE
                035604  016102  000014                  MOV     14(R1),R2       ;ADDRESS OF SAVED REGISTER TABLE
                035610  016237  000036  002266          MOV     36(R2),CYL.RD   ;GET CURRENT CYLINDER
                035616  116237  000006  002272          MOVB    6(R2),SEC.RD    ;GET CURRENT SECTOR
                035624  116237  000007  002270          MOVB    7(R2),TRK.RD    ;GET CURRENT TRACK
                035632  004737  010700                  JSR     PC,RESREG       ;;RESTORE R0-R5
150             035636  104456                          TRAP    C$ERHRD
                035640  000024                          .WORD   20
                035642  006112                          .WORD   EM20
                035644  007604                          .WORD   DH44
151             035646                          T14.8$:
                035646  012777  000040  145014          MOV     #CLR,@RPCS2     ;CLEAR THE MASSBUS
                035654  013777  002620  145006          MOV     DTADPB,@RPCS2   ;& SELECT DRIVE
152             035662  004737  011676                  JSR     PC,ST.CLK       ;INITIALIZE THE CLOCK
153             035666  005737  002310          1$:     TST     TIM.UP+6        ;ANY SEARCH-READ TIMED > 1 REVOLUTION?
154             035672  001423                          BEQ     4$              ;NO, SKIP
155             035674  023727  002310  000001          CMP     TIM.UP+6,#1     ;ONLY ONE REV LOST?
156             035702  001405                          BEQ     2$              ;YES, FLAG SOFT ERROR
157             035704  104456                          TRAP    C$ERHRD
                035706  000064                          .WORD   52
                035710  007432                          .WORD   EM52
                035712  010532                          .WORD   DH52
158             035714  000404                          BR      3$
159             035716                          2$:
                035716  104457                          TRAP    C$ERSOFT
                035720  000065                          .WORD   53
                035722  007432                          .WORD   EM52
```

```
                035724  010532                  .WORD   DH52
160             035726                  3$:
                035726  004437  016370          JSR     R4,TYPTIM       ;GO TYPE THE TIMES
                035732  002472                  T1420                   ;POINTER
161             035734  004437  016240          JSR     R4,SPTYP
162             035740  002532                  S1420
163             035742                  4$:
164             035742                  XIT14:                          ;SETUP RHXX/RP07 VECTOR
165             035742  013746  002646          MOV     RPVEC+2,-(SP)
                035746  012746  022674          MOV     #ISRV,-(SP)
                035752  013746  002644          MOV     RPVEC,-(SP)
                035756  012746  000003          MOV     #3,-(SP)
                035762  104437                  TRAP    C$SVEC
                035764  062706  000010          ADD     #10,SP
166             035770                  L10074:
                035770  104401                  TRAP    C$ETST
```

```
                                .SBTTL  TEST 15: FE CYLINDER ADDRESSING TEST

                                ;;*************************************************************************
                                ;       THIS TEST LOCATES THE FE CYLINDERS;
                                ;       THE FE CYLINDERS ARE CYL 630 AND 631,
                                ;
                                ;       AT THE FIRST TEST CYCLE, THE TEST SETS
                                ;       "DMD" BIT OF THE RPMR REGISTER IN ORDER TO ACCESS
                                ;       FE CYLINDERS.
                                ;
                                ;       THEN, THIS TEST EXECUTES READ HEADER AND DATA COMMANDS
                                ;       SEQUENTIALLY TO VERIFY THE ADDRESSING OF THE SECTOR 0
                                ;       OF EACH TRACK ( 0 TO 31 ) ON THE FIRST FE CYLINDER.
                                ;
                                ;       AT THE SECOND TEST CYCLE,
                                ;       A SEEK COMMAND IS EXECUTED TO ACCESS THE SECOND FE CYLINDER.
                                ;;*************************************************************************

035772                          T15::
035772  004737  020226                JSR     PC,RPINIT       ;INITIALIZE THE SUB-SYSTEM
035776  004737  012262                JSR     PC,STOPCK       ;STOP THE CLOCK
036002  012737  000012  002240        MOV     #10.,ITCNT      ;SET ITERATION COUNT
036010  113737  002654  002620  TEST15: MOVB    DRVNO,DTADPB    ;LOAD THE DRIVE ADDRESS INTO DPB
036016  012737  177400  002624        MOV     #SCTRWC,DTADPB+4        ;256 WORDS
036024  012737  042610  002626        MOV     #DBUFF,DTADPB+6 ;BUFFER ADDRESS
036032  012737  000000  002630        MOV     #0,DTADPB+10    ;TRACK 0, SECTOR 0
036040  013737  002260  002632        MOV     NC2,DTADPB+12   ;ASSUME NO FIX HEAD OPTION
036046  013704  002654                MOV     DRVNO,R4        ;TO FIND OUT FIX HEAD OPTION
036052  122764  000005  020146        CMPB    #5,DRVTYP(R4)   ;BRANCH IF NO FIX HEAD
036060  001411                        BEQ     1$
036062  122764  000004  020146        CMPB    #4,DRVTYP(R4)   ;DOES IT CONTAIN FIX HEAD
036070  001405                        BEQ     1$              ;BRANCH IS SO
036072  104455                        TRAP    C$ERDF
036074  000044                        .WORD   36
036076  006730                        .WORD   EM36
036100  010600                        .WORD   DH25
036102  104444                        TRAP    C$DCLN
036104  052737  100000  002620  1$:   BIS     #DMD,DTADPB     ;SET MAINTENACE MODE FLAG AT THE 2ND BYTE
036112  112737  000105  002622        MOVB    #SEEK,DTADPB+2  ;DO AN EXPLICIT SEEK
036120                          T15.1:
036120  104402                        TRAP    C$BSUB
036122  004437  014742                JSR     R4,DRVCAL       ;START A DATA TRANSFER
036126                          L10101:
036126  104403                        TRAP    C$ESUB
036130  005737  002636                TST     DTADPB+16       ;ANY ERROR CONDITION EXISTS ?
036134  100437                        BMI     EXIT15          ;EXIT IF SO
036136                          T15.2:
036136  104402                        TRAP    C$BSUB
036140  112737  000173  002622  TST15:  MOVB    #RDHD,DTADPB+2  ;READ THE HEADER AND DATA
036146  004437  014742                JSR     R4,DRVCAL       ;START A DATA TRANSFER
036152                          L10102:
036152  104403                        TRAP    C$ESUB
036154  005737  002636                TST     DTADPB+16       ;ANY ERROR
036160  100425                        BMI     EXIT15          ;EXIT IF SO
036162  123737  002262  002631        CMPB    NT1,DTADPB+11   ;LAST TRACK CHECKED ?
036170  101403                        BLOS    1$              ;BRANCH IF NOT
036172  105237  002631                INCB    DTADPB+11
```

```
                                        BR      TST15
                                1$:     CLRB    DTADPB+11       ;RESET TO TRACK 0
                                        INC     DTADPB+12       ;ACCESS 2ND FE CYL
                                        MOVB    #SEEK,DTADPB+2  ;DO AN EXPLICIT SEEK
                                T15.3:
                                        TRAP    C$BSUB
                                        JSR     R4,DRVCAL       ;START A DATA TRANSFER
                                L10103:
                                        TRAP    C$ESUB
                                        DEC     ITCNT           ;DONE ITERATIONS ?
                                        BNE     TEST15          ;BR IF NO
                                EXIT15: JSR     PC,RPINIT       ;INITIALIZE THE SUB-SYSTEM
                                        BIC     #DMD,DTADPB     ;CLEAR THE DMD BIT IN THE DPB
                                L10100:
                                        TRAP    C$ETST
```

```
                                .SBTTL  TEST 16: FE CYLINDER WRITE AND WRITE CHECK TEST
                                ;
                                ;*****************************************************************************
                                ;THIS TEST EXECUTES WRITE-DATA SEQUENTIALLY FROM TRACK FT TO TRACK LT
                                ;ON THE FIRST FE CYLINDER WHICH IS ACCESSIBLE IN MAINTENANCE MODE.
                                ;THE PARAMETERS ARE AS FOLLOWS:
                                ;
                                ;THE FULL TRACK TRANSFER IS MADE IN 2 PASSES:
                                ;       1ST PASS, SECTORS:  00. THRU 24.
                                ;       2ND PASS, SECTORS:  25. THRU 49.
                                ;
                                ;       STARTING TRACK          = FT
                                ;       ENDING TRACK            = LT
                                ;       INCREMENT TRACK         = IT
                                ;       STARTING SECTOR         = FS
                                ;*****************************************************************************
                                ;
036250                          T16::
036250  004737  020226          JSR     PC,RPINIT       ;INITIALIZE THE SUB-SYSTEM
036254  113737  002654  002620  MOVB    DRVNO,DTADPB    ;LOAD THE DRIVE ADDRESS
036262  013737  002344  002624  MOV     TRKWC,DTADPB+4  ;WORD COUNT = HALF TRACK
036270  012737  042610  002626  MOV     #DBUFF,DTADPB+6 ;BUFFER ADDRESS
036276  113737  002212  002631  MOVB    FT,DTADPB+11    ;FIRST  TRACK
036304  013737  002260  002632  MOV     NC2,DTADPB+12   ;FIRST FE CYLINDER W/O FIX H
036312  012737  002744  002634  MOV     #REG,DTADPB+14  ;SAVED RHXX/RP07 REGISTER
036320  105037  002621          CLRB    DTADPB+1        ;CLEAR THE HCI
036324  052737  100000  002620  BIS     #DMD,DTADPB     ;SET THE MAINTENANCE MODE FLAG
036332  004737  012262          JSR     PC,STOPCK       ;STOP THE CLOCK
                                ;
036336  005037  002246  TEST16: CLR     DOTWO           ;RESET 2 ITERATIONS CONTROL
036342  105037  002630          CLRB    DTADPB+10       ;RESTART AT SECTOR 0
036346  013702  002224          MOV     PAT,R2          ;FILL THE DATA PATTERN
036352  013703  002626          MOV     DTADPB+6,R3     ;BUFFER ADDRESS
036356  013704  002624          MOV     DTADPB+4,R4     ;WORD COUNT
036362  010223          1$:     MOV     R2,(R3)+
036364  005204                  INC     R4
036366  001375                  BNE     1$              ;BRANCH IF PATTERN IS WRITTEN TO ALL BUFF LOC
036370                          T16.1:
036370  104402                  TRAP    C$BSUB
036372  112737  000105  002622  WRPAT:  MOVB    #SEEK,DTADPB+2  ;DO A SEEK FIRST
036400  004437  014742          JSR     R4,DRVCAL       ;START A DATA TRANSFER
036404                          L10105:
036404  104403                  TRAP    C$ESUB
036406                          T16.2:
036406  104402                  TRAP    C$BSUB
036410  112737  000161  002622          MOVB    #WRTDAT,DTADPB+2        ;WRITE DATA COMMAND
036416  004437  014742          JSR     R4,DRVCAL       ;START A DATA TRANSFER
036422  112737  000151  002622  MOVB    #WCKD,DTADPB+2  ;CHANGE TO WRITE CHECK DATA COMMAND
036430  004437  014742          JSR     R4,DRVCAL       ;START A DATA TRANSFER
036434                          L10106:
036434  104403                  TRAP    C$ESUB
036436  005737  002246          TST     DOTWO           ;DONE HALF TRACK TWICE?
036442  100406                  BMI     1$              ;YES, EXIT 2 ITERATIONS LOOP
036444  005337  002246          DEC     DOTWO           ;NO, MARK 2ND ITERATION
036450  112737  000031  002630  MOVB    #25.,DTADPB+10  ;TFR 2ND HALF OF TRACK
036456  000745                  BR      WRPAT           ;LOOP TO TFR 2ND HALF TRACK
                                ;
```

```
                                        1$:     CLR     DOTWO           ;RESET PARAMETERS FOR 1ST LOOP
                                                CLRB    DTADPB+10       ;RESTART AT SECTOR 0
                                        2$:     MOV     PAT,R2          ;COMPLEMENT THE PATTERN
                                                COM     R2
                                                MOV     DTADPB+6,R3     ;BUFFER ADDRESS
                                                MOV     DTADPB+4,R4     ;WORD COUNT
                                        3$:     MOV     R2,(R3)+        ;FILL THE BUFFER WITH COMPLEMENT DATA
                                                INC     R4
                                                BNE     3$              ;BRANCH IF NOT DONE
                                        T16.3:
                                                TRAP    C$BSUB
                                        WRPATN: MOVB    #SEEK,DTADPB+2  ;SEEK COMMAND
                                                JSR     R4,DRVCAL       ;START A DATA TRANSFER
                                        L10107:
                                                TRAP    C$ESUB
                                        T16.4:
                                                TRAP    C$BSUB
                                                MOVB    #WRTDAT,DTADPB+2        ;WRITE DATA FIRST
                                                JSR     R4,DRVCAL       ;START A DATA TRANSFER
                                                MOVB    #WCKD,DTADPB+2  ;CHANGE TO WRITE-CHECK
                                                JSR     R4,DRVCAL       ;START A DATA TRANSFER
                                        L10110:
                                                TRAP    C$ESUB
                                                TST     DOTWO           ;DONE HALF TRACK TWICE?
                                                BMI     1$              ;YES, EXIT 2 ITERATIONS LOOP
                                                DEC     DOTWO           ;NO, MARK 2ND ITERATION
                                                MOVB    #25.,DTADPB+10  ;TFR 2ND HALF OF TRACK
                                                BR      WRPATN          ;2ND ITERATION

                                        1$:     MOVB    DTADPB+11,R2    ;UPDATE THE TRACK ADDRESS
                                                ADD     IT,R2
                                                MOVB    R2,DTADPB+11
                                                CMP     LT,R2
                                                BHI     TEST16
                                        EXIT16: BIC     #DMD,DTADPB     ;RESET THE MAINTENANCE FLAG
                                        L10104:
                                                TRAP    C$ETST
```

```
                                .SBTTL  TEST 17: WRITE TEST
                                ;
                                ;*************************************************************************
                                ;THIS TEST EXECUTES WRITE + WRITE CHECK DATA ON EVERY TRACK OF STARTING
                                ;CYLINDER AND ENDING CYLINDER. AFTER EACH WRITE + WRITE CHECK OPERATION,
                                ;THE TRACK ADDRESS IS UPDATE BY THE AMOUNT SPECIFIED IN THE "INCREMENT
                                ;TRACK".
                                ;
                                ;NOTE: CYLINDER 629. WILL NOT BE USED, IN ORDER TO PRESERVE THE BAD
                                ;      SECTOR FILE DATA.
                                ;
                                ;THE FULL TRACK TRANSFER IS MADE IN 2 PASSES:
                                ;       1ST PASS, SECTORS:  00. THRU 24.
                                ;       2ND PASS, SECTORS:  25. THRU 49.
                                ;
                                ;THE PARAMETERS:
                                ;       STARTING CYLINDER
                                ;       ENDING CYLINDER
                                ;       STARTING TRACK
                                ;       ENDING TRACK
                                ;       INCREMENT TRACK
                                ;       STARTING SECTOR
                                ;*************************************************************************
                                ;
036636                          T17::
036636  004737  020226                  JSR     PC,RPINIT       ;INITIALIZE THE SUB-SYSTEM
036642  105737  002235                  TSTB    WRTALL          ;DID OPERATOR WANT TO WRITE ON MEDIUM?
036646  001015                          BNE     1$              ;BR IF YES
                                                                ;NOTIFY OPERATOR THAT TEST WAS NOT RUN
036650  013746  002114                  MOV     L$TEST,-(SP)
036654  012746  004345                  MOV     #WRTENM,-(SP)
036660  012746  000002                  MOV     #2,-(SP)
036664  010600                          MOV     SP,R0
036666  104417                          TRAP    C$PNTF
036670  062706  000006                  ADD     #6,SP
036674  005000                          CLR     R0              ;CLEAR R0 FOR TRAP
036676  104432                          TRAP    C$EXIT
036700  000256                          .WORD   L10111-.
                                ;
036702  113737  002654  002620  1$:     MOVB    DRVNO,DTADPB    ;DRIVE ADDRESS
036710  013737  002344  002624          MOV     TRKWC,DTADPB+4  ;HALF TRACK
036716  012737  042610  002626          MOV     #DBUFF,DTADPB+6 ;BUFFER ADDRESS
036724  112737  000000  002630          MOVB    #0,DTADPB+10    ;SECTOR ADDRESS
036732  113737  002212  002631          MOVB    FT,DTADPB+11    ;TRACK ADDRESS
036740  013737  002204  002632          MOV     FC,DTADPB+12    ;CYLINDER ADDRESS
036746  012737  002744  002634          MOV     #REG,DTADPB+14  ;THE SAVED REGISTER TABLE ADDRESS
036754  005037  002246                  CLR     DOTWO           ;RESET 2 ITERATION CONTROL
036760  013702  002224                  MOV     PAT,R2          ;PATTERN IN R2,FILL
036764  013703  002626                  MOV     DTADPB+6,R3     ;BUFFER ADDRESS
036770  013704  002624                  MOV     DTADPB+4,R4     ;TOTAL NUMBER OF WORD COUNT
036774  010223                  2$:     MOV     R2,(R3)+        ;LOAD DATA PATTERN BUFFER
036776  005204                          INC     R4              ;INCREMENT WORD COUNT
037000  001375                          BNE     2$              ;BRANCH IF NOT DONE
037002  004737  012262                  JSR     PC,STOPCK       ;STOP THE CLOCK
037006  005005                          CLR     R5              ;1ST PASS FLAG
037010                          T17.1:
037010  104402                          TRAP    C$BSUB
```

```
 53 037012  023727  002632  001165  TEST17: CMP     DTADPB+12,#629. ;IS THIS THE LAST USER CYLINDER ?
 54 037020  001002                          BNE     1$              ;BR IF NO
 55 037022  005337  002632                  DEC     DTADPB+12       ;DON'T WRITE ON LAST USER CYLINDER
 56 037026  112737  000161  002622  1$:     MOVB    #WRTDAT,DTADPB+2        ;WRITE DATA COMMAND
 57 037034  004437  014742                  JSR     R4,DRVCAL       ;DO THE WRITE COMMAND
 58 037040  112737  000151  002622          MOVB    #WCKD,DTADPB+2  ;DO THE WRITE CHECK COMMAND
 59 037046  004437  014742                  JSR     R4,DRVCAL       ;DO THE WRITE CHECK COMMAND
 60 037052                          L10112:
    037052  104403                          TRAP    C$ESUB
 61 037054  005737  002246                  TST     DOTWO           ;DONE HALF TRACK TWICE?
 62 037060  100406                          BMI     3$              ;YES, EXIT 2 ITERATIONS LOOP
 63 037062  005337  002246                  DEC     DOTWO           ;NO, MARK 2ND ITERATION
 64 037066  112737  000031  002630          MOVB    #25.,DTADPB+10  ;GET STARTING SECTOR FOR 2ND HALF OF TRACK
 65 037074  000746                  2$:     BR      TEST17          ;LOOP TO XFER 2ND HALF OF TRACK
 66
 67 037076  005037  002246          3$:     CLR     DOTWO           ;RESET PARAMETERS FOR 1ST LOOP
 68 037102  105037  002630                  CLRB    DTADPB+10       ;RESTART AT SECTOR 0
 69 037106  113702  002631          4$:     MOVB    DTADPB+11,R2    ;UPDATE THE TRACK ADDRESS
 70 037112  063702  002216                  ADD     IT,R2           ;INCREMENT BY THE SPECIFIED AMOUNT
 71 037116  023702  002214                  CMP     LT,R2           ;OVER THE LIMIT ?
 72 037122  103403                          BLO     5$              ;BRANCH IF SO
 73 037124  110237  002631                  MOVB    R2,DTADPB+11    ;UPDATE THE TRACK ADDRESS
 74 037130  000730                          BR      TEST17          ;LOOP BACK
 75
 76 037132  005705                  5$:     TST     R5              ;IS IT 2ND PASS?
 77 037134  001010                          BNE     EXIT17          ;YES, EXIT
 78 037136  005205                          INC     R5              ;NO, FLAG 2ND PASS
 79 037140  113737  002212  002631          MOVB    FT,DTADPB+11    ;RESET THE STARTING TRACK
 80 037146  013737  002206  002632          MOV     LC,DTADPB+12    ;UPDATE THE CYLINDER ADDRESS TO LC
 81 037154  000716                          BR      TEST17          ;LOOP BACK
 82
 83 037156                          EXIT17:
    037156                          L10111:
    037156  104401                          TRAP    C$ETST
```

```
                        .SBTTL  TEST 18: RANDOM WRITE TEST
                        ;
                        ;;*****************************************************************************
                        ;THIS TEST EXECUTES WRITE + WRITE CHECK DATA RANDOMLY;
                        ;IN THE PACK AREA BONDED BY THE (STARTING CYLINDER, ENDING CYLINDER)
                        ;                              (STARTING TRACK, ENDING TRACK)
                        ;                              (STARTING SECTOR, ENDING SECTOR)
                        ;THE TRANSFER SIZE IS ALWAYS EQUAL TO ONE SECTOR.
                        ;
                        ;IF THERE IS A P-CLOCK,THE PROGRAM PERFORMS AN ADDRESS MARK DETECTION TEST:
                        ;IT VERIFIES THAT DATA CAN BE WRITTEN CORRECTLY WITHIN THE SAME DISC REVOLUTION
                        ;AS A SECTOR DETECTION. SEARCH FOR THE SECOND LOGICAL SECTOR PRECEDING THE
                        ;SELECTED SECTOR TO WRITE, THEN WRITE THE SELECTED SECTOR. TIME THE SEARCH
                        ;DONE-WRITE DONE TO BE WITHIN A DISC REVOLUTION. FLAG LOST REVOLUTIONS.
                        ;
                        ;NOTE: CYLINDER 629. WILL NOT BE USED, IN ORDER TO PRESERVE THE BAD
                        ;      SECTOR FILE DATA.
                        ;
                        ;PARAMETERS:
                        ;       STARTING CYLINDER
                        ;       ENDING CYLINDER
                        ;       STARTING TRACK
                        ;       ENDING TRACK
                        ;       STARTING SECTOR
                        ;       ENDING SECTOR
                        ;       PATTERN
                        ;;*****************************************************************************
                        ;
037160                  T18::
037160  004737  020226          JSR     PC,RPINIT       ;INITIALIZE THE SUB-SYSTEM
037164  105737  002235          TSTB    WRTALL          ;DID OPERATOR WANT TO WRITE ON MEDIUM?
037170  001015                  BNE     1$              ;BR IF YES
                                                        ;NOTIFY OPERATOR THAT TEST WAS NOT RUN
037172  013746  002114          MOV     L$TEST,-(SP)
037176  012746  004345          MOV     #WRTENM,-(SP)
037202  012746  000002          MOV     #2,-(SP)
037206  010600                  MOV     SP,R0
037210  104417                  TRAP    C$PNTF
037212  062706  000006          ADD     #6,SP
037216  005000                  CLR     R0              ;CLEAR R0 FOR TRAP
037220  104432                  TRAP    C$EXIT
037222  001600                  .WORD   L10113-.
                        ;
037224  013737  002244  002240  1$:     MOV     XTIMES,ITCNT    ;SET ITERATION COUNT
037232  113737  002654  002620          MOVB    DRVNO,DTADPB    ;YES, PROCEED:  SET UP THE PAPAMETERS
037240  012737  177400  002624          MOV     #-256.,DTADPB+4 ;WORD COUNT SET TO ONE SECTOR
037246  012737  042610  002626          MOV     #DBUFF,DTADPB+6 ;BUFFER ADDRESS
037254  012737  002744  002634          MOV     #REG,DTADPB+14  ;THE SAVED RHXX/RP07 REGISTER TABLE
037262  013702  002624                  MOV     DTADPB+4,R2     ;WORD COUNT
037266  013703  002626                  MOV     DTADPB+6,R3     ;BUFFER ADDRESS
037272  013704  002224                  MOV     PAT,R4          ;PATTERN
037276  010423                  2$:     MOV     R4,(R3)+        ;FILL THE BUFFER WITH DEFAULT PATTERN
037300  005202                  INC     R2              ;INCREMENT THE WORD COUNT
037302  001375                  BNE     2$              ;LOOP IF NOT DONE
037304  005737  002250          TST     CLKSTA          ;P-CLK PRESENT?
037310  003055                  BGT     TST18A          ;YES, EXEC RAND WRT TST + AD MRK DET TST
037312  004737  020226          JSR     PC,RPINIT       ;INITIALIZE THE SUB-SYSTEM
```

```
037316  004737  012262          TEST18: JSR     PC,STOPCK               ;STOP THE CLOCK
037322  004437  017544          1$:     JSR     R4,RANADR               ;GENERATE THE RANDOM STARTING ADDRESS
                                                                        ;MAKE SURE YOU DON'T WRITE IN THE BAD SEC FILE
037326  123727  002631  000037          CMPB    DTADPB+11,#31.          ;IS THIS THE LAST TRACK ?
037334  001004                          BNE     2$                      ;BR IF NO
037336  023727  002632  001165          CMP     DTADPB+12,#629.         ;IS THIS THE LAST USER CYLINDER ?
037344  001766                          BEQ     1$                      ;BR IF YES
037346  105737  002234          2$:     TSTB    RANPAT                  ;SELECT RANDOM PATTERN ?
037352  001413                          BEQ     5$                      ;BRANCH IF NOT
037354  013702  002624                  MOV     DTADPB+4,R2             ;WORD COUNT 2'S COMPLEMENT
037360  013703  002626                  MOV     DTADPB+6,R3             ;BUFFER ADDRESS
037364  004737  011610          3$:     JSR     PC,RAND                 ;GERERATE NEW RANDOM NUMBER
037370  013723  011672          4$:     MOV     $RP1,(R3)+              ;FILL THE BUFFER WITH RANDOM PATTERN
037374  062702  000001                  ADD     #1,R2                   ;FINISH ?
037400  100773                          BMI     4$                      ;LOOP BACK , IF NOT DONE
037402                          5$:
037402                          T18.1:
037402  104402                          TRAP    C$BSUB
037404  112737  000161  002622          MOVB    #WRTDAT,DTADPB+2                ;DO A WRITE DATA
037412  004437  014742                  JSR     R4,DRVCAL
037416  112737  000151  002622          MOVB    #WCKD,DTADPB+2          ;DO A WRITE CHECK DATA
037424  004437  014742                  JSR     R4,DRVCAL
037430                          L10114:
037430  104403                          TRAP    C$ESUB
037432  005337  002240                  DEC     ITCNT                   ;DONE ITERATIONS ?
037436  001327                          BNE     TEST18                  ;BR IF NO
037440                          EXIT18:
037440  104432                          TRAP    C$EXIT
037442  001360                          .WORD   L10113-.

037444  004437  015476          TST18A: JSR     R4,SRCH00               ;MASS BUS INIT & RECAL
037450  000402                          BR      1$                      ;NO RECAL ERROR, CONTINUE
037452  000137  040774                  JMP     XIT18                   ;EXIT ON RECAL ERROR
037456  004737  015626          1$:     JSR     PC,STRTMR               ;INIT THE TIMERS
037462  042777  000101  152430          BIC     #101,@PKCS              ;STOP THE P-CLOCK
                                                                        ;SETUP VECTOR IN CASE OF CLOCK OVERFLOW
037470  012746  000300                  MOV     #PRI06,-(SP)
037474  012746  040574                  MOV     #T18OFL,-(SP)
037500  013746  012126                  MOV     PKV,-(SP)
037504  012746  000003                  MOV     #3,-(SP)
037510  104437                          TRAP    C$SVEC
037512  062706  000010                  ADD     #10,SP
                                                                        ;SETUP RHXX/RP07 VECTOR
037516  012746  000000                  MOV     #PRI00,-(SP)
037522  012746  015624                  MOV     #DORTI,-(SP)
037526  013746  002644                  MOV     RPVEC,-(SP)
037532  012746  000003                  MOV     #3,-(SP)
037536  104437                          TRAP    C$SVEC
037540  062706  000010                  ADD     #10,SP
037544  005005                          CLR     R5                      ;SET COUNT-UP FLAG FOR COUNT SUBR

037546  105737  002234          TST18B: TSTB    RANPAT                  ;SELECT RANDOM PATTERN ?
037552  001413                          BEQ     2$                      ;BRANCH IF NOT
037554  013702  002624                  MOV     DTADPB+4,R2             ;WORD COUNT 2'S COMPLEMENT
037560  013703  002626                  MOV     DTADPB+6,R3             ;BUFFER ADDRESS
037564  004737  011610                  JSR     PC,RAND                 ;GERERATE NEW RANDOM NUMBER
```

TEST 18: RANDOM WRITE TEST

```
     96 037570  013723  011672          1$:     MOV     $RP1,(R3)+      ;FILL THE BUFFER WITH RANDOM PATTERN
     97 037574  062702  000001                  ADD     #1,R2           ;FINISH ?
     98 037600  100773                          BMI     1$              ;LOOP BACK , IF NOT DONE
     99
    100                                         ;REDUCE THE TARGET SECTOR BY 2, TO COMPUTE THE VALUE OF THE 2ND LOGICAL
    101                                         ;SECTOR.
    102
    103 037602  004437  017544          2$:     JSR     R4,RANADR       ;GEN A RAND ADR: CYL, TRK, SEC
    104                                                                 ;MAKE SURE YOU DON'T WRITE IN THE BAD SEC FILE
    105 037606  123727  002631  000037          CMPB    DTADPB+11,#31.  ;IS THIS THE LAST TRACK ?
    106 037614  001004                          BNE     3$              ;BR IF NO
    107 037616  023727  002632  001165          CMP     DTADPB+12,#629. ;IS THIS THE LAST USER CYLINDER ?
    108 037624  001766                          BEQ     2$              ;BR IF YES
    109 037626  113701  002630          3$:     MOVB    DTADPB+10,R1    ;GET TARGET SECTOR ADDRESS TO WRITE
    110 037632  032777  000004  143032          BIT     #ILV,@RPDS      ;IS INTERLEAVED SECTOR ENABLED ?
    111 037640  001006                          BNE     5$              ;BR IF YES
    112 037642  162701  000002                  SUB     #2,R1           ;BACKUP THE SECTOR ADDRESS FOR THE SEARCH
    113 037646  002002                          BGE     4$              ;BR IF < SECTOR 0
    114 037650  062701  000062                  ADD     #50.,R1         ;ADJUST FOR THE ADDRESS BEFORE SECTOR 0
    115 037654  000411                  4$:     BR      7$              ;EXIT
    116
    117 037656  005701                  5$:     TST     R1              ;IS IT SECTOR ADDR 0 ?
    118 037660  001405                          BEQ     6$              ;BR IF YES
    119 037662  162701  000031                  SUB     #25.,R1         ;IS IT SECTOR ADDR 25 ?
    120 037666  001002                          BNE     6$              ;BR IF NO
    121 037670  062701  000031                  ADD     #25.,R1         ;ADJUST FOR THE ADDRESS BEFORE SECTOR 0
    122 037674  062701  000030          6$:     ADD     #24.,R1         ;REDUCE THE TARGET SECTOR BY 2
    123
    124                                         ;PREPARE TO SEARCH
    125 037700                          7$:
        037700                          T18.2:
        037700  104402                          TRAP    C$BSUB
    126 037702  013777  002632  143004          MOV     DTADPB+12,@RPDC ;CYL
    127 037710  110146                          MOVB    R1,-(SP)        ;MERGE SECTOR
    128 037712  113766  002631  000001          MOVB    DTADPB+11,1(SP) ;AND TRK
    129 037720  012677  142742                  MOV     (SP)+,@RPDA     ;LOAD TRK/SEC
    130 037724  013777  002624  142730          MOV     DTADPB+4,@RPWC  ;WRITE 1 SECTOR
    131 037732  013777  002626  142724          MOV     DTADPB+6,@RPBA  ;SET DATA BUFFER ADR
    132 037740  012703  002472                  MOV     #T1420,R3       ;TIMING LIMITS FOR COUNT SUBR
    133 037744  012777  000006  152150          MOV     #6,@PKB         ;ALLOW > 6 REVOLUTIONS PER SEARCH:
    134
    135                                         ;3 FOR IMPLIED MAX SEEK (46 MSEC OR ABOUT 3 REVOLUTIONS)
    136                                         ;3 FOR WORST CASE SEARCH(SECT CMP ERR OR HDR CRC ERR)
    137
    138 037752  012777  000105  152140          MOV     #105,@PKCS      ;START P-CLOCK:IE=1,COUNT DOWN,LINE FREQ
    139 037760  012777  000131  142672          MOV     #SEARCH,@RPCS1  ;START A SEARCH
    140 037766  000001                          WAIT                    ;WAIT ON INTERRUPT
    141 037770  017746  152130                  MOV     @PKC,-(SP)      ;SAVE THE CLOCK
    142 037774  042777  000101  152116          BIC     #101,@PKCS      ;STOP THE CLOCK
    143 040002  012677  152114                  MOV     (SP)+,@PKB      ;AND RESTORE THE COUNTED VALUE
    144 040006  032777  040000  142656          BIT     #BIT14,@RPDS    ;ERROR?
    145 040014  001534                          BEQ     T1811$          ;NO--BRANCH
    146 040016  004737  010646                  JSR     PC,SAVREG       ;;SAVE R0-R5
        040022  012702  002620                  MOV     #DTADPB,R2      ;DPB POINTER
        040026  004737  024472                  JSR     PC,SVRHXX       ;SAVE ALL THE RHXX/RP07 REGISTERS
        040032  012777  000040  142630          MOV     #CLR,@RPCS2     ;MASSBUS CLEAR
        040040  013777  002620  142622          MOV     DTADPB,@RPCS2   ;SELECT DRIVE
```

TEST 18: RANDOM WRITE TEST

```
                040046  004737  010700                  JSR     PC,RESREG       ;;RESTORE R0-R5
147             040052  004537  012664                  JSR     R5,ERRANY
148             040056  002620                          DTADPB                  ;FIND OUT WHAT ERROR
149             040060                          L10115:
                040060  104403                          TRAP    C$ESUB
150             040062  032737  000210  002254          BIT     #BIT3!BIT7,SVSTAT       ;RETRY ALLOWED ?
151             040070  001022                          BNE     8$              ;BRANCH IS SO
152             040072  012746  004422                  MOV     #SEAERR,-(SP)
                040076  012746  000001                  MOV     #1,-(SP)
                040102  010600                          MOV     SP,R0
                040104  104417                          TRAP    C$PNTF
                040106  062706  000004                  ADD     #4,SP
153             040112  012746  004525                  MOV     #ABOTST,-(SP)
                040116  012746  000001                  MOV     #1,-(SP)
                040122  010600                          MOV     SP,R0
                040124  104417                          TRAP    C$PNTF
                040126  062706  000004                  ADD     #4,SP
154             040132  000137  040700                  JMP     T18END
155
156             040136  012737  000020  002340  8$:     MOV     #16.,WCEFLG     ;RETRY 16 TIMES
157             040144  012777  000006  151750  9$:     MOV     #6,@PKB         ;ALLOW > 6 REVOLUTIONS PER SEARCH:
158
159                                                     ;3 FOR IMPLIED MAX SEEK (46 MSEC OR ABOUT 3 REVOLUTIONS)
160                                                     ;3 FOR WORST CASE SEARCH (SECT CMP ERR OR HDR CRC ERR)
161
162             040152  012777  000105  151740          MOV     #105,@PKCS      ;START P-CLOCK:IE,COUNT DOWN,LINE FREQ
163             040160  012777  000131  142472          MOV     #SEARCH,@RPCS1  ;START A SEARCH
164             040166  000001                          WAIT                    ;WAIT ON INTERRUPT
165             040170  017746  151730                  MOV     @PKC,-(SP)      ;SAVE THE CLOCK
166             040174  042777  000101  151716          BIC     #101,@PKCS      ;STOP THE CLOCK
167             040202  012677  151714                  MOV     (SP)+,@PKB      ;AND RESTORE THE COUNTED VALUE
168             040206  032777  040000  142456          BIT     #BIT14,@RPDS    ;ERROR?
169             040214  001434                          BEQ     T1811$          ;EXIT IF NONE
170             040216  012777  000040  142444          MOV     #CLR,@RPCS2     ;MASSBUS CLEAR
171             040224  013777  002620  142436          MOV     DTADPB,@RPCS2   ;DRIVE ADDRESS
172             040232  005337  002340                  DEC     WCEFLG          ;OVER RETRY LIMIT ?
173             040236  001342                          BNE     9$              ;BRANCH IF NOT
174             040240  012746  004461                  MOV     #SEABAD,-(SP)
                040244  012746  000001                  MOV     #1,-(SP)
                040250  010600                          MOV     SP,R0
                040252  104417                          TRAP    C$PNTF
                040254  062706  000004                  ADD     #4,SP
175             040260  012746  004525                  MOV     #ABOTST,-(SP)
                040264  012746  000001                  MOV     #1,-(SP)
                040270  010600                          MOV     SP,R0
                040272  104417                          TRAP    C$PNTF
                040274  062706  000004                  ADD     #4,SP
176             040300  000137  040700                  JMP     T18END          ;OTHERWISE EXIT
177             040304                          T18.3:
                040304  104402                          TRAP    C$BSUB
178             040306  013777  002630  142352  T1811$: MOV     DTADPB+10,@RPDA ;SET TRK/SECT TO WRITE
179             040314  005077  151602                  CLR     @PKB            ;CLEAR P-CLK BUFFER COUNT
180             040320  012777  000161  142332          MOV     #WRTDAT,@RPCS1  ;START A WRITE
181             040326  012777  000121  151564          MOV     #121,@PKCS      ;START THE CLOCK:IE=1,UP,SINGLE,10US
182             040334  000001                          WAIT                    ;WAIT ON INTERRUPT
183             040336  017746  151562                  MOV     @PKC,-(SP)      ;SAVE THE CLOCK
184             040342  042777  000101  151550          BIC     #101,@PKCS      ;STOP THE CLOCK
```

```
                                                MOV     (SP)+,@PKB      ;AND RESTORE THE COUNTED VALUE
                                                BIT     #BIT14,@RPDS    ;ERR=1?
                                                BEQ     T1812$          ;NO--BRANCH
                                                JSR     PC,SAVREG       ;;SAVE R0-R5
                                                MOV     #DTADPB,R2      ;DPB POINTER
                                                JSR     PC,SVRHXX       ;SAVE ALL THE RHXX/RP07 REGISTERS
                                                MOV     #CLR,@RPCS2     ;MASSBUS CLEAR
                                                MOV     DTADPB,@RPCS2   ;SELECT DRIVE
                                                JSR     PC,RESREG       ;;RESTORE R0-R5
                                                JSR     R5,ERRANY       ;FIND OUT WHAT ERROR
                                                DTADPB
                                        L10116:
                                                TRAP    C$ESUB
                                                BIT     #BIT5,SVSTAT    ;POSITION ERROR?
                                                BEQ     T1812$          ;NO, CONTINUE
                                                MOV     #POSERR,-(SP)
                                                MOV     #1,-(SP)
                                                MOV     SP,R0
                                                TRAP    C$PNTF
                                                ADD     #4,SP
                                                BR      T18END

                                        T1812$: JSR     PC,COUNT        ;COUNT TIME SEARCH DONE-WRITE DONE
                                                                        ;SETUP RHXX/RP07 VECTOR
                                                MOV     RPVEC+2,-(SP)
                                                MOV     #ISRV,-(SP)
                                                MOV     RPVEC,-(SP)
                                                MOV     #3,-(SP)
                                                TRAP    C$SVEC
                                                ADD     #10,SP
                                                MOVB    #WCKD,DTADPB+2  ;DO A WRITE CHECK DATA CMD
                                                TRAP    C$BSEG
                                                JSR     R4,DRVCAL       ;DO RECALIBRATE
                                        10000$:
                                                TRAP    C$ESEG
                                                CMP     TIM.UP+14,XTIMES        ;REPEATED 1024 TIMES?
                                                BGE     T18END          ;YES, CONCLUDE TEST
                                                                        ;SETUP RHXX/RP07 VECTOR
                                                MOV     RPVEC+2,-(SP)
                                                MOV     #DORTI,-(SP)
                                                MOV     RPVEC,-(SP)
                                                MOV     #3,-(SP)
                                                TRAP    C$SVEC
                                                ADD     #10,SP
                                                JMP     TST18B          ;CONTINUE

                                        T180FL: JSR     PC,FORSEC       ;RESET TIMER TO 4 SEC, CHANGE CLK SERVICE AD
                                                                        ;DROP THE PRIORITY
                                                MOV     #PR100,R0
                                                TRAP    C$SPRI
                                                JSR     PC,SAVREG       ;;SAVE R0-R5
                                                MOV     #DTADPB,R2      ;DPB POINTER
                                                JSR     PC,SVRHXX       ;SAVE ALL THE RHXX/RP07 REGISTERS
                                                MOV     #CLR,@RPCS2     ;MASSBUS CLEAR
                                                MOV     DTADPB,@RPCS2   ;SELECT DRIVE
                                                MOV     14(R1),R2       ;ADDRESS OF SAVED REGISTER TABLE
                                                MOV     36(R2),CYL.RD   ;GET CURRENT CYLINDER
```

TEST 18: RANDOM WRITE TEST

```
        040650  116237  000006  002272          MOVB    6(R2),SEC.RD    ;GET CURRENT SECTOR
        040656  116237  000007  002270          MOVB    7(R2),TRK.RD    ;GET CURRENT TRACK
        040664  004737  010700                  JSR     PC,RESREG       ;;RESTORE R0-R5
    214 040670  104456                          TRAP    C$ERHRD
        040672  000024                          .WORD   20
        040674  006112                          .WORD   EM20
        040676  007604                          .WORD   DH44
    215 040700                          T18END:
        040700  012777  000040  141762          MOV     #CLR,@RPCS2     ;CLEAR THE MASSBUS
        040706  013777  002620  141754          MOV     DTADPB,@RPCS2   ;& SELECT DRIVE
    216 040714  004737  011676                  JSR     PC,ST.CLK       ;INITIALIZE THE CLOCK
    217
    218 040720  005737  002310          TST18C: TST     TIM.UP+6        ;ANY SEARCH-WRITE TIMED > 1 REVOLUTION?
    219 040724  001423                          BEQ     3$              ;NO, SKIP
    220 040726  023727  002310  000001          CMP     TIM.UP+6,#1     ;ONLY ONE LOST REV?
    221 040734  001405                          BEQ     1$              ;YES, FLAG SOFT ERROR
    222 040736  104456                          TRAP    C$ERHRD
        040740  000064                          .WORD   52
        040742  007432                          .WORD   EM52
        040744  010532                          .WORD   DH52
    223 040746  000404                          BR      2$
    224 040750                          1$:
        040750  104457                          TRAP    C$ERSOFT
        040752  000065                          .WORD   53
        040754  007432                          .WORD   EM52
        040756  010532                          .WORD   DH52
    225 040760                          2$:
        040760  004437  016370                  JSR     R4,TYPTIM       ;GO TYPE THE TIMES
        040764  002472                          T1420                   ;POINTER
    226 040766  004437  016240                  JSR     R4,SPTYP
    227 040772  002532                          S1420
    228 040774                          3$:
    229 040774                          XIT18:                          ;SETUP RHXX/RP07 VECTOR
    230 040774  013746  002646                  MOV     RPVEC+2,-(SP)
        041000  012746  022674                  MOV     #ISRV,-(SP)
        041004  013746  002644                  MOV     RPVEC,-(SP)
        041010  012746  000003                  MOV     #3,-(SP)
        041014  104437                          TRAP    C$SVEC
        041016  062706  000010                  ADD     #10,SP
    231
    237
    249
    250                                         .EVEN
    251
    252 041022                          L10113:
        041022  104401                          TRAP    C$ETST
    253
```

TEST 18: RANDOM WRITE TEST

```
      1
      3
```

```
                                .TITLE PARAMETER CODING
                                .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.
                                ;--

041024  000022                          .WORD L10117-L$HARD/2
041026                          L$HARD::
                                                                ;PRINT 'RPCS1 ADRS?'
041026  000031                          .WORD   T$CODE
041030  041072                          .WORD   MESG1
041032  160000                          .WORD   T$LOLIM
041034  177777                          .WORD   T$HILIM
                                                                ;PRINT 'VECTOR ADRS?'
041036  001031                          .WORD   T$CODE
041040  041105                          .WORD   MESG2
041042  000000                          .WORD   T$LOLIM
041044  000377                          .WORD   T$HILIM
                                                                ;PRINT 'BR LEVEL?'
041046  002032                          .WORD   T$CODE
041050  041121                          .WORD   MESG3
041052  000340                          .WORD   340
041054  000000                          .WORD   T$LOLIM
041056  000007                          .WORD   T$HILIM
                                                                ;PRINT 'DRIVE #?'
041060  003032                          .WORD   T$CODE
041062  041132                          .WORD   MESG4
041064  000007                          .WORD   7
041066  000000                          .WORD   T$LOLIM
041070  000007                          .WORD   T$HILIM
                                        .EVEN
041072                          L10117:

041072      122     120     103 MESG1:  .ASCIZ  /RPCS1 ADRS/
041105      126     105     103 MESG2:  .ASCIZ  /VECTOR ADRS/
041121      102     122     040 MESG3:  .ASCIZ  /BR LEVEL/
041132      104     122     111 MESG4:  .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.
                                ;--

041142  000116                          .WORD L10120-L$SOFT/2
041144                          L$SOFT::
                                                                ;PRINT 'CHANGE DRIVE PARAMETERS?'
041144  015130                          .WORD   T$CODE
041146  041400                          .WORD   PARMSG
041150  000001                          .WORD   1
                                                                ;GO TO 1$ IF NO
041152  056044                          .WORD   T$CODE
                                                                ;PRINT 'STARTING  CYL?'
041154  000052                          .WORD   T$CODE
041156  041430                          .WORD   FCMSG
041160  001777                          .WORD   1777
041162  000000                          .WORD   T$LOLIM
041164  001164                          .WORD   T$HILIM
                                                                ;PRINT 'ENDING    CYL?'
041166  001052                          .WORD   T$CODE
041170  041446                          .WORD   LCMSG
041172  001777                          .WORD   1777
041174  000001                          .WORD   T$LOLIM
041176  001165                          .WORD   T$HILIM
                                                                ;PRINT 'INCREMENT CYL?'
041200  002052                          .WORD   T$CODE
041202  041464                          .WORD   ICMSG
041204  001777                          .WORD   1777
041206  000001                          .WORD   T$LOLIM
041210  001164                          .WORD   T$HILIM
                                                                ;PRINT 'STARTING  TRK?'
041212  003052                          .WORD   T$CODE
041214  041502                          .WORD   FTMSG
041216  000037                          .WORD   37
041220  000000                          .WORD   T$LOLIM
041222  000036                          .WORD   T$HILIM
                                                                ;PRINT 'ENDING    TRK?'
041224  004052                          .WORD   T$CODE
041226  041520                          .WORD   LTMSG
041230  000037                          .WORD   37
041232  000001                          .WORD   T$LOLIM
041234  000037                          .WORD   T$HILIM
                                                                ;PRINT 'INCREMENT TRK?'
041236  005052                          .WORD   T$CODE
041240  041536                          .WORD   ITMSG
041242  000037                          .WORD   37
041244  000001                          .WORD   T$LOLIM
041246  000036                          .WORD   T$HILIM
                                                                ;PRINT 'STARTING  SEC?'
041250  006052                          .WORD   T$CODE
```

```
                041252  041554                          .WORD   FSMSG
                041254  000077                          .WORD   77
                041256  000000                          .WORD   T$LOLIM
                041260  000060                          .WORD   T$HILIM
          31
          32    041262  007052                          .WORD   T$CODE
                041264  041572                          .WORD   LSMSG
                041266  000077                          .WORD   77
                041270  000001                          .WORD   T$LOLIM
                041272  000061                          .WORD   T$HILIM
          33
          34    041274  010032                          .WORD   T$CODE
                041276  041610                          .WORD   PATMSG
                041300  177777                          .WORD   177777
                041302  000000                          .WORD   T$LOLIM
                041304  177777                          .WORD   T$HIL!M
          35    041306                          1$:
          37
          38    041306  014130                          .WORD   T$CODE
                041310  041626                          .WORD   WRITMG
                041312  000400                          .WORD   400
          39
          40    041314  007044                          .WORD   T$CODE
          41
          42
          43
          44    041316  014120                          .WORD   T$CODE
                041320  041675                          .WORD   WRSAFM
                041322  000400                          .WORD   400
          46
          47    041324  014130                          .WORD   T$CODE
                041326  042030                          .WORD   RPATMG
                041330  000001                          .WORD   1
          48    041332                          2$:
          49    041332  011130                          .WORD   T$CODE
                041334  042107                          .WORD   RDHDMG
                041336  000001                          .WORD   1
          50
          51    041340  011130                          .WORD   T$CODE
                041342  042157                          .WORD   TIMMSG
                041344  000400                          .WORD   400
          52
          53    041346  013130                          .WORD   T$CODE
                041350  042201                          .WORD   STOMSG
                041352  000400                          .WORD   400
          54
          55    041354  012130                          .WORD   T$CODE
                041356  042233                          .WORD   STLTIM
                041360  000001                          .WORD   1
          56
          57    041362  012130                          .WORD   T$CODE
                041364  042327                          .WORD   STALMG
                041366  000400                          .WORD   400
          58
          59    041370  004044                          .WORD   T$CODE
          60    041372  013130                          .WORD   T$CODE
                041374  042414                          .WORD   STALRM

;PRINT 'ENDING    SEC?'

;PRINT 'DATA  PATTERN?'

;PRINT 'DO YOU WANT TO WRITE DATA ANYWHERE ON MEDIA?

;GO TO 2$ IF NO

;PRINT '! CUSTOMER DATA WILL BE OVERWRITTEN !
;       ---------------------------------
;  CONTINUE?'

;PRINT 'USE RANDOM DATA PATTERNS FOR RANDOM WRITE -
;        TEST?'

;PRINT 'PERFORM READ HEADER & DATA DURING SEEKS?'

;PRINT 'TYPE TIME REPORTS?'

;PRINT 'INHIBIT SOFTWARE TIMEOUTS?'

;PRINT 'TIMING TESTS, STALL BETWEEN SEEKS: RANDOM IN

;PRINT 'STALL AFTER EVERY DRIVE FUNCTION IN NON-TIMI

;GO TO 3$ IF NO
```

```
                041376  000001                          .WORD   1
     61         041400                          3$:
     62
     71                                                  .EVEN
                041400                          L10120:
     72
     76         041400      103     110     101  PARMSG: .ASCIZ  /CHANGE DRIVE PARAMETERS/
     77         041430      123     124     101  FCMSG:  .ASCIZ  /STARTING  CYL/
     78         041446      105     116     104  LCMSG:  .ASCIZ  /ENDING    CYL/
     79         041464      111     116     103  ICMSG:  .ASCIZ  /INCREMENT CYL/
     80         041502      123     124     101  FTMSG:  .ASCIZ  /STARTING  TRK/
     81         041520      105     116     104  LTMSG:  .ASCIZ  /ENDING    TRK/
     82         041536      111     116     103  ITMSG:  .ASCIZ  /INCREMENT TRK/
     83         041554      123     124     101  FSMSG:  .ASCIZ  /STARTING  SEC/
     84         041572      105     116     104  LSMSG:  .ASCIZ  /ENDING    SEC/
     85         041610      104     101     124  PATMSG: .ASCIZ  /DATA  PATTERN/
     87         041626      104     117     040  WRITMG: .ASCIZ  /DO YOU WANT TO WRITE ANYWHERE ON MEDIA/
     88         041675      007     011     041  WRSAFM: .ASCII  <BELL>/ ! CUSTOMER DATA WILL BE OVERWRITTEN !/<CR><LF>
     89         041746      007     011     055          .ASCII  <BELL>/ ----------------------------------/<CR><LF>
     90         042017      103     117     116          .ASCIZ  /CONTINUE/
     92         042030      125     123     105  RPATMG: .ASCIZ  /USE RANDOM DATA PATTERNS FOR RANDOM WRITE TEST/
     93         042107      120     105     122  RDHDMG: .ASCIZ  /PERFORM READ HEADER & DATA DURING SEEKS/
     94         042157      124     131     120  TIMMSG: .ASCIZ  /TYPE TIME REPORTS/
     95         042201      111     116     110  STOMSG: .ASCIZ  /INHIBIT SOFTWARE TIMEOUTS/
     96         042233      124     111     115  STLTIM: .ASCIZ  /TIMING TESTS, STALL BETWEEN SEEKS: RANDOM INSTEAD OF 2 MSEC/
     97         042327      123     124     101  STALMG: .ASCIZ  /STALL AFTER EVERY DRIVE FUNCTION IN NON-TIMING TESTS/
     98         042414      125     123     105  STALRM: .ASCIZ  /USE RANDOM STALL TIMES/
     99
    100                                                  .EVEN
    110
    111         042444                          $PATCH::.BLKW   50.             ;PROGRAM PATCH AREA (50. WORDS)
    112
    113         042610                          DBUFF:: .BLKW   256.*25.        ;DATA BUFFER FOR HALF A TRACK
    114         073610                                  .BLKW   256.            ;ONE SECTOR EXTRA FOR MID-TRANSFER SEEK TEST
    115
    122                                                  .EVEN
                074610  074630                          .WORD T$FREE
                074612  000006                          .WORD T$SIZE
                074614                          L$LAST::
```

```
      1
     14
     16 074614  000000                        .WORD   0
        074616  000004                        .WORD   L10123-./2-1
        074620                        L10121:
     17 074620  176700                        .WORD   176700
     18 074622  000254                        .WORD   254
     19 074624  000240                        .WORD   240
     20 074626  000000                        .WORD   0
     21 074630                        L10123:
     23         000001                .END
```

SYMBOL TABLE

```
ABOPAS  015272          CI7     022364          C$RDBU= 000007          DRVTYP  020146          ERRABO  015100
ABORT   026162          CI7B    022400          C$REFG= 000047          DSNMSG  004316 G        ERRANY  012664
ABOTST  004525 G        CI8     022452          C$RESE= 000033          DTADPB  002620 G        ERRVEC= 000004
ACTDRV  020202          CLKSTA  002250 G        C$REVI= 000003          DTE    = 010000 G       EVL    = 000004 G
ACTSTR  020203          CLR    = 000040 G       C$RFLA= 000021          DTUW    020224          EWN    = 000002 G
ADJUST  014206          CLRQUE  025176          C$RPT  = 000025          DVA    = 004000 G       EXECMD  015044
ADR    = 000020 G       CMOD   = 100000 G       C$SEFG= 000046          DVC    = 000200 G       EXINIT  026236
AOE    = 001000 G       CONTIN  026124          C$SPRI= 000041          ECH    = 000100 G       EXIT1   026654
ASSEMB= 000010          COUNT   016076          C$SVEC= 000037          ECI    = 004000 G       EXIT11  034030
ATA    = 100000 G       COUNT2  015676          C$TPRI= 000013          EF.CON= 000036 G        EXIT12  034262
ATABIT  002734 G        CR     = 000015 G       DBUFF   042610 G        EF.NEW= 000035 G        EXIT13  034452
AVERAG  017106          CRLF    003054 G        DCK    = 100000 G       EF.PWR= 000034 G        EXIT14  034552
AVERGE  004721 G        CYL.DS  002274 G        DCU    = 000040 G       EF.RES= 000037 G        EXIT15  036234
AVGVAL  017167          CYL.RD  002266 G        DELTA   002342 G        EF.STA= 000040 G        EXIT16  036626
A16    = 000400 G       C$AU   = 000052         DFPTBL  002172 G        EMPTYQ  025260          EXIT17  037156
A17    = 001000 G       C$AUTO= 000061          DH25    010600 G        EM1     005331 G        EXIT18  037440
BELL   = 000007 G       C$BRK  = 000022         DH25A   003057 G        EM11    005644 G        EXIT2   026764
BITS    002352 G        C$BSEG= 000004          DH44    007604 G        EM12    005666 G        EXIT3   027210
BIT0   = 000001 G       C$BSUB= 000002          DH44A   003075 G        EM13    005707 G        EXIT4   027424
BIT00  = 000001 G       C$CEFG= 000045          DH44B   003114 G        EM14    005730 G        EXIT5   027662
BIT01  = 000002 G       C$CLCK= 000062          DH44C   003133 G        EM15    005765 G        EXIT6   027770
BIT02  = 000004 G       C$CLEA= 000012          DH44D   003152 G        EM16    006032 G        EXIT7   031020
BIT03  = 000010 G       C$CLOS= 000035          DH44E   003201 G        EM17    006065 G        E$END  = 002100
BIT04  = 000020 G       C$CLP1= 000006          DH44F   003272 G        EM2     005376 G        E$LOAD= 000035
BIT05  = 000040 G       C$CVEC= 000036          DH44G   003352 G        EM20    006112 G        FC      002204
BIT06  = 000100 G       C$DCLN= 000044          DH44H   003443 G        EM21    006161 G        FCMSG   041430
BIT07  = 000200 G       C$DODU= 000051          DH44I   003523 G        EM22    006205 G        FER    = 000020 G
BIT08  = 000400 G       C$DRPT= 000024          DH44J   003615 G        EM23    006235 G        FMTRK  = 000163 G
BIT09  = 001000 G       C$DU   = 000053         DH44K   003677 G        EM24    006271 G        FMT16  = 010000 G
BIT1   = 000002 G       C$EDIT= 000003          DH44L   003717 G        EM25    006330 G        FORSEC  012324
BIT10  = 002000 G       C$ERDF= 000055          DH45    010340 G        EM26    006366 G        FS      002220
BIT11  = 004000 G       C$ERHR= 000056          DH45A   003736 G        EM27    006436 G        FSMSG   041554
BIT12  = 010000 G       C$ERRO= 000060          DH45B   003764 G        EM3     005440 G        FT      002212
BIT13  = 020000 G       C$ERSF= 000054          DH45C   004021 G        EM30    006475 G        FTMSG   041502
BIT14  = 040000 G       C$ERSO= 000057          DH45D   004076 G        EM31    006552 G        FWD     005100 G
BIT15  = 100000 G       C$ESCA= 000010          DH52    010532 G        EM32    006614 G        F$AU   = 000015
BIT2   = 000004 G       C$ESEG= 000005          DH52A   004164 G        EM33    006637 G        F$AUTO= 000020
BIT3   = 000010 G       C$ESUB= 000003          DIAG   = 000135 G       EM34    006657 G        F$BGN  = 000040
BIT4   = 000020 G       C$ETST= 000001          DIAGMC= 000000          EM35    006674 G        F$CLEA= 000007
BIT5   = 000040 G       C$EXIT= 000032          DLT    = 100000 G       EM36    006730 G        F$DU   = 000016
BIT6   = 000100 G       C$GETB= 000026          DMD    = 100000 G       EM4     005516 G        F$END  = 000041
BIT7   = 000200 G       C$GETW= 000027          DORTI   015624          EM41    006765 G        F$HARD= 000004
BIT8   = 000400 G       C$GMAN= 000043          DOTWO   002246 G        EM42    007020 G        F$HW   = 000013
BIT9   = 001000 G       C$GPHR= 000042          DPB.A   002540 G        EM43    007045 G        F$INIT= 000006
BOE    = 000400 G       C$GPLO= 000030          DPB.B   002560 G        EM44    007067 G        F$JMP  = 000050
BSE    = 100000 G       C$GPRI= 000040          DPB.C   002600 G        EM45    007135 G        F$MOD  = 000000
BYPASS  002252 G        C$INIT= 000011          DPE    = 000010 G       EM46    007166 G        F$MSG  = 000011
CALL.A  014260          C$INLP= 000020          DPINT   020156          EM47    007216 G        F$PROT= 000021
CALL.B  014376          C$MANI= 000050          DPRQS   020166          EM5     005540 G        F$PWR  = 000017
CALL.C  014560          C$MEM  = 000031         DRVACT  020126          EM50    007246 G        F$RPT  = 000012
CHANGE  002236          C$MSG  = 000023         DRVCAL  014742          EM51    007340 G        F$SEG  = 000003
CHKTIM  017462          C$OPEN= 000034          DRVCLR= 000111 G        EM52    007432 G        F$SOFT= 000005
CI1     021456          C$PNTB= 000014          DRVINT  020414          EM54    007460 G        F$SRV  = 000010
CI3     021642          C$PNTF= 000017          DRVNO   002654 G        EM55    007521 G        F$SUB  = 000002
CI4     021754          C$PNTS= 000016          DRVQUE  025300          EM6     005560 G        F$SW   = 000014
CI5     022300          C$PNTX= 000015          DRVSN   002656 G        EM7     005616 G        F$TEST= 000001
CI6     022322          C$QIO  = 000377         DRVSTA  020136          ERR    = 040000 G       GETREG= 000141 G
```

SYMBOL TABLE

```
GETREQ  025354
G$CNTO= 000200
G$DELM= 000372
G$DISP= 000003
G$EXCP= 000400
G$HILI= 000002
G$LOLI= 000001
G$NO  = 000000
G$OFFS= 000400
G$OFSI= 000376
G$PRMA= 000001
G$PRMD= 000002
G$PRML= 000000
G$RADA= 000140
G$RADB= 000000
G$RADD= 000040
G$RADL= 000120
G$RADO= 000020
G$XFER= 000004
G$YES = 000010
HCE   = 000200 G
HCI   = 002000 G
HCRC  = 000400 G
HELP  = 000000
HERTZ   012142
HOE   = 100000 G
IAE   = 002000 G
IBE   = 010000 G
IC      002210
ICMSG   041464
IDU   = 000040 G
IE    = 000100 G
IER   = 020000 G
ILF   = 000001 G
ILLCMD= 000143 G
ILR   = 000002 G
ILV   = 000004 G
INCCYL  032754
ISR   = 000100 G
ISRCNT  002242 G
ISRV    022674
IT      002216
ITCNT   002240 G
ITMSG   041536
IXE   = 004000 G
IXU   = 000100 G
I$AU  = 000041
I$AUTO= 000041
I$CLN = 000041
I$DU  = 000041
I$HRD = 000041
I$INIT= 000041
I$MOD = 000041
I$MSG = 000041
I$PROT= 000040
I$PTAB= 000041
I$PWR = 000041

I$RPT = 000041
I$SEG = 000041
I$SETU= 000041
I$SFT = 000041
I$SRV = 000041
I$SUB = 000041
I$TST = 000041
J$JMP = 000167
KWSRV   012312
LBC   = 002000 G
LC      002206
LCE   = 001000 G
LCLKTB  012132
LCMSG   041446
LDCMD   012622
LF    = 000012 G
LKS     012134
LKV     012136
LOE   = 040000 G
LOT   = 000010 G
LS      002222
LSMSG   041572
LST   = 002000 G
LT      002214
LTMSG   041520
L$ACP   002110 G
L$APT   002036 G
L$AU    026602 G
L$AUT   002070 G
L$AUTO  026502 G
L$CCP   002106 G
L$CLEA  026504 G
L$CO    002032 G
L$DEPO  002011 G
L$DESC  003026 G
L$DESP  002076 G
L$DEVP  002060 G
L$DISP  002124 G
L$DLY   002116 G
L$DTP   002040 G
L$DTYP  002034 G
L$DU    026574 G
L$DUT   002072 G
L$DVTY  003020 G
L$EF    002052 G
L$ENVI  002044 G
L$ETP   002102 G
L$EXP1  002046 G
L$EXP4  002064 G
L$EXP5  002066 G
L$HARD  041026 G
L$HIME  002120 G
L$HPCP  002016 G
L$HPTP  002022 G
L$HW    002172 G
L$ICP   002104 G
L$INIT  025460 G

L$LADP  002026 G
L$LAST  074614 G
L$LOAD  002100 G
L$LUN   002074 G
L$MREV  002050 G
L$NAME  002000 G
L$PRIO  002042 G
L$PROT  025452 G
L$PRT   002112 G
L$REPP  002062 G
L$REV   002010 G
L$RPT   025444 G
L$SOFT  041144 G
L$SPC   002056 G
L$SPCP  002020 G
L$SPTP  002024 G
L$STA   002030 G
L$SW    002204 G
L$TEST  002114 G
L$TIML  002014 G
L$UNIT  002012 G
L10000  002202
L10001  002240
L10002  010336
L10003  010530
L10004  010576
L10005  010644
L10006  012322
L10007  012414
L10010  012566
L10011  015624
L10012  022742
L10013  025450
L10015  026500
L10016  026502
L10017  026572
L10020  026600
L10021  026606
L10022  026656
L10023  026654
L10024  026764
L10025  026710
L10026  026744
L10027  027216
L10030  027100
L10031  027164
L10032  027432
L10033  027314
L10034  027400
L10035  027662
L10036  027504
L10037  027514
L10040  027556
L10041  027566
L10042  027630
L10043  027640
L10044  027770

L10045  027736
L10046  027746
L10047  031046
L10050  030254
L10051  030560
L10052  032036
L10053  031134
L10054  031362
L10055  031554
L10056  032752
L10057  032312
L10060  032460
L10061  033630
L10062  033220
L10063  033364
L10064  034034
L10065  034002
L10066  034262
L10067  034154
L10070  034230
L10071  034452
L10072  034374
L10073  034436
L10074  035770
L10075  034550
L10076  035124
L10077  035470
L10100  036246
L10101  036126
L10102  036152
L10103  036224
L10104  036634
L10105  036404
L10106  036434
L10107  036530
L10110  036560
L10111  037156
L10112  037052
L10113  041022
L10114  037430
L10115  040060
L10116  040426
L10117  041072
L10120  041400
L10121  074620
L10123  074630
MAINT = 000145 G
MARK    005033 G
MCPE  = 020000 G
MESG1   041072
MESG2   041105
MESG3   041121
MESG4   041132
MPE   = 000400 G
MSGABV  017257
MSGAVG  017156
MSGBEL  017202

MSGMAX  017133
MSGMIN  017110
MSGNON  017443
MSGNUM  017334
MSGOPE  017411 G
MSGSEA  017361
MSG10X  005132 G
MSG11X  005132 G
MSG12X  005132 G
MSG14X  005132 G
MSG7X   005132 G
MSPGE = 002000 G
MSSC  = 100000 G
MXF   = 001000 G
MXSEEK  004766 G
NC1     002256 G
NC2     002260 G
NED   = 010000 G
NEDMSG  005201 G
NEM   = 004000 G
NOCLK   004232 G
NOOP  = 000101 G
NOTMSG  005273 G
NS1     002264 G
NT1     002262 G
OCTHEX  011430
OFFSET= 000115 G
OFLMSG  005240 G
OM    = 000001 G
ONECYL  004647 G
ONEFIL= 000001
OPI   = 020000 G
OPT     021212
O$APTS= 000000
O$AU  = 000000
O$BGNR= 000000
O$BGNS= 000001
O$DU  = 000000
O$ERRT= 000000
O$GNSW= 000001
O$POIN= 000001
O$SETU= 000001
PARMSG  041400
PAT     002224
PATMSG  041610
PCLKTB  012116
PGE   = 100000 G
PHF   = 000400 G
PKB     012122
PKC     012124
PKCS    012120
PKV     012126
PNT   = 001000 G
POPQUE  025376
POSERR  004544 G
PRI   = 002000 G
PRIOO = 000000 G
```

SYMBOL TABLE

```
PRI01 = 000040 G    RPEC2   002726 G    STALLF  002231      TST12   034156      T$$SUB= 010116
PRI02 = 000100 G    RPER1   002674 G    STALL1  002346 G    TST12A  034232      T$$SW = 010001
PRI03 = 000140 G    RPER2   002720 G    STALL2  002350 G    TST13   034376      T$$TES= 010113
PRI04 = 000200 G    RPER3   002722 G    STALMG  042327      TST14A  034564      T1      026610 G
PRI05 = 000240 G    RPINIT  020226      STALRD  002232      TST15   036140      T1.1    026634
PRI06 = 000300 G    RPLA    002700 G    STALRM  042414      TST18A  037444      T10     032756 G
PRI07 = 000340 G    RPMR1   002704 G    STLTIM  042233      TST18B  037546      T10.1   033076
PSTACK  011564      RPOF    002712 G    STO     024026      TST18C  040720      T10.1$  033100
QCNT    024704      RPSN    002710 G    STOFLG  002233      TWOMS   012450      T10.2   033244
QDRV0   024776      RPSTU0  020026      STOMSG  042201      TYPTIM  016370      T10.2$  033232
QDRV1   025016      RPSTU1  020036      STOPCK  012262      T$ARGC= 000001      T10.3$  033420
QDRV2   025036      RPSTU2  020046      STRTMR  015626      T$CODE= 013130      T10.4$  033376
QDRV3   025056      RPSTU3  020056      ST.CLK  011676      T$ERRN= 000065      T10.7$  033442
QDRV4   025076      RPSTU4  020066      ST.LCL  012216      T$EXCP= 000000      T10.8$  033546
QDRV5   025116      RPSTU5  020076      ST.PCL  012144      T$FLAG= 000040      T11     033632 G
QDRV6   025136      RPSTU6  020106      SVCGBL= 000000      T$FREE= 074630      T11.1   033726
QDRV7   025156      RPSTU7  020116      SVCINS= 000000      T$GMAN= 000000      T11.2$  033730
QINPT   024714      RPTMR   023732      SVCSUB= 000000      T$HILI= 177777      T11.5$  034004
QOUTPT  024734      RPVEC   002644 G    SVCTAG= 000000      T$LAST= 000001      T12     034036 G
QSTART  024754      RPWC    002662 G    SVCTST= 000000      T$LOLI= 000000      T12.1   034126
QSTOP   024756      RP07    020750      SVRHXX  024472      T$LSYM= 010000      T12.2   034202
QTERP = 025176      RTC   = 000117 G    SVSTAT  002254 G    T$LTNO= 000022      T13     034264 G
RANADR  017544      RWU1  = 002000 G    S$LSYM= 010000      T$NEST= 177777      T13.1   034342
RAND    011610      RWU2  = 004000 G    S1420   002532 G    T$NS0 = 000000      T13.1$  034444
RANPAT  002234      RWU3  = 010000 G    TD      022744      T$NS1 = 000005      T13.2   034404
RDDAT = 000171 G    SAVREG  010646      TEST1   026616      T$NS2 = 000003      T14     034454 G
RDHD  = 000173 G    SC      023132      TEST10  033006      T$PCNT= 000000      T14.1   034542
RDHDMG  042107      SCTRWC= 177400 G    TEST13  034276      T$PTAB= 010122      T14.1$  034666
RDTD  = 000175 G    SC11    023440      TEST14  034536      T$PTHV= 000001      T14.2   034744
RDY   = 000200 G    SC12    023530      TEST15  036010      T$PTNU= 000001      T14.3   035346
RD.RP   024254      SC13    023614      TEST16  036336      T$SAVL= 177777      T14.7$  035542
READIN= 000121 G    SC3     023202      TEST17  037012      T$SEGL= 177777      T14.8$  035646
RECAL = 000107 G    SC4     023206      TEST18  037316      T$SEK0= 010000      T1410$  034744
REDHDR  002226      SC5     023220      TEST3   027010      T$SIZE= 000006      T1411$  035350
REG     002744 G    SC6     023362      TEST4   027242      T$SUBN= 000003      T1412$  035524
RELSE = 000113 G    SC8     023410      TEST5   027464      T$TAGL= 177777      T1420   002472 G
RESREG  010700      SDF   = 000020 G    TEST6   027714      T$TAGN= 010124      T15     035772 G
REV     005115 G    SEABAD  004461 G    TEST7   030024      T$TEMP= 000000      T15.1   036120
RHEXT   002650 G    SEAERR  004422 G    TEST8   031100      T$TEST= 000022      T15.2   036136
RHTYPE  002652 G    SEARCH= 000131 G    TEST9   032070      T$TSTM= 177777      T15.3   036216
RMR   = 000004 G    SEC.DS  002276 G    TICKMS  012112      T$TSTS= 000001      T16     036250 G
ROTATE  004605 G    SEC.RD  002272 G    TICKUS  012114      T$$AU = 010021      T16.1   036370
RPADR   002642 G    SEEK  = 000105 G    TIMER   020204      T$$AUT= 010016      T16.2   036406
RPAS    002676 G    SETFOR= 000147 G    TIMMSG  042157      T$$CLE= 010017      T16.3   036514
RPATMG  042030      SET.IE  024632      TIMSTL  002230      T$$DAT= 010123      T16.4   036532
RPBA    002664 G    SFPTBL  002204 G    TIMTYP  002227      T$$DU = 010020      T17     036636 G
RPBAE   002730 G    SIZE70  010732      TIMT10  002442 G    T$$HAR= 010117      T17.1   037010
RPCC    002716 G    SKI   = 040000 G    TIMT11  002452 G    T$$HW = 010000      T18     037160 G
RPCS1   002660 G    SNDIGT  004342 G    TIMT12  002462 G    T$$INI= 010015      T18END  040700
RPCS2   002670 G    SPTYP   016240      TIM.DN  002320 G    T$$MSG= 010005      T18OFL  040574
RPCS3   002732 G    SP10    002510 G    TIM.PT  002336 G    T$$PC = 000001      T18.1   037402
RPDA    002666 G    SP11    002516 G    TIM.UP  002302 G    T$$PRO= 010014      T18.2   037700
RPDB    002702 G    SP12    002524 G    TRE   = 040000 G    T$$PTA= 010122      T18.3   040304
RPDC    002714 G    SP7     002502 G    TRKWC   002344 G    T$$RPT= 010013      T1811$  040306
RPDS    002672 G    SRCHWT  020200      TRK.DS  002300 G    T$$SEG= 010000      T1812$  040462
RPDT    002706 G    SRCH00  015476      TRK.RD  002270 G    T$$SOF= 010120      T2      026660 G
RPEC1   002724 G    STALL   015274      TRNSWT  020176      T$$SRV= 010012      T2.1    026702
```

SYMBOL TABLE

```
T2.11   026702          T6      027664 G        T8.10$  031610          T9.8$   032670          WRTDAT= 000161 G
T2.2    026736          T6.1    027730          T8.2    031240          UAM    = 000200 G       WRTENM  004345 G
T2.21   026736          T6.11   027732          T8.2$   031374          UNIT    002640 G        WRTTD = 000165 G
T3      026766 G        T6.2    027740          T8.3    031432          UNS    = 040000 G       WRT.RP  024346
T3.1    027072          T7      027772 G        T8.3$   031406          UNSMSG  005150 G        WRYUNS= 000400 G
T3.11   027074          T7A     002432 G        T8.4$   031416          UPE    = 020000 G       XIT14   035742
T3.2    027102          T7.1    030140          T8.5$   031136          VERIFY  015354          XIT18   040774
T4      027220 G        T7.1$   030142          T8.6$   031622          WCE    = 040000 G       XTIMES  002244 G
T4.1    027306          T7.10$  030266          T8.7$   031650          WCEFLG  002340 G        X$ALWA= 000000
T4.2    027316          T7.2    030444          T8.8$   031754          WCF    = 000040 G       X$FALS= 000040
T5      027434 G        T7.2$   030446          T8.9$   031566          WCKD   = 000151 G       X$OFFS= 000400
T5.1    027476          T7.20$  030402          T9      032040 G        WCKHD  = 000153 G       X$TRUE= 000020
T5.11   027500          T7.3$   030644          T9.1    032202          WLE    = 004000 G       $DIV    011074
T5.2    027506          T7.44$  030332          T9.1$   032164          WOR    = 001000 G       $MULT   011316
T5.3    027550          T7.7$   030660          T9.2    032336          WRITMG  041626          $PATCH  042444 G
T5.31   027552          T7.8$   030764          T9.2$   032324          WRPAT   036372          $RNCON  011670
T5.4    027560          T8      031050 G        T9.3$   032514          WRPATN  036516          $RP1    011672
T5.5    027622          T8.1    031126          T9.4$   032472          WRSAFM  041675          $RP2    011674
T5.51   027624          T8.1$   031224          T9.7$   032536          WRTALL  002235          $$FLG   017542
T5.6    027632

. ABS.  074630      000
        000000      001
ERRORS DETECTED:  0

VIRTUAL MEMORY USED:  30464 WORDS  ( 119 PAGES)
DYNAMIC MEMORY AVAILABLE FOR  70 PAGES
CZRJLA.BIC,CZRJLA/C=[20,0]SVC34R.MLB,[20,12]CZRJLA.DOC,CZRJLA.HIS,CZRJLA
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CROSS REFERENCE TABLE (CREF V04.00)

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$$$MFG    2-16     2-29     6-3      7-267    7-320    64-27    65-31    68-36    68-86
$$FLG    31-37    31-43    31-101*  31-114*  31-117#
$DIV     20-25#   30-84    31-50    31-107   50-39    51-36
$MULT    21-14#   30-77
$PATCH   68-111#
$RNCON   23-10*   23-13    23-25#
$RP1     23-8     23-15*   23-26#   24-160   28-60    32-9     32-34    32-59    50-34    51-31    65-67    65-96
$RP2     23-14    23-18    23-21*   23-27#
A16      12-7#    19-31    19-36
A17      12-8#    19-31    19-36
ABOPAS   28-45#   42-11    42-139
ABORT    42-35    42-93#   42-135
ABOTST   16-68#   54-61    54-74    61-97    61-119   65-153   65-175
ACTDRV   33-104#  34-148*  34-197*  36-5*    36-14*   36-202
ACTSTR   33-110#  36-204*  36-218*
ADJUST   25-24    26-6#
ADR      11-57#
AOE      12-88#   25-108   59-33    59-37
ASSEMB    7-278    7-278
ATA      12-74#
ATABIT   15-37#   34-113   34-210   35-74    36-36    36-134   36-140   36-141   36-170
AVERAG   31-54*   31-55    31-75#
AVERGE   13-90    16-73#
AVGVAL   31-55    31-83#
BELL     16-14    68-88    68-89
BIT0     11-57#   22-14    25-170
BIT00    11-57    11-57#   13-50    13-66
BIT01    11-57    11-57#   13-51    13-67    34-188   35-206
BIT02    11-57    11-57#   13-52    13-68
BIT03    11-57    11-57#   13-53    13-69
BIT04    11-57    11-57#   13-54    13-70
BIT05    11-57    11-57#   13-55    13-71
BIT06    11-57    11-57#   13-56    13-72    34-122   34-178   34-250   36-45    36-393
BIT07    11-57    11-57#   13-57    13-73    34-122   35-150   36-26    36-138   36-357
BIT08    11-57    11-57#   13-58    34-122
BIT09    11-57    11-57#   13-59
BIT1     11-57#   25-173   28-17
BIT10    11-57#   13-60    28-29    35-209
BIT11    11-57#   13-61    28-29    34-77    35-176
BIT12    11-57#   13-62    28-33    34-71    34-104   34-122   34-191   34-225   35-204   36-294   36-329   36-394
BIT13    11-57#   13-63    36-102   36-296
BIT14    11-57#   13-64    28-33    34-185   34-222   36-181   36-262   36-391   54-52    54-67    54-84    54-95    55-50    55-78
         56-41    56-61    57-38    57-58    61-88    61-112   61-130   65-144   65-168   65-186
BIT15    11-57#   13-65    30-50    30-51    34-185   34-188   34-191   34-222   34-225   35-38    35-41    35-62    35-65    35-160
         35-163   35-176   35-206   35-209   36-45    36-181   36-247   36-250   36-262   36-269
BIT2     11-57#   25-176   28-21    36-269
BIT3     11-57#   25-180   36-333   54-58    54-90    61-94    65-150
BIT4     11-57#   25-183
BIT5     11-57#   25-186   55-56    55-84    56-47    56-67    57-44    57-64    61-136   65-192
BIT6     11-57#   25-189
BIT7     11-57#   25-192   26-37    26-66    26-106   54-58    54-90    61-94    65-150
BIT8     11-57#   25-195   34-217   36-186
BIT9     11-57#   28-25    36-247   36-250
BITS     13-50#
BOE      11-57#
BSE      12-166#  25-198
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CROSS REFERENCE TABLE (CREF V04.00)

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BYPASS  13-13#  28-37   42-11*  42-135* 42-139*
C$AU     7-278# 46-34
C$AUTO   7-278# 43-17
C$BRK    7-278#
C$BSEG   7-278# 65-201
C$BSUB   7-278# 48-62   49-18   49-25   50-46   50-49   51-41   51-44   52-27   52-30   52-42   52-45   52-57   52-60
        53-15   53-18   54-44   54-76   55-25   55-41   55-69   56-34   56-52   57-29   57-49   58-32   59-20   59-31
        60-19   60-28   61-30   61-69   61-121  62-37   62-42   62-56   63-38   63-42   63-63   63-67   64-52   65-70
        65-125  65-177
C$CEFG   7-278#
C$CLCK   7-278# 24-16   24-35
C$CLEA   7-278# 44-26
C$CLOS   7-278#
C$CLP1   7-278#
C$CVEC   7-278# 42-98   42-100  42-101  44-18   44-21   44-23
C$DCLN   7-278# 28-45   42-102  62-34
C$DODU   7-278#
C$DRPT   7-278#
C$DU     7-278# 45-33
C$EDIT   7-278#  7-323
C$ERDF   7-278# 28-19   28-23   28-27   28-31   28-35   62-33
C$ERHR   7-278# 25-27   25-32   25-39   25-44   25-49   25-58   25-63   25-68   25-73   25-84   25-89   25-92   25-95
        25-100  25-105  25-110  25-115  25-120  25-125  25-132  25-137  25-144  25-147  25-152  25-157  25-162  25-167
        25-200  29-22   54-112  55-102  56-84   57-79   59-24   59-35   60-24   60-33   61-150  61-157  65-214  65-222
C$ERRO   7-278#
C$ERSF   7-278#
C$ERSO   7-278# 61-159  65-224
C$ESCA   7-278#
C$ESEG   7-278# 65-203
C$ESUB   7-278# 48-67   49-20   49-27   50-48   50-64   51-43   51-60   52-29   52-32   52-44   52-47   52-59   52-62
        53-17   53-20   54-57   54-89   55-27   55-55   55-83   56-46   56-66   57-43   57-63   58-44   59-25   59-36
        60-25   60-34   61-32   61-93   61-135  62-39   62-45   62-58   63-41   63-47   63-66   63-72   64-60   65-75
        65-149  65-191
C$ETST   7-278# 48-68   49-31   50-71   51-67   52-67   53-25   54-120  55-110  56-92   57-87   58-52   59-45   60-38
        61-166  62-63   63-85   64-83   65-252
C$EXIT   7-278# 42-91   42-103  42-165  44-24   54-26   55-15   55-18   56-18   56-21   57-17   57-20   60-35   61-35
        64-33   65-37   65-78
C$GETB   7-278#
C$GETW   7-278#
C$GMAN   7-278#
C$GPHR   7-278# 42-39
C$GPLO   7-278#
C$GPRI   7-278# 34-18   34-145  34-209
C$INIT   7-278# 42-180
C$INLP   7-278#
C$MANI   7-278#
C$MEM    7-278#
C$MSG    7-278# 17-27   17-36   17-42   17-48
C$OPEN   7-278#
C$PNTB   7-278# 17-4    17-5    17-6    17-10   17-26   17-30   17-31   17-35   17-39   17-41   17-45   17-47
C$PNTF   7-278# 30-165  30-168  30-171  30-173  31-29   31-32   31-34   31-39   31-40   31-45   31-46   31-55   31-62
        31-64   31-66   42-29   42-71   42-73   42-75   42-77   42-85   42-114  42-127  42-132  54-60   54-61   54-73
        54-74   55-86   56-69   57-66   61-96   61-97   61-118  61-119  61-138  64-31   65-35   65-152  65-153  65-174
        65-175  65-194
C$PNTS   7-278#
C$PNTX   7-278# 17-12   17-13   17-15   17-16   17-18   17-19   17-23   17-24   17-32   17-33
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CROSS REFERENCE TABLE (CREF V04.00)

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C$QIO    7-278#
C$RDBU   7-278#
C$REFG   7-278#  42-16   42-20   42-25
C$RESE   7-278#   7-278#  42-10
C$REVI   7-278#   7-323
C$RFLA   7-278#
C$RPT    7-278#  40-76
C$SEFG   7-278#
C$SPRI   7-278#  34-20   34-45   34-147  34-199  34-254  44-10   54-110  55-100  56-80   57-77   61-148  65-212
C$SVEC   7-278#  24-84   24-94   24-126  24-135  24-155  24-170  34-36   42-89   54-37   54-39   54-119  55-32   55-34
        55-109  56-27   56-29   56-83   56-91   57-26   57-28   57-86   61-44   61-46   61-165  65-86   65-88   65-199
        65-207  65-230
C$TPRI   7-278#
CALL.A  26-26#  26-28   29-24   42-138  48-63   50-47   51-42
CALL.B  26-55#  26-57   48-64   49-19   49-26   50-63   51-59   52-28   52-43   52-58   53-16
CALL.C  26-95#  26-97   52-31   52-46   52-61   53-19
CHANGE  10-29#
CHKTIM  31-28   31-101#
CI1     34-237  35-12#
CI3     34-240  35-52#
CI4     34-232  35-77#
CI5     35-50   35-75   35-154#  35-171
CI6     35-94   35-105  35-108   35-110  35-160#
CI7     34-171  34-249  35-23    35-33   35-37   35-44   35-48   35-57   35-61   35-68   35-73   35-85   35-93   35-100
        35-104  35-115  35-119   35-130  35-142  35-148  35-166  35-170  35-172#  36-30   36-126  36-371
CI7B    35-178#  36-129
CI8     35-181  35-191#  36-58
CLKSTA  13-12#  24-13*   24-31*   24-46*  24-102  42-80   42-95   44-14   54-24   55-13   56-16   57-15   61-19   65-51
CLR     12-30#  30-11    34-37    35-224  42-94   44-11   54-54   54-69   54-86   54-97   54-111  54-113  55-52   55-80
        55-101  55-103   56-43    56-63   56-81   56-85   57-40   57-60   57-78   57-80   61-90   61-114  61-132  61-149
        61-151  65-146   65-170   65-188  65-213  65-215
CLRQUE  34-21   35-223   38-7#
CMOD    12-174#
CONTIN  42-23   42-88#
COUNT   30-117#  54-103   55-58    55-88   57-47   57-69   61-141  65-197
COUNT2  30-71#  56-50    56-72
CR      16-12   68-88    68-89
CRLF    16-39#  17-26    17-35    17-41   17-47   30-173  42-29   42-132
CYL.DS  13-25#  17-31    17-33    26-32*  26-61*  26-101*  27-18*  29-20*  30-21*
CYL.RD  13-22#  17-4     17-33    25-19*  26-12*  28-13*  29-15*  54-111*  55-101*  56-81*  57-78*  61-149*  65-213*
DBUFF   14-8    14-32    14-56    14-80   29-10*  29-11   29-13   29-15   29-16   29-17   30-49   30-143  58-26   59-15
        61-26   61-75    62-25    63-22   64-38   65-43   68-113#
DCK     12-94#  25-78
DCU     12-159#  25-155
DELTA   13-44#
DFPTBL   9-9#
DH25    17-44#  28-19    28-31    28-35   62-33
DH25A   16-40#  17-45
DH44    17-3#   25-27    25-32    25-39   25-44   25-49   25-58   25-63   25-68   25-73   25-84   25-89   25-92   25-95
        25-100  25-105   25-110   25-115  25-120  25-125  25-132  25-137  25-144  25-147  25-152  25-157  25-162  25-167
        25-200  28-23    28-27    54-112  55-102  56-84   57-79   61-150  65-214
DH44A   16-42#  17-4
DH44B   16-43#  17-5
DH44C   16-44#  17-6
DH44D   16-45#  17-10
DH44E   16-46#  17-12
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DH44F    16-47#  17-13
DH44G    16-48#  17-15
DH44H    16-49#  17-16
DH44I    16-50#  17-18
DH44J    16-51#  17-19
DH44K    16-52#  17-23
DH44L    16-53#  17-24
DH45     17-29#  29-22
DH45A    16-55#  17-30
DH45B    16-56#  17-31
DH45C    16-57#  17-32
DH45D    16-58#  17-33
DH52     17-38#  61-157  61-159  65-222  65-224
DH52A    16-60#  17-39
DIAG     12-208# 35-17
DIAGMC    7-278   7-278
DLT      12-40#  25-47
DMD      12-99#  35-20   35-139  62-35   62-62   63-27   63-84
DORTI    30-35#  54-39   55-34   56-29   57-28   61-46   65-88   65-207
DOTWO    13-11#  55-20*  55-92   55-94*  58-31*  58-34   58-36*  58-41*  63-30*  63-48   63-50*  63-54*  63-73   63-75*
         64-43*  64-61   64-63*  64-67*
DPB.A    14-3#   26-27   26-29   26-32   26-32   26-32   26-34   26-36   26-39   26-40*  26-42   26-44*  29-23*  42-105*
         42-136* 42-137* 48-59*  50-26*  50-45*  50-50   51-25*  51-45
DPB.B    14-27#  24-187* 24-190* 26-56   26-58   26-61   26-61   26-61   26-63   26-65   26-68   26-69*  26-71   26-73*
         26-75   26-77   26-80   42-106* 48-60*  48-61*  49-15*  49-16*  49-17*  49-21*  49-22   49-24*  49-28*  49-29
         50-25*  50-27*  50-40*  50-45   50-55*  50-57   50-60*  50-62*  50-65*  50-66   50-68*  51-24*  51-26*  51-37*
         51-50*  51-52   51-55*  51-58*  51-61*  51-62   51-64*  52-18*  52-19*  52-25*  52-33*  52-40*  52-48*  52-55*
         52-63*  53-9*   53-10*  53-13*  53-21*
DPB.C    14-51#  24-188* 24-191* 26-96   26-98   26-101  26-101  26-101  26-103  26-105  26-108  26-109* 26-111  26-113*
         26-116  26-118  26-121  42-107* 52-20*  52-21*  52-26*  52-34*  52-35   52-41*  52-49*  52-50   52-56*  52-64*
         52-65   53-11*  53-12*  53-14*  53-22*  53-23
DPE      12-157# 25-98
DPINT    33-64#  34-63*  34-79   34-130* 36-171  36-173* 36-239  36-256*
DPRQS    33-77#  34-160  34-211* 34-243* 35-183* 35-196  35-212*  36-78   36-241  36-265*
DRVACT   33-22#  34-166  35-157* 35-184* 35-194  35-211*  36-19*  36-89   36-123  36-133*  36-252*
DRVCAL   27-9#   27-12   55-26   58-33   60-20   60-29   61-31   62-38   62-44   62-57   63-40   63-44   63-46   63-65
         63-69   63-71   64-57   64-59   65-72   65-74   65-202
DRVCLR   12-202#
DRVINT   34-39   34-62#  34-155  36-159  36-174
DRVNO    15-7#   17-13   17-31   17-45   34-38   42-60*  42-63   42-105  42-106  42-107  42-108  42-113  42-114  44-12
         58-23   59-12   60-13   61-23   62-23   62-28   63-20   64-36   65-41
DRVQUE   34-163  34-174  38-47#
DRVSN    15-8#   42-126* 42-127
DRVSTA   33-36#  34-31*  34-32*  34-33*  34-34*  34-43*  34-67*  34-76*  34-119* 34-124*  34-153  34-158  34-183  34-219
         34-223  35-228* 36-81   36-87   36-93   36-176  36-257*  42-64
DRVTYP   33-51#  34-68*  34-87*  34-92*  34-97*  34-186  35-229*  42-67   62-29   62-31
DSNMSG   16-63#  42-114
DTADPB   14-75#  27-11   27-13   27-18   27-18   27-18   27-20   27-22   27-36   27-38   27-44   27-45   30-12*  30-13*
         30-14*  30-16   30-18   30-21   30-21   30-21   30-23   30-25   32-33*  32-57*  32-83*  42-108* 54-54   54-54
         54-56   54-70   54-86   54-86   54-88   54-98   54-111  54-111  54-113  55-21*  55-24*  55-38*  55-39   55-43
         55-52   55-52   55-54   55-61*  55-66*  55-67   55-71   55-80   55-80   55-82   55-91*  55-101  55-101  55-103
         56-43   56-43   56-45   56-63   56-63   56-65   56-81   56-81   56-85   57-40   57-40   57-42   57-60   57-60
         57-62   57-78   57-78   57-80   58-23*  58-24*  58-25*  58-26*  58-27*  58-28*  58-29*  58-30*  58-37*  58-38*
         58-42*  58-43*  58-45   58-49*  59-12*  59-13*  59-14*  59-15*  59-16*  59-17*  59-18*  59-19*  59-29   59-30*
         59-43   60-13*  60-14*  60-15*  60-16*  60-17*  60-18*  60-21   60-27*  60-30   61-23*  61-24*  61-25*  61-26*
         61-27*  61-53   61-70   61-72   61-90   61-90   61-92   61-115  61-122  61-132  61-132  61-134  61-149  61-149
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CROSS REFERENCE TABLE (CREF V04.00)

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        61-151   62-23*   62-24*   62-25*   62-26*   62-27*   62-35*   62-36*   62-40    62-43*   62-46    62-48    62-50*   62-53*
        62-54*   62-55*   62-62*   63-20*   63-21*   63-22*   63-23*   63-24*   63-25*   63-26*   63-27*   63-31*   63-33    63-34
        63-39*   63-43*   63-45*   63-51*   63-55*   63-58    63-59    63-64*   63-68*   63-70*   63-76*   63-79    63-81*   63-84*
        64-36*   64-37*   64-38*   64-39*   64-40*   64-41*   64-42*   64-45    64-46    64-53    64-55*   64-56*   64-58*   64-64*
        64-68*   64-69    64-73*   64-79*   64-80*   65-41*   65-42*   65-43*   65-44*   65-45    65-46    65-58    65-60    65-64
        65-65    65-71*   65-73*   65-93    65-94    65-105   65-107   65-109   65-126   65-128   65-130   65-131   65-146   65-146
        65-148   65-171   65-178   65-188   65-188   65-190   65-200*  65-213   65-213   65-215
DTE     12-91#   25-76
DTUW    33-129#  34-27    34-235   35-49*   35-188*  35-199   35-213   35-215*  35-221*  36-8     36-20*   36-237   36-254*
DVA     12-57#
DVC     12-161#  59-39
E$END    7-278#
E$LOAD   7-278#   7-323
ECH     12-85#   25-80    25-129   25-130
ECI     12-172#
EF.CON  11-57#   42-20
EF.NEW  11-57#   42-25
EF.PWR  11-57#   42-16
EF.RES  11-57#
EF.STA  11-57#
EM1     16-92#   25-27
EM11    16-100#  25-68
EM12    16-101#  25-73
EM13    16-102#  25-92
EM14    16-103#  25-100
EM15    16-104#  25-105
EM16    16-105#  25-110
EM17    16-106#  25-120
EM2     16-93#   25-32
EM20    16-108#  54-112   55-102   56-84    57-79    61-150   65-214
EM21    16-109#  25-125
EM22    16-110#  25-132
EM23    16-111#  25-137
EM24    16-112#  25-144
EM25    16-113#  28-19
EM26    16-114#  28-23
EM27    16-115#  28-27
EM3     16-94#   25-39
EM30    16-117#  28-31
EM31    16-118#  28-35
EM32    16-119#  25-152
EM33    16-120#  25-157
EM34    16-121#  25-162
EM35    16-122#  25-167
EM36    16-123#  62-33
EM4     16-95#   25-44
EM41    16-125#  25-115
EM42    16-126#  29-22
EM43    16-127#  25-89
EM44    16-128#  25-200
EM45    16-129#  25-95
EM46    16-130#  25-147
EM47    16-131#  25-84
EM5     16-96#   25-49
EM50    16-133#  59-24
EM51    16-134#  59-35
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EM52     16-135#  61-157   61-159   65-222   65-224
EM54     16-136#  60-24
EM55     16-137#  60-33
EM6      16-97#   25-58
EM7      16-98#   25-63
EMPTYQ   35-182   35-227   36-46    36-271   38-32#
ERR      12-73#   25-37    25-52    59-26
ERRABO   26-33    26-62    26-102   27-19    27-41    28-9#    30-22
ERRANY   25-15#   26-35    26-64    26-104   27-21    30-24    54-55    54-87    55-53    55-81    56-44    56-64    57-41    57-61
         59-28    59-42    61-91    61-133   65-147   65-189
ERRVEC   19-8     19-11    19-12*   19-39*
EVL      11-57#
EWN      12-63#   25-123
EXECMD   27-35#   27-37    59-21    59-32
EXINIT   42-81    42-83    42-86    42-105#
EXIT1    48-67#
EXIT11   58-48    58-51#
EXIT12   59-45#
EXIT13   60-38#
EXIT14   61-33#
EXIT15   62-41    62-47    62-61#
EXIT16   63-84#
EXIT17   64-77    64-83#
EXIT18   65-78#
EXIT2    49-31#
EXIT3    50-69#
EXIT4    51-65#
EXIT5    52-67#
EXIT6    53-25#
EXIT7    54-29    54-118#
F$AU      7-278#  46-9     46-34
F$AUTO    7-278#  43-10    43-17
F$BGN     7-278#   7-304   10-40    11-51    17-3     17-29    17-38    17-44    24-112   24-130   24-165   30-34    36-4     39-1
         40-41    40-47    41-8     42-8     42-91    42-103   42-165   43-10    44-8     44-24    45-8     46-9     46-35    48-38
         48-57    48-62    48-62    48-67    48-68    49-14    49-18    49-18    49-20    49-25    49-25    49-27    49-31    50-23
         50-46    50-46    50-48    50-49    50-49    50-64    50-71    51-22    51-41    51-41    51-43    51-44    51-44    51-60
         51-67    52-17    52-27    52-27    52-29    52-30    52-30    52-32    52-42    52-42    52-44    52-45    52-45    52-47
         52-57    52-57    52-59    52-60    52-60    52-62    52-67    53-8     53-15    53-15    53-17    53-18    53-18    53-20
         53-25    54-23    54-26    54-44    54-44    54-57    54-76    54-76    54-89    54-120   55-12    55-15    55-18    55-25
         55-25    55-27    55-41    55-41    55-55    55-69    55-69    55-83    55-110   56-15    56-18    56-21    56-34    56-34
         56-46    56-52    56-52    56-66    56-92    57-14    57-17    57-20    57-29    57-29    57-43    57-49    57-49    57-63
         57-87    58-20    58-32    58-32    58-44    58-52    59-9     59-20    59-20    59-25    59-31    59-31    59-36    59-45
         60-10    60-19    60-19    60-25    60-28    60-28    60-34    60-35    60-38    61-17    61-30    61-30    61-32    61-35
         61-69    61-69    61-93    61-121   61-121   61-135   61-166   62-19    62-37    62-37    62-39    62-42    62-42    62-45
         62-56    62-56    62-58    62-63    63-18    63-38    63-38    63-41    63-42    63-42    63-47    63-63    63-63    63-66
         63-67    63-67    63-72    63-85    64-25    64-33    64-52    64-52    64-60    64-83    65-29    65-37    65-70    65-70
         65-75    65-78    65-125   65-125   65-149   65-177   65-177   65-191   65-201   65-252   66-2     67-43    67-53    68-12
         68-123   69-15    69-16    69-16    69-21    69-22
F$CLEA    7-278#  44-8     44-26
F$DU      7-278#  45-8     45-33
F$END     7-278    7-278    7-278    7-278    7-278    7-278    7-278    7-278    7-278    7-278    7-278    7-278    7-278    7-278
          7-278    7-278    7-278#   7-304   10-40    11-51    17-27    17-36    17-42    17-48    24-115   24-133   24-168   30-36
         36-15    39-1     40-41    40-61    40-76    42-91    42-103   42-165   42-180   43-17    44-24    44-26    45-18    45-33
         46-19    46-34    46-35    48-38    48-57    48-57    48-57    48-62    48-62    48-67    48-67    48-68    48-68    49-14
         49-14    49-14    49-18    49-18    49-20    49-20    49-25    49-25    49-27    49-27    49-31    49-31    50-23    50-23
         50-23    50-46    50-46    50-48    50-48    50-49    50-49    50-64    50-64    50-71    50-71    51-22    51-22    51-22
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CROSS REFERENCE TABLE (CREF V04.00)

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                51-41   51-41   51-43   51-43   51-44   51-44   51-60   51-60   51-67   51-67   52-17   52-17   52-17   52-27
                52-27   52-29   52-29   52-30   52-30   52-32   52-32   52-42   52-42   52-44   52-44   52-45   52-45   52-47
                52-47   52-57   52-57   52-59   52-59   52-60   52-60   52-62   52-62   52-67   52-67   53-8    53-8    53-8
                53-15   53-15   53-17   53-17   53-18   53-18   53-20   53-20   53-25   53-25   54-23   54-23   54-23   54-26
                54-44   54-44   54-57   54-57   54-76   54-76   54-89   54-89   54-120  54-120  55-12   55-12   55-12   55-15
                55-18   55-25   55-25   55-27   55-27   55-41   55-41   55-55   55-55   55-69   55-69   55-83   55-83   55-110
                55-110  56-15   56-15   56-15   56-18   56-21   56-34   56-34   56-46   56-46   56-52   56-52   56-66   56-66
                56-92   56-92   57-14   57-14   57-14   57-17   57-20   57-29   57-29   57-43   57-43   57-49   57-49   57-63
                57-63   57-87   57-87   58-20   58-20   58-20   58-32   58-32   58-44   58-44   58-52   58-52   59-9    59-9
                59-9    59-20   59-20   59-25   59-25   59-31   59-31   59-36   59-36   59-45   59-45   60-10   60-10   60-10
                60-19   60-19   60-25   60-25   60-28   60-28   60-34   60-34   60-35   60-38   60-38   61-17   61-17   61-17
                61-30   61-30   61-32   61-32   61-35   61-69   61-69   61-93   61-93   61-121  61-121  61-135  61-135  61-166
                61-166  62-19   62-19   62-19   62-37   62-37   62-39   62-39   62-42   62-42   62-45   62-45   62-56   62-56
                62-58   62-58   62-63   62-63   63-18   63-18   63-18   63-38   63-53   63-41   63-41   63-42   63-42   63-47
                63-47   63-63   63-63   63-66   63-66   63-67   63-67   63-72   63-72   63-85   63-85   64-25   64-25   64-25
                64-33   64-52   64-52   64-60   64-60   64-83   64-83   65-29   65-29   65-29   65-37   65-70   65-70   65-75
                65-75   65-78   65-125  65-125  65-149  65-149  65-177  65-177  65-191  65-191  65-203  65-252  65-252  66-2
                67-43   67-62   68-71   68-123  69-15   69-16   69-21   69-22
F$HARD           7-278# 67-53   67-62   68-16   68-40   68-59
F$HW             7-278#  9-9     9-21
F$INIT           7-278# 42-8    42-180
F$JMP            7-278# 40-61   40-61   42-91   42-103  42-165  44-24   45-18   45-18   46-19   46-19   54-26   55-15   55-18
                56-18   56-21   57-17   57-20   60-35   61-35   64-33   65-37   65-78
F$MOD            7-278#  7-304  10-40   11-51   39-1    40-41   46-35   48-38   66-2    67-43   68-123
F$MSG            7-278# 17-3    17-27   17-29   17-36   17-38   17-42   17-44   17-48
F$PROT           7-278# 41-8    41-12
F$PWR            7-278#
F$RPT            7-278# 40-47   40-76
F$SEG            7-278# 65-201  65-203
F$SOFT           7-278# 68-12   68-16   68-40   68-59   68-71
F$SRV            7-278# 24-112  24-115  24-130  24-133  24-165  24-168  30-34   30-36   36-4    36-15
F$SUB            7-278# 48-62   48-67   49-18   49-20   49-25   49-27   50-46   50-48   50-49   50-64   51-41   51-43   51-44
                51-60   52-27   52-29   52-30   52-32   52-42   52-44   52-45   52-47   52-57   52-59   52-60   52-62   53-15
                53-17   53-18   53-20   54-44   54-57   54-76   54-89   55-25   55-27   55-41   55-55   55-69   55-83   56-34
                56-46   56-52   56-66   57-29   57-43   57-49   57-63   58-32   58-44   59-20   59-25   59-31   59-36   60-19
                60-25   60-28   60-34   61-30   61-32   61-69   61-93   61-121  61-135  62-37   62-39   62-42   62-45   62-56
                62-58   63-38   63-41   63-42   63-47   63-63   63-66   63-67   63-72   64-52   64-60   65-70   65-75   65-125
                65-149  65-177  65-191
F$SW             7-278# 10-8    10-39
F$TEST           7-278# 48-57   48-68   49-14   49-31   50-23   50-71   51-22   51-67   52-17   52-67   53-8    53-25   54-23
                54-120  55-12   55-110  56-15   56-92   57-14   57-87   58-20   58-52   59-9    59-45   60-10   60-38   61-17
                61-166  62-19   62-63   63-18   63-85   64-25   64-83   65-29   65-252
FC              10-9#   32-66   32-69   32-72   49-17   49-29   50-27   50-28   50-38   51-26   51-35   53-13   53-23   54-40
                55-21   55-22   55-67   58-29   60-16   64-41
FCMSG           68-18   68-77#
FER             12-83#  25-129  25-130  25-135
FMT16           12-173#
FMTRK           12-213#
FORSEC          24-123# 54-108  55-98   56-78   57-75   61-146  65-210
FS              10-15#  32-16   32-19   32-22   49-15   52-18   53-9    54-41   60-14
FSMSG           68-30   68-83#
FT              10-12#  32-41   32-44   32-46   49-16   50-25   50-68   51-24   51-64   52-19   53-10   54-42   58-28   60-15
                63-23   64-40   64-79
FTMSG           68-24   68-80#
FWD             16-76#
G$CNTO           7-278#
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CROSS REFERENCE TABLE (CREF V04.00)

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G$DELM    7-278#
G$DISP    7-278#
G$EXCP    7-278#
G$HILI    7-278#
G$LOLI    7-278#
G$NO      7-278#  68-44
G$OFFS    7-278#  67-55   67-57   67-59   67-61   68-14   68-18   68-20   68-22   68-24   68-26   68-28   68-30   68-32
          68-34   68-38   68-44   68-47   68-49   68-51   68-53   68-55   68-57   68-60
G$OFSI    7-278#  67-55   67-57   67-59   67-61   68-14   68-18   68-20   68-22   68-24   68-26   68-28   68-30   68-32
          68-34   68-38   68-44   68-47   68-49   68-51   68-53   68-55   68-57   68-60
G$PRMA    7-278#  67-55   67-57
G$PRMD    7-278#  67-59   67-61   68-18   68-20   68-22   68-24   68-26   68-28   68-30   68-32   68-34
G$PRML    7-278#  68-14   68-38   68-44   68-47   68-49   68-51   68-53   68-55   68-57   68-60
G$RADA    7-278#
G$RADB    7-278#
G$RADD    7-278#  68-18   68-20   68-22   68-24   68-26   68-28   68-30   68-32
G$RADL    7-278#  68-14   68-38   68-44   68-47   68-49   68-51   68-53   68-55   68-57   68-60
G$RADO    7-278#  67-55   67-57   67-59   67-61   68-34
G$XFER    7-278#  68-16   68-40   68-59
G$YES     7-278#  67-55   67-57   67-59   67-61   68-14   68-18   68-20   68-22   68-24   68-26   68-28   68-30   68-32
          68-34   68-38   68-47   68-49   68-51   68-53   68-55   68-57   68-60
GETREG    12-223# 35-122
GETREQ    34-212  35-201  36-37   36-83   36-120  36-125  36-180  36-244  36-259  36-266  38-68#
HCE       12-86#  25-129  25-130  25-140
HCI       12-171#
HCRC      12-87#  25-129  25-130  25-140  25-142
HELP       7-259#  7-273   7-295   7-312   7-326   8-10    9-15   10-32   11-4#   11-41   12-232  15-50   16-19   16-29
          16-143  16-155  17-50   38-94   38-103  38-110  40-4#   40-49   40-63   41-14   42-141  42-167  43-11   45-9
          45-20   46-10   46-21   47-5#   48-45   48-52   65-232  65-238  65-254  67-5#   67-77   67-87   68-63   68-104
          68-116  69-2
HERTZ     24-14*  24-30*  24-45*  24-53   24-78#
HOE       11-57#
I$AU       7-278# 46-9#   46-34#
I$AUTO     7-278# 43-10#  43-17#
I$CLN      7-278# 44-8#   44-24   44-26#
I$DU       7-278# 45-8#   45-33#
I$HRD     67-53#  67-62#
I$INIT     7-278# 42-8#   42-91   42-103  42-165  42-180#
I$MOD      7-278#  7-304   7-304#  10-40   10-40#  11-51   11-51#  39-1    39-1#   40-41   40-41#  46-35   46-35#  48-38
          48-38#  66-2    66-2#   67-43   67-43#  68-123  68-123#
I$MSG      7-278# 17-3#   17-27#  17-29#  17-36#  17-38#  17-42#  17-44#  17-48#
I$PROT     7-278# 41-8#
I$PTAB     7-278# 69-16   69-16#  69-21   69-21#
I$PWR      7-278#
I$RPT      7-278# 40-47#  40-76#
I$SEG      7-278# 48-57   48-62   49-14   49-18   49-25   50-23   50-46   50-49   51-22   51-41   51-44   52-17   52-27
          52-30   52-42   52-45   52-57   52-60   53-8    53-15   53-18   54-23   54-44   54-76   55-12   55-25   55-41
          55-69   56-15   56-34   56-52   57-14   57-29   57-49   58-20   58-32   59-9    59-20   59-31   60-10   60-19
          60-28   61-17   61-30   61-69   61-121  62-19   62-37   62-42   62-56   63-18   63-38   63-42   63-63   63-67
          64-25   64-52   65-29   65-70   65-125  65-177  65-201# 65-203#
I$SETU     7-278# 69-15   69-15#  69-16   69-22   69-22#
I$SFT     68-12#  68-71#
I$SRV      7-278# 24-112# 24-115# 24-130# 24-133# 24-165# 24-168# 30-34# 30-36#  36-4#  36-15#
I$SUB      7-278# 48-57   48-62   48-62#  48-67   48-67#  48-67#  49-14   49-18   49-18#  49-20   49-20#  49-20#  49-25
          49-25#  49-27   49-27#  49-27#  50-23   50-46   50-46#  50-48   50-48#  50-48#  50-49   50-49#  50-64   50-64#
          50-64#  51-22   51-41   51-41#  51-43   51-43#  51-43#  51-44   51-44#  51-60   51-60#  51-60#  52-17   52-27
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CROSS REFERENCE TABLE (CREF V04.00)

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L$DESC    7-323    16-27#
L$DESP    7-323#
L$DEVP    7-323#
L$DISP    7-323     8-8#
L$DLY     7-323#
L$DTP     7-323#
L$DTYP    7-323#
L$DU     45-8#
L$DUT     7-323#
L$DVTY    7-323    16-17#
L$EF      7-323#
L$ENVI    7-323#
L$ETP     7-323#
L$EXP1    7-323#
L$EXP4    7-323#
L$EXP5    7-323#
L$HARD    7-323    67-53    67-53#
L$HIME    7-323#
L$HPCP    7-323#
L$HPTP    7-323#
L$HW      7-323     9-9      9-9#
L$ICP     7-323#
L$INIT    7-323    42-8#
L$LADP    7-323#
L$LAST    7-323    68-122#  69-22
L$LOAD    7-323#
L$LUN     7-323#
L$MREV    7-323#
L$NAME    7-323#
L$PRIO    7-323#
L$PROT    7-323    41-8#
L$PRT     7-323#
L$REPP    7-323#
L$REV     7-323#
L$RPT    40-47#
L$SOFT    7-323    68-12    68-12#
L$SPC     7-323#
L$SPCP    7-323#
L$SPTP    7-323#
L$STA     7-323#
L$SW      7-323    10-8     10-8#
L$TEST    7-323#   30-138   31-56    31-58    31-60    31-102   64-31    65-35
L$TIML    7-323#
L$UNIT    7-323#   42-34
L10000    9-9       9-21#
L10001   10-8      10-39#
L10002   17-27#
L10003   17-36#
L10004   17-42#
L10005   17-48#
L10006   24-115#
L10007   24-133#
L10010   24-168#
L10011   30-36#
L10012   36-15#
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CROSS REFERENCE TABLE (CREF V04.00)

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L10013  40-61    40-76#
L10015  42-91    42-103   42-165   42-180#
L10016  43-17#
L10017  44-24    44-26#
L10020  45-18    45-33#
L10021  46-19    46-34#
L10022  48-68#
L10023  48-67#
L10024  49-31#
L10025  49-20#
L10026  49-27#
L10027  50-71#
L10030  50-48#
L10031  50-64#
L10032  51-67#
L10033  51-43#
L10034  51-60#
L10035  52-67#
L10036  52-29#
L10037  52-32#
L10040  52-44#
L10041  52-47#
L10042  52-59#
L10043  52-62#
L10044  53-25#
L10045  53-17#
L10046  53-20#
L10047  54-26    54-120#
L10050  54-57#
L10051  54-89#
L10052  55-15    55-18    55-110#
L10053  55-27#
L10054  55-55#
L10055  55-83#
L10056  56-18    56-21    56-92#
L10057  56-46#
L10060  56-66#
L10061  57-17    57-20    57-87#
L10062  57-43#
L10063  57-63#
L10064  58-52#
L10065  58-44#
L10066  59-45#
L10067  59-25#
L10070  59-36#
L10071  60-35    60-38#
L10072  60-25#
L10073  60-34#
L10074  61-35    61-166#
L10075  61-32#
L10076  61-93#
L10077  61-135#
L10100  62-63#
L10101  62-39#
L10102  62-45#
L10103  62-58#
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L10104   63-85#
L10105   63-41#
L10106   63-47#
L10107   63-66#
L10110   63-72#
L10111   64-33    64-83#
L10112   64-60#
L10113   65-37    65-78    65-252#
L10114   65-75#
L10115   65-149#
L10116   65-191#
L10117   67-53    67-62#
L10120   68-12    68-71#
L10121   69-16#
L10123   69-16    69-21#
LBC      12-164#  25-61
LC       10-10#   30-81    32-64    32-74    49-22    49-24    50-28    50-36    51-33    53-14    55-39    57-31    64-80
LCE      12-163#  25-118
LCLKTB   24-41*   24-73#
LCMSG    68-20    68-78#
LDCMD    24-184#  42-134
LF       16-13    68-88    68-89
LKS      24-42*   24-75#   24-95*   24-107*
LKV      24-44*   24-76#   24-94    42-100   44-21
LOE      11-57#
LOT      11-57#
LS       10-16#   32-14    32-24    52-20    53-11
LSMSG    68-32    68-84#
LST      12-69#   59-22
LT       10-13#   32-39    32-48    50-66    51-62    52-21    53-12    58-47    63-82    64-71
LTMSG    68-26    68-81#
MAINT    12-225#  35-137
MARK     13-100   16-75#
MCPE     12-10#   25-25
MESG1    67-55    67-67#
MESG2    67-57    67-68#
MESG3    67-59    67-69#
MESG4    67-61    67-70#
MPE      12-33#   25-30
MSG10X   13-115   16-80#
MSG11X   13-119   16-81#
MSG12X   13-123   16-83#
MSG14X   13-127   16-82#
MSG7X    13-110   16-79#
MSGABV   31-45    31-85#
MSGAVG   31-46    31-82#
MSGBEL   31-39    31-84#
MSGMAX   30-171   31-40    31-81#
MSGMIN   30-168   31-34    31-80#
MSGNON   31-32    31-89#
MSGNUM   31-62    31-86#
MSGOPE   31-66    31-88#
MSGSEA   31-64    31-87#
MSPGE    12-35#   25-35
MSSC     12-12#
MXF      12-34#   25-35
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CROSS REFERENCE TABLE (CREF V04.00)

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MXSEEK  13-95    16-74#
NC1     13-17#   52-35    52-50    52-65    56-23    59-18
NC2     13-18#   62-27    63-24
NED     12-37#   25-35
NEDMSG  16-86#   42-75
NEM     12-36#   25-35
NOCLK   16-62#   42-85
NOOP    12-199#
NOTMSG  16-88#   42-71
NS1     13-20#   26-8     50-56    51-51    59-16
NT1     13-19#   26-11    59-17    62-48
O$APTS   7-278#   7-323
O$AU     7-278#   7-323
O$BGNR   7-278#   7-323
O$BGNS   7-278#   7-310#   7-323
O$DU     7-278#   7-323
O$ERRT   7-278#   7-323
O$GNSW   7-278#   7-310#   7-323
O$POIN   7-278#   7-310    7-310#   7-310#   7-310#   7-323
O$SETU   7-278#   7-310#   7-323    68-122
OCTHEX  17-9     22-4#
OFFSET  12-204#  35-96    60-18
OFLMSG  16-87#   42-73
OM      12-62#   60-22    60-31
ONECYL  13-85    16-72#
ONEFIL   2-4#     2-8      4-903    5-1      7-263#   7-299    10-41    11-1     11-8#    11-13    39-2     40-1     40-8#    40-13
        46-36    47-1     47-9#    48-3     66-4     67-1     67-9#    67-15
OPI     12-92#   25-113
OPT     34-168   34-208#  36-40    36-145   36-194
PARMSG  68-14    68-76#
PAT     10-17#   63-32    63-56    64-44    65-47
PATMSG  68-34    68-85#
PCLKTB  24-22*   24-64#
PGE     12-151#  25-56
PHF     12-162#  25-165
PKB     24-24*   24-25*   24-67#   24-85*   24-127*  24-136*  24-156*  24-162*  24-171*  54-45*   54-51*   54-77*   54-83*   55-42*
        55-49*   55-70*   55-77*   56-33*   56-40*   56-53*   56-60*   57-30*   57-37*   57-50*   57-57*   61-77*   61-87*   61-101*
        61-111*  61-123*  61-129*  65-133*  65-143*  65-157*  65-167*  65-179*  65-185*
PKC     24-26*   24-27*   24-68#   30-76    30-91    30-93    30-95    30-96    30-99    30-101   30-102   30-121   30-123   30-124
        30-128   30-130   30-131   30-135   30-146   54-49    54-81    55-47    55-75    56-38    56-58    57-35    57-55    61-85
        61-109   61-127   65-141   65-165   65-183
PKCS    24-23*   24-66#   24-86*   24-105*  24-123*  24-128*  24-131*  24-152*  24-163*  24-166*  54-46*   54-50*   54-79*   54-82*
        55-45*   55-48*   55-73*   55-76*   56-36*   56-39*   56-56*   56-59*   57-33*   57-36*   57-53*   57-56*   61-42*   61-82*
        61-86*   61-106*  61-110*  61-125*  61-128*  65-84*   65-138*  65-142*  65-162*  65-166*  65-181*  65-184*
PKV     24-29*   24-69#   24-84    24-124   24-126   24-135   24-153   24-155   24-170   42-98    44-18    54-37    55-32    56-27
        57-26    61-44    65-86
PNT     11-57#
POPQUE  34-221   35-12    35-149   36-137   36-183   38-83#
POSERR  16-69#   55-86    56-69    57-66    61-138   65-194
PRI     11-57#
PRI00   11-57#   54-39    54-110   55-34    55-100   56-29    56-80    57-28    57-77    61-46    61-148   65-88    65-212
PRI01   11-57#
PRI02   11-57#
PRI03   11-57#
PRI04   11-57#
PRI05   11-57#   34-20
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CROSS REFERENCE TABLE (CREF V04.00)

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PR106   11-57#  24-84   24-94   24-126  24-135  24-155  24-170  54-37   55-32   56-27   57-26   61-44   65-86
PR107   11-57#  44-10
PSTACK  17-10   17-10   17-10   17-10   22-6    22-21   22-40#
QCNT    37-3#   38-8    38-32*  38-47   38-49*  38-69   38-83*
QDRV0   37-14   37-25   37-34   37-46#
QDRV1   37-15   37-26   37-35   37-47#
QDRV2   37-16   37-27   37-36   37-48#
QDRV3   37-17   37-28   37-37   37-49#
QDRV4   37-18   37-29   37-38   37-50#
QDRV5   37-19   37-30   37-39   37-51#
QDRV6   37-20   37-31   37-40   37-52#
QDRV7   37-21   37-32   37-41   37-53#
QINPT   37-14#  38-34   38-51*  38-52*  38-53   38-55*
QOUTPT  37-25#  38-34*  38-72   38-85   38-86*  38-87*  38-88   38-90*
QSTART  37-34#  38-14   38-19   38-55   38-90
QSTOP   37-35#  38-53   38-88
QTERP   37-42   37-54#
RANADR  32-8#   61-29   61-52   65-56   65-103
RAND    23-7#   24-159  28-59   32-8    32-58   50-33   51-30   65-66   65-95
RANPAT  10-26#  65-62   65-91
RD.RP   34-83   34-108  34-114  35-98   35-113  35-128  36-28   36-56   36-287#  36-362
RDDAT   12-215# 58-24   59-13   61-24   61-124
RDHD    12-216# 24-187  24-188  26-75   26-116  62-43
RDHDMG  68-49   68-93#
RDTD    12-217#
RDY     12-6#
READIN  12-206#
RECAL   12-201# 26-40   26-69   26-109  29-23   30-14   35-107  48-59   48-59   51-25   51-25
REDHDR  10-19#  24-185
REG     14-15   14-39   14-63   14-87   15-48#  17-7    17-13   17-13   17-13   17-13   17-13   17-13   17-16   17-16
        17-16   17-16   17-16   17-16   17-16   17-19   17-19   17-19   17-19   17-19   17-19   17-19   17-24   17-24
        58-30   59-19   60-17   61-27   63-25   64-42   65-44
RELSE   12-203#
RESREG  18-21#  30-52   34-46   34-192  34-195  34-255  35-231  36-13   36-217  36-378  38-23   54-54   54-86   54-111
        55-52   55-80   55-101  56-43   56-63   56-81   57-40   57-60   57-78   61-90   61-132  61-149  65-146  65-188
        65-213
REV     13-86   13-91   13-96   16-77#
RHEXT   15-5#   19-9*   19-18*  19-22*  19-28   36-375  42-50
RHTYPE  15-6#   17-20   19-10*  19-38*  36-372  42-48
RMR     12-81#  25-103
ROTATE  13-79   16-71#
RP07    26-26   26-41   26-55   26-70   26-95   26-110  27-10   27-35   30-15   34-144#
RPADR   15-3#   36-374  42-57*
RPAS    15-17#  34-113* 36-36*  36-54   36-140* 36-170*
RPATMG  68-47   68-92#
RPBA    15-12#  61-75*  65-131*
RPBAE   15-30#
RPCC    15-25#  34-177* 34-247*
RPCS1   15-10#  34-70*  34-77   34-178  34-216* 34-250  35-15   35-52   35-77   36-43*  36-48*  36-49*  36-289  36-292
        36-296  36-320  36-325  36-327  36-331  36-388  42-37   54-47*  54-65*  54-78*  54-93*  55-44*  55-72*  56-35*
        56-55*  57-32*  57-52*  61-83*  61-107* 61-124* 65-139* 65-163* 65-180*
RPCS2   15-14#  30-11*  34-37*  34-69*  34-71   34-162* 34-215* 35-16*  35-53*  35-78*  35-204  35-224* 36-27*  36-121*
        36-148* 36-169* 36-351* 36-357  36-389* 36-394  42-94*  42-113* 44-11*  44-12*  50-50*  51-45*  54-54*  54-54*
        54-69*  54-70*  54-86*  54-86*  54-97*  54-98*  54-111* 54-111* 54-113* 54-113* 55-52*  55-52*  55-80*  55-80*
        55-101* 55-101* 55-103* 55-103* 56-43*  56-43*  56-63*  56-63*  56-81*  56-81*  56-85*  56-85*  57-40*  57-40*
        57-60*  57-60*  57-78*  57-78*  57-80*  57-80*  61-90*  61-90*  61-114* 61-115* 61-132* 61-132* 61-149* 61-149*
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	61-151*	61-151*	65-146*	65-146*	65-170*	65-171*	65-188*	65-188*	65-213*	65-213*	65-215*	65-215*		
RPCS3	15-31#													
RPDA	15-13#	30-28*	54-43*	61-73*	61-122*	65-129*	65-178*							
RPDB	15-19#													
RPDC	15-24#	30-29*	54-40*	55-43*	55-71*	56-32*	56-54*	57-31*	57-51*	61-70*	65-126*			
RPDS	15-15#	34-217	36-152	36-186	54-52	54-67	54-84	54-95	55-50	55-78	56-41	56-61	57-38	57-58
	61-54	61-88	61-112	61-130	65-110	65-144	65-168	65-186						
RPDT	15-21#													
RPEC1	15-28#													
RPEC2	15-29#													
RPER1	15-16#	36-153												
RPER2	15-26#	36-154												
RPER3	15-27#	36-155												
RPINIT	34-15#	42-62	58-21	58-51	59-10	60-11	61-21	62-20	62-61	63-19	64-26	65-30	65-53	
RPLA	15-18#	50-51	51-46											
RPMR1	15-20#													
RPOF	15-23#													
RPSN	15-22#	42-115												
RPSTU0	33-11#	34-22	36-98	36-152*	36-153*	36-154*	36-155*							
RPSTU1	33-11#													
RPSTU2	33-													
RPSTU3	33-													
RPSTU4	33-1													
RPSTU5	33-11#													
RPSTU6	33-11#													
RPSTU7	33-11#													
RPTMR	24-114	36-202#												
RPVEC	15-4#	34-36	34-36	34-147	42-58*	42-59*	42-89	42-89	42-101	44-23	54-39	54-119	54-119	55-34
	55-109	55-109	56-29	56-83	56-83	56-91	56-91	57-28	57-86	57-86	61-46	61-165	61-165	65-88
	65-199	65-199	65-207	65-207	65-230	65-230								
RPWC	15-11#	61-74*	65-130*											
RTC	12-205#	35-109	60-27											
RWU1	12-148#	25-150												
RWU2	12-149#	25-150												
RWU3	12-150#	25-150												
S$LSYM	7-278#	9-21#	10-39#	17-27#	17-36#	17-42#	17-48#	24-115#	24-133#	24-168#	30-36#	36-15#	40-76#	42-180#
	43-17#	44-26#	45-33#	46-34#	48-67#	48-68#	49-20#	49-27#	49-31#	50-48#	50-64#	50-71#	51-43#	51-60#
	51-67#	52-29#	52-32#	52-44#	52-47#	52-59#	52-62#	52-67#	53-17#	53-20#	53-25#	54-57#	54-89#	54-120#
	55-27#	55-55#	55-83#	55-110#	56-46#	56-66#	56-92#	57-43#	57-63#	57-87#	58-44#	58-52#	59-25#	59-36#
	59-45#	60-25#	60-34#	60-38#	61-32#	61-93#	61-135#	61-166#	62-39#	62-45#	62-58#	62-63#	63-41#	63-47#
	63-66#	63-72#	63-85#	64-60#	64-83#	65-75#	65-149#	65-191#	65-201	65-201	65-201#	65-252#	67-62#	68-71#
S1420	13-127#	61-162	65-227											
SAVREG	18-6#	30-43	34-15	34-149	34-208	35-191	36-7	36-205	36-348	38-7	54-54	54-86	54-111	55-52
	55-80	55-101	56-43	56-63	56-81	57-40	57-60	57-78	61-90	61-132	61-149	65-146	65-188	65-213
SC	36-12	36-41	36-44	36-50	36-54#									
SC11	36-122	36-132#												
SC12	36-85	36-91	36-148#											
SC13	36-80	36-166#												
SC3	36-70#	36-74												
SC4	36-72#	36-111	36-115	36-130	36-146	36-195								
SC5	36-71	36-77#												
SC6	36-90	36-117#												
SC8	36-107	36-123#	36-164											
SCTRWC	12-219#	59-14	59-30	62-24										
SDF	12-158#													
SEABAD	16-67#	54-73	61-118	65-174										

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SEAERR  16-66#    54-60     61-96     65-152
SEARCH  12-207#   35-70     35-80     54-47     54-65     54-78     54-93     61-83     61-107    65-139    65-163
SEC.DS  13-26#    17-31     17-33     26-32*    26-61*    26-101*   27-18*    29-18*    30-21*
SEC.RD  13-24#    17-6      17-33     25-20*    26-6      26-8*     26-14*    28-14*    29-17*    54-111*   55-101*   56-81*    57-78*    61-149*
        65-213*
SEEK    12-200#   24-190    24-191    35-88     50-26     50-26     55-24     55-44     55-72     56-35     56-55     57-32     57-52     62-36
        62-55     63-39     63-64
SET.IE  34-73     34-180    34-252    35-230    36-64     36-191    36-387#
SETFOR  12-226#   35-111    42-137    48-59     50-26     51-25
SFPTBL  10-8#
SIZE70  19-9#     42-47
SKI     12-165#   25-118
SNDIGT  16-64#    42-127
SP10    13-115#   55-107
SP11    13-119#   56-89
SP12    13-123#   57-84
SP7     13-110#   54-117
SPTYP   30-161#   54-116    55-106    56-88     57-83     61-161    65-226
SRCH00  30-10#    54-27     55-16     56-19     57-18     61-37     65-80
SRCHWT  33-98#    34-210*   35-74*    36-134    36-141*
ST.CLK  24-13#    34-16     42-90     54-114    55-104    56-86     57-81     61-152    65-216
ST.LCL  24-47     24-90#
ST.PCL  24-32     24-80#
STALL   26-85     26-125    27-26     28-56#
STALL1  13-46#    26-86     26-126
STALL2  13-47#    27-27
STALLF  10-22#    26-83     26-123    27-24
STALMG  68-57     68-97#
STALRD  10-24#    28-57
STALRM  68-60     68-98#
STLTIM  68-55     68-96#
STO     36-212    36-232#
STOFLG  10-25#    24-81     24-91
STOMSG  68-53     68-95#
STOPCK  24-102#   42-93     44-13     54-35     55-30     56-25     57-24     58-22     59-11     61-22     62-21     63-28     64-50     65-55
STRTMR  30-43#    54-34     55-29     56-24     57-23     61-41     65-83
SVCGBL    7-278#    7-287#    7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323
          7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323
          7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323
          7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323
          7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323
          7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323
          7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323
          7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323
          7-323     7-323     7-323     7-323     8-8       8-8       8-8       9-9       9-9       9-9       9-9       9-9       9-9       10-8
        10-8      10-8      10-8      10-8      10-8      16-17     16-17     16-17     16-27     16-27     16-27     17-3      17-3      17-3
        17-29     17-29     17-29     17-38     17-38     17-38     17-44     17-44     17-44     40-47     40-47     40-47     41-8      41-8
        41-8      42-8      42-8      42-8      43-10     43-10     43-10     44-8      44-8      44-8      45-8      45-8      45-8      46-9
        46-9      46-9      67-53     67-53     67-53     68-12     68-12     68-12     68-122    68-122    68-122    68-122#
SVCINS    7-278#    7-284#    7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323     7-323
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CROSS REFERENCE TABLE (CREF V04.00)

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CROSS REFERENCE TABLE (CREF V04.00)

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CROSS REFERENCE TABLE (CREF V04.00)

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61-165	61-165	61-165	61-165	61-165	61-165	61-165	61-165	61-166	61-166	62-33	62-33	62-33	62-33
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62-56	62-56	62-58	62-58	62-63	62-63	63-38	63-38	63-41	63-41	63-42	63-42	63-47	63-47
63-63	63-63	63-66	63-66	63-67	63-67	63-72	63-72	63-85	63-85	64-31	64-31	64-31	64-31
64-31	64-31	64-31	64-31	64-31	64-31	64-31	64-31	64-33	64-33	64-33	64-33	64-52	64-52
64-60	64-60	64-83	64-83	65-35	65-35	65-35	65-35	65-35	65-35	65-35	65-35	65-35	65-35
65-35	65-35	65-37	65-37	65-37	65-37	65-70	65-70	65-75	65-75	65-78	65-78	65-78	65-78
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65-88	65-88	65-88	65-88	65-88	65-88	65-88	65-88	65-88	65-88	65-125	65-125	65-149	65-149
65-152	65-152	65-152	65-152	65-152	65-152	65-152	65-152	65-152	65-152	65-153	65-153	65-153	65-153
65-153	65-153	65-153	65-153	65-153	65-153	65-174	65-174	65-174	65-174	65-174	65-174	65-174	65-174
65-174	65-174	65-175	65-175	65-175	65-175	65-175	65-175	65-175	65-175	65-175	65-175	65-177	65-177
65-191	65-191	65-194	65-194	65-194	65-194	65-194	65-194	65-194	65-194	65-194	65-194	65-199	65-199
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65-230	65-230	65-230	65-230	65-230	65-230	65-230	65-230	65-230	65-230	65-252	65-252	67-53	67-53
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68-71	68-71	68-122	68-122	68-122	68-122	68-122	68-122	69-16	69-16	69-16	69-16		
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50-49	50-49	50-49	51-41	51-41	51-41	51-44	51-44	51-44	52-27	52-27	52-27	52-30	52-30
52-30	52-42	52-42	52-42	52-45	52-45	52-45	52-57	52-57	52-57	52-60	52-60	52-60	53-15
53-15	53-15	53-18	53-18	53-18	54-44	54-44	54-44	54-76	54-76	54-76	55-25	55-25	55-25
55-41	55-41	55-41	55-69	55-69	55-69	56-34	56-34	56-34	56-52	56-52	56-52	57-29	57-29
57-29	57-49	57-49	57-49	58-32	58-32	58-32	59-20	59-20	59-20	59-31	59-31	59-31	60-19
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62-37	62-37	62-37	62-42	62-42	62-42	62-56	62-56	62-56	63-38	63-38	63-38	63-42	63-42
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CROSS REFERENCE TABLE (CREF V04.00)

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        17-42   17-42   17-42   17-48   17-48   17-48  24-115 24-115 24-115 24-133 24-133 24-133 24-168 24-168
        24-168  30-36   30-36   30-36   36-15   36-15  36-15  40-76  40-76  40-76  42-180 42-180 42-180 43-17
        43-17   43-17   44-26   44-26   44-26   45-33  45-33  45-33  46-34  46-34  46-34  48-67  48-67  48-67
        48-68   48-68   48-68   49-20   49-20   49-20  49-27  49-27  49-27  49-31  49-31  49-31  50-48  50-48
        50-48   50-64   50-64   50-64   50-71   50-71  50-71  51-43  51-43  51-43  51-60  51-60  51-60  51-67
        51-67   51-67   52-29   52-29   52-29   52-32  52-32  52-32  52-44  52-44  52-44  52-47  52-47  52-47
        52-59   52-59   52-59   52-62   52-62   52-62  52-67  52-67  52-67  53-17  53-17  53-17  53-20  53-20
        53-20   53-25   53-25   53-25   54-57   54-57  54-57  54-89  54-89  54-89  54-120 54-120 54-120 55-27
        55-27   55-27   55-55   55-55   55-55   55-83  55-83  55-83  55-110 55-110 55-110 56-46  56-46  56-46
        56-66   56-66   56-66   56-92   56-92   56-92  57-43  57-43  57-43  57-63  57-63  57-63  57-87  57-87
        57-87   58-44   58-44   58-44   58-52   58-52  58-52  59-25  59-25  59-25  59-36  59-36  59-36  59-45
        59-45   59-45   60-25   60-25   60-25   60-34  60-34  60-34  60-38  60-38  60-38  61-32  61-32  61-32
        61-93   61-93   61-93   61-135  61-135  61-135 61-166 61-166 61-166 62-39  62-39  62-39  62-45  62-45
        62-45   62-58   62-58   62-58   62-63   62-63  62-63  63-41  63-41  63-41  63-47  63-47  63-47  63-66
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        56-15   57-14   57-14   57-14   58-20   58-20  58-20  59-9   59-9   59-9   60-10  60-10  60-10  61-17
        61-17   61-17   62-19   62-19   62-19   63-18  63-18  63-18  64-25  64-25  64-25  65-29  65-29  65-29
SVRHXX  35-151  36-33   36-47   36-84   36-139  36-182 36-251 36-270 36-348# 54-54  54-86  54-111 55-52  55-80
        55-101  56-43   56-63   56-81   57-40   57-60  57-78  61-90  61-132 61-149 65-146 65-188 65-213
SVSTAT  13-15#  25-16*  25-170* 25-173* 25-176* 25-180* 25-183* 25-186* 25-189* 25-192* 25-195* 26-37  26-66  26-106
        54-58   54-90   55-56   55-84   56-47   56-67  57-44  57-64  61-94  61-136 65-150 65-192
T$$AU   46-9#   46-19   46-34
T$$AUT  43-10#  43-17
T$$CLE  44-8#   44-24   44-26
T$$DAT  69-16   69-16#  69-21
T$$DU   45-8#   45-18   45-33
T$$HAR  67-53   67-53#  67-62
T$$HW    9-9     9-9#    9-21
T$$INI  42-8#   42-91   42-103  42-165  42-180
T$$MSG  17-3#   17-27   17-29#  17-36   17-38#  17-42  17-44#  17-48
T$$PC   69-15#  69-22
T$$PRO  41-8#
T$$PTA  69-15#  69-16   69-16#
T$$RPT  40-47#  40-61   40-76
T$$SEG  65-201  65-201#  65-203  65-203#
T$$SOF  68-12   68-12#  68-71
T$$SRV  24-112#  24-115  24-130#  24-133  24-165#  24-168  30-34#  30-36  36-4#  36-15
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        56-52#  56-66   57-29#  57-43   57-49#  57-63  58-32#  58-44  59-20#  59-25  59-31#  59-36  60-19#  60-25
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        63-38#  63-41   63-42#  63-47   63-63#  63-66  63-67#  63-72  64-52#  64-60  65-70#  65-75  65-125#  65-149
        65-177#  65-191
T$$SW   10-8    10-8#   10-39
T$$TES  48-57#  48-68   49-14#  49-31   50-23#  50-71  51-22#  51-67  52-17#  52-67  53-8#  53-25  54-23#  54-26
        54-120  55-12#  55-15   55-18   55-110  56-15#  56-18  56-21  56-92  57-14#  57-17  57-20  57-87  58-20#
        58-52   59-9#   59-45   60-10#  60-35   60-38  61-17#  61-35  61-166  62-19#  62-63  63-18#  63-85  64-25#
        64-33   64-83   65-29#  65-37   65-78   65-252
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CROSS REFERENCE TABLE (CREF V04.00)

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	17-10#	17-12	17-12	17-12#	17-13	17-13	17-13	17-13	17-13	17-13	17-13	17-13	17-13	17-13#
	17-13#	17-13#	17-13#	17-13#	17-13#	17-13#	17-13#	17-15	17-15	17-15#	17-16	17-16	17-16	17-16
	17-16	17-16	17-16	17-16	17-16	17-16#	17-16#	17-16#	17-16#	17-16#	17-16#	17-16#	17-16#	17-18
	17-18	17-18#	17-19	17-19	17-19	17-19	17-19	17-19	17-19	17-19	17-19	17-19#	17-19#	17-19#
	17-19#	17-19#	17-19#	17-19#	17-19#	17-23	17-23	17-23#	17-24	17-24	17-24	17-24	17-24#	17-24#
	17-24#	17-26	17-26	17-26#	17-30	17-30	17-30#	17-31	17-31	17-31	17-31	17-31	17-31	17-31#
	17-31#	17-31#	17-31#	17-31#	17-32	17-32	17-32#	17-33	17-33	17-33	17-33	17-33	17-33	17-33
	17-33	17-33#	17-33#	17-33#	17-33#	17-33#	17-33#	17-33#	17-35	17-35	17-35#	17-39	17-39	17-39
	17-39#	17-39#	17-41	17-41	17-41#	17-45	17-45	17-45	17-45#	17-45#	17-47	17-47	17-47#	30-165
	30-165	30-165#	30-168	30-168	30-168	30-168#	30-168#	30-171	30-171	30-171	30-171#	30-171#	30-173	30-173
	30-173#	31-29	31-29	31-29#	31-32	31-32	31-32#	31-34	31-34	31-34	31-34#	31-34#	31-39	31-39
	31-39	31-39	31-39#	31-39#	31-39#	31-40	31-40	31-40	31-40#	31-40#	31-45	31-45	31-45	31-45
	31-45#	31-45#	31-45#	31-46	31-46	31-46#	31-55	31-55	31-55	31-55#	31-55#	31-62	31-62	31-62
	31-62#	31-62#	31-64	31-64	31-64	31-64#	31-64#	31-66	31-66	31-66	31-66#	31-66#	42-29	42-29
	42-29#	42-71	42-71	42-71	42-71#	42-71#	42-73	42-73	42-73	42-73#	42-73#	42-75	42-75	42-75
	42-75#	42-75#	42-77	42-77	42-77	42-77#	42-77#	42-85	42-85	42-85#	42-114	42-114	42-114	42-114#
	42-114#	42-127	42-127	42-127	42-127#	42-127#	42-132	42-132	42-132#	54-60	54-60	54-60#	54-61	54-61
	54-61#	54-73	54-73	54-73#	54-74	54-74	54-74#	55-86	55-86	55-86#	56-69	56-69	56-69#	57-66
	57-66	57-66#	61-96	61-96	61-96#	61-97	61-97	61-97#	61-118	61-118	61-118#	61-119	61-119	61-119#
	61-138	61-138	61-138#	64-31	64-31	64-31	64-31#	64-31#	65-35	65-35	65-35	65-35#	65-35#	65-152
	65-152	65-152#	65-153	65-153	65-153#	65-174	65-174	65-174#	65-175	65-175	65-175#	65-194	65-194	65-194#
T$CODE	67-55	67-55	67-55	67-55#	67-55#	67-55#	67-57	67-57	67-57	67-57#	67-57#	67-57#	67-59	67-59
	67-59	67-59#	67-59#	67-59#	67-61	67-61	67-61	67-61#	67-61#	67-61#	68-14	68-14	68-14	68-14#
	68-14#	68-14#	68-16	68-16	68-16	68-16	68-16	68-16	68-16#	68-16#	68-16#	68-16#	68-18	68-18
	68-18	68-18#	68-18#	68-18#	68-20	68-20	68-20	68-20#	68-20#	68-20#	68-22	68-22	68-22	68-22#
	68-22#	68-22#	68-24	68-24	68-24	68-24#	68-24#	68-24#	68-26	68-26	68-26	68-26#	68-26#	68-26#
	68-28	68-28	68-28	68-28#	68-28#	68-28#	68-30	68-30	68-30	68-30#	68-30#	68-30#	68-32	68-32
	68-32	68-32#	68-32#	68-32#	68-34	68-34	68-34	68-34#	68-34#	68-34#	68-38	68-38	68-38	68-38#
	68-38#	68-38#	68-40	68-40	68-40	68-40	68-40	68-40	68-40#	68-40#	68-40#	68-40#	68-44	68-44
	68-44	68-44#	68-44#	68-44#	68-47	68-47	68-47	68-47#	68-47#	68-47#	68-49	68-49	68-49	68-49#
	68-49#	68-49#	68-51	68-51	68-51	68-51#	68-51#	68-51#	68-53	68-53	68-53	68-53#	68-53#	68-53#
	68-55	68-55	68-55	68-55#	68-55#	68-55#	68-57	68-57	68-57	68-57#	68-57#	68-57#	68-59	68-59
	68-59	68-59	68-59	68-59	68-59#	68-59#	68-59#	68-59#	68-60	68-60	68-60	68-60#	68-60#	68-60#
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	25-63#	25-68	25-68#	25-73	25-73#	25-84	25-84#	25-89	25-89#	25-92	25-92#	25-95	25-95#	25-100
	25-100#	25-105	25-105#	25-110	25-110#	25-115	25-115#	25-120	25-120#	25-125	25-125#	25-132	25-132#	25-137
	25-137#	25-144	25-144#	25-147	25-147#	25-152	25-152#	25-157	25-157#	25-162	25-162#	25-167	25-167#	25-200
	25-200#	28-19	28-19#	28-23	28-23#	28-27	28-27#	28-31	28-31#	28-35	28-35#	29-22	29-22#	54-112
	54-112#	55-102	55-102#	56-84	56-84#	57-79	57-79#	59-24	59-24#	59-35	59-35#	60-24	60-24#	60-33
	60-33#	61-150	61-150#	61-157	61-157#	61-159	61-159#	62-33	62-33#	65-214	65-214#	65-222	65-222#	65-224
	65-224#													
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	68-24	68-24#	68-26	68-26#	68-28	68-28#	68-30	68-30#	68-32	68-32#	68-34	68-34#		
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	42-165#	44-24	44-24	44-24#	44-24#	45-18	45-18#	45-18#	46-19	46-19#	46-19#	54-26	54-26	54-26#
	54-26#	55-15	55-15	55-15#	55-15#	55-18	55-18	55-18#	55-18#	56-18	56-18	56-18#	56-18#	56-21
	56-21	56-21#	56-21#	57-17	57-17	57-17#	57-17#	57-20	57-20	57-20#	57-20#	60-35	60-35	60-35#
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	65-78	65-78#	65-78#											
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T$GMAN	7-278#													
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	68-24	68-24#	68-26	68-26#	68-28	68-28#	68-30	68-30#	68-32	68-32#	68-34	68-34#		
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                55-25   55-41   55-69   56-15   56-15   56-15#  56-34    56-52   57-14    57-14   57-14#   57-29   57-49   58-20
                58-20   58-20#  58-32   59-9    59-9    59-9#   59-20    59-31   60-10    60-10   60-10#   60-19   60-28   61-17
                61-17   61-17#  61-30   61-69   61-121  62-19   62-19    62-19#  62-37    62-42   62-56    63-18   63-18   63-18#
                63-38   63-42   63-63   63-67   64-25   64-25   64-25#   64-52   65-29    65-29   65-29#   65-70   65-125  65-177
                68-122
T$TSTM           7-278#  17-4    17-5    17-6    17-10   17-12   17-13    17-15   17-16    17-18   17-19    17-23   17-24   17-26
                17-27   17-30   17-31   17-32   17-33   17-35   17-36    17-39   17-41    17-42   17-45    17-47   17-48   24-16
                24-35   24-84   24-94   24-126  24-135  24-155  24-170   25-27   25-32    25-39   25-44    25-49   25-58   25-63
                25-68   25-73   25-84   25-89   25-92   25-95   25-100   25-105  25-110   25-115  25-120   25-125  25-132  25-137
                25-144  25-147  25-152  25-157  25-162  25-167  25-200   28-19   28-23    28-27   28-31    28-35   28-45   29-22
                30-165  30-168  30-171  30-173  31-29   31-32   31-34    31-39   31-40    31-45   31-46    31-55   31-62   31-64
                31-66   34-18   34-20   34-36   34-45   34-145  34-147   34-199  34-209   34-254  40-76    42-10   42-16   42-20
                42-25   42-29   42-39   42-71   42-73   42-75   42-77    42-85   42-89    42-91   42-98    42-100  42-101  42-102
                42-103  42-114  42-127  42-132  42-165  42-180  43-17    44-10   44-18    44-21   44-23    44-24   44-26   45-33
                46-34   48-62   48-67   48-68   49-18   49-20   49-25    49-27   49-31    50-46   50-48    50-49   50-64   50-71
                51-41   51-43   51-44   51-60   51-67   52-27   52-29    52-30   52-32    52-42   52-44    52-45   52-47   52-57
                52-59   52-60   52-62   52-67   53-15   53-17   53-18    53-20   53-25    54-26   54-37    54-39   54-44   54-57
                54-60   54-61   54-73   54-74   54-76   54-89   54-110   54-112  54-119   54-120  55-15    55-18   55-25   55-27
                55-32   55-34   55-41   55-55   55-69   55-83   55-86    55-100  55-102   55-109  55-110   56-18   56-21   56-27
                56-29   56-34   56-46   56-52   56-66   56-69   56-80    56-83   56-84    56-91   56-92    57-17   57-20   57-26
                57-28   57-29   57-43   57-49   57-63   57-66   57-77    57-79   57-86    57-87   58-32    58-44   58-52   59-20
                59-24   59-25   59-31   59-35   59-36   59-45   60-19    60-24   60-25    60-28   60-33    60-34   60-35   60-38
                61-30   61-32   61-35   61-44   61-46   61-69   61-93    61-96   61-97    61-118  61-119   61-121  61-135  61-138
                61-148  61-150  61-157  61-159  61-165  61-166  62-33    62-34   62-37    62-39   62-42    62-45   62-56   62-58
                62-63   63-38   63-41   63-42   63-47   63-63   63-66    63-67   63-72    63-85   64-31    64-33   64-52   64-60
                64-83   65-35   65-37   65-70   65-75   65-78   65-86    65-88   65-125   65-149  65-152   65-153  65-174  65-175
                65-177  65-191  65-194  65-199  65-201  65-203  65-207   65-212  65-214   65-222  65-224   65-230  65-252
T$TSTS           7-278#  48-57#  49-14#  50-23#  51-22#  52-17#  53-8#    54-23#  55-12#   56-15#  57-14#   58-20#  59-9#   60-10#
                61-17#  62-19#  63-18#  64-25#  65-29#
T1               8-8     48-57#
```

CROSS REFERENCE TABLE (CREF V04.00)

```
T1.1     48-62#
T10       8-8      57-14#
T10.1    57-29#
T10.1$   57-30#    57-72
T10.2    57-49#
T10.2$   57-39     57-46#
T10.3$   57-59     57-65     57-68#
T10.4$   57-45     57-66#
T10.7$   57-26     57-75#
T10.8$   57-67     57-73     57-80#
T11       8-8      58-20#
T11.1    58-32#
T11.2$   58-33#    58-39     58-50
T11.5$   58-45#
T12       8-8      59-9#
T12.1    59-20#
T12.2    59-31#
T13       8-8      60-10#
T13.1    60-19#
T13.1$   60-32     60-36#
T13.2    60-28#
T14       8-8      61-17#
T14.1    61-30#
T14.1$   61-52#    61-144
T14.2    61-69#
T14.3    61-121#
T14.7$   61-44     61-146#
T14.8$   61-98     61-120    61-139    61-143    61-151#
T1410$   61-69#
T1411$   61-89     61-113    61-122#
T1412$   61-131    61-137    51-141#
T1420    13-100#   61-76     61-160    65-132    65-225
T15       8-8      62-19#
T15.1    62-37#
T15.2    62-42#
T15.3    62-56#
T16       8-8      63-18#
T16.1    63-38#
T16.2    63-42#
T16.3    63-63#
T16.4    63-67#
T17       8-8      64-25#
T17.1    64-52#
T18       8-8      65-29#
T18.1    65-70#
T18.2    65-125#
T18.3    65-177#
T1811$   65-145    65-169    65-178#
T1812$   65-187    65-193    65-197#
T18END   65-154    65-176    65-195    65-205    65-215#
T18OFL   65-86     65-210#
T2        8-8      49-14#
T2.1     49-18#
T2.11    49-18#    49-23
T2.2     49-25#
T2.21    49-25#    49-30
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CROSS REFERENCE TABLE (CREF V04.00)

```
T3          8-8       50-23#
T3.1       50-46#
T3.11      50-29      50-47#
T3.2       50-49#
T4          8-8       51-22#
T4.1       51-41#
T4.2       51-44#
T5          8-8       52-17#
T5.1       52-27#
T5.11      52-28#     52-36
T5.2       52-30#
T5.3       52-42#
T5.31      52-43#     52-51
T5.4       52-45#
T5.5       52-57#
T5.51      52-58#     52-66
T5.6       52-60#
T6          8-8       53-8#
T6.1       53-15#
T6.11      53-16#     53-24
T6.2       53-18#
T7          8-8       54-23#
T7.1       54-44#
T7.1$      54-45#     54-106
T7.10$     54-60#     54-91
T7.2       54-76#
T7.2$      54-53      54-68      54-77#
T7.20$     54-73#     54-101
T7.3$      54-85      54-96      54-103#
T7.44$     54-59      54-64#
T7.7$      54-37      54-108#
T7.8$      54-62      54-75      54-105     54-113#
T7A        13-79#     54-32      54-115
T8          8-8       55-1?#
T8.1       55-25#
T8.1$      55-38#     55-60      55-96
T8.10$     55-79      55-85      55-88#
T8.2       55-41#
T8.2$      55-51      55-58#
T8.3       55-69#
T8.3$      55-40      55-61#
T8.4$      55-66#     55-90
T8.5$      55-23      55-28#
T8.6$      55-68      55-91#
T8.7$      55-32      55-98#
T8.8$      55-87      55-93      55-103#
T8.9$      55-57      55-86#
T9          8-8       56-15#
T9.1       56-34#
T9.1$      56-31#     56-75
T9.2       56-52#
T9.2$      56-42      56-49#
T9.3$      56-62      56-68      56-71#
T9.4$      56-48      56-69#
T9.7$      56-27      56-78#
T9.8$      56-70      56-76      56-85#
```

CROSS REFERENCE TABLE (CREF V04.00)

```
TD        36-10    36-19#
TEST1     48-59#   48-66
TEST10    57-22#
TEST13    60-13#   60-37
TEST14    61-29#   61-34
TEST15    62-23#   62-60
TEST16    63-30#   63-83
TEST17    64-53#   64-65    64-74    64-81
TEST18    65-55#   65-77
TEST3     50-27#   50-67    50-70
TEST4     51-26#   51-63    51-66
TEST5     52-25#
TEST6     53-13#
TEST7     54-33#
TEST8     55-20#
TEST9     56-23#
TICKMS    24-51*   24-55*   24-59#   24-113
TICKUS    24-52*   24-56*   24-60#
TIM.DN    13-36#   30-51*   30-74    30-120
TIM.PT    13-42#   30-45    30-91*   30-92*   30-143   30-146*  30-147*
TIM.UP    13-29#   17-39    30-44    30-50*   30-71    30-117   31-27    61-153   61-155   65-204   65-218   65-220
TIMER     33-116#  34-23    34-65*   34-128*  34-246*  35-155*  35-210*  36-22*   36-118*  36-143*  36-208   36-210*  36-243*  36-258*
          36-264*
TIMMSG    68-51    68-94#
TIMSTL    10-21#   24-157
TIMT10    13-85#   55-19    55-105
TIMT11    13-90#   56-22    56-87
TIMT12    13-95#   57-21    57-82
TIMTYP    10-20#   30-162   31-18
TRE       12-11#
TRK.DS    13-27#   17-31    17-33    26-32*   26-61*   26-101*  27-18*   29-19*   30-21*
TRK.RD    13-23#   17-5     17-33    25-21*   26-9     26-11*   26-16*   28-15*   29-16*   54-111*  55-101*  56-81*   57-78*   61-149*
          65-213*
TRKWC     13-45#   58-25    63-21    64-37
TRNSWT    33-90#   35-13*   35-185   35-187*  35-198   35-216*  35-222*  36-24    36-25*   36-236   36-253*
TST12     59-23    59-26#
TST12A    59-34    59-37#
TST13     60-23    60-27#
TST14A    61-20    61-37#
TST15     62-43#   62-51
TST18A    65-52    65-80#
TST18B    65-91#   65-208
TST18C    65-218#
TWOMS     24-152#  55-59    55-89    56-51    56-73    57-48    57-70
TYPTIM    31-17#   54-115   55-105   56-87    57-82    61-160   65-225
UAM       11-57#
UNIT      15-2#    42-30*   42-33*   42-34    42-39
UNS       12-93#
UNSMSG    16-85#   42-77
UPE       12-38#   25-30
VERIFY    26-79    26-120   29-8#
WCE       12-39#   25-42
WCEFLG    13-43#   27-9*    54-64*   54-71*   54-92*   54-99*   61-100*  61-116*  65-156*  65-172*
WCF       12-84#   25-66
WCKD      12-210#  63-45    63-70    64-58    65-73    65-200
WCKHD     12-211#
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CROSS REFERENCE TABLE (CREF V04.00)

PARAMETER CODING MACRO V04.00 1-JAN-83 11:06:45 PAGE M-1 SEQ 0193
CROSS REFERENCE TABLE (CREF V04.00)

```
BCOMPL    1-15#     7-278#  42-18
BERROR    1-19#     7-278#
BGNAU     1-23#     7-278#  46-9
BGNAUT    1-31#     7-278#  43-10
BGNCLN    1-39#     7-278#  44-8
BGNDU     1-47#     7-278#  45-8
BGNHRD    1-55#     7-278#  67-53
BGNHW     1-66#     7-278#   9-9
BGNINI    1-77#     7-278#  42-8
BGNMOD    1-85#     7-278#   7-304   11-51   40-41   48-38   67-43
BGNMSG    1-98#     7-278#  17-3     17-29   17-38   17-44
BGNPRO    1-106#    7-278#  41-8
BGNPTA    1-114#    7-278#  69-16
BGNRPT    1-144#    7-278#  40-47
BGNSEG    1-152#    7-278#  65-201
BGNSET    1-161#    7-278#  69-15
BGNSFT    1-182#    7-278#  68-12
BGNSRV    1-193#    7-278#  24-112  24-130  24-165  30-34   36-4
BGNSUB    1-201#    7-278#  48-62   49-18   49-25   50-46   50-49   51-41   51-44   52-27   52-30   52-42   52-45   52-57
          52-60     53-15   53-18   54-44   54-76   55-25   55-41   55-69   56-34   56-52   57-29   57-49   58-32   59-20
          59-31     60-19   60-28   61-30   61-69   61-121  62-37   62-42   62-56   63-38   63-42   63-63   63-67   64-52
          65-70     65-125  65-177
BGNSW     1-225#    7-278#  10-8
BGNTST    1-236#    7-278#  48-57   49-14   50-23   51-22   52-17   53-8    54-23   55-12   56-15   57-14   58-20   59-9
          60-10     61-17   62-19   63-18   64-25   65-29
BNCOMP    1-266#    7-278#  24-18   24-37   42-22   42-27   42-40
BNERRO    1-270#    7-278#
BREAK     1-274#    7-278#
BRESET    1-278#    7-278#  42-10
CKLOOP    1-282#    7-278#
CLOCK     1-286#    7-278#  24-16   24-35
CLOSE     1-292#    7-278#
CLRVEC    1-296#    7-278#  42-98   42-100  42-101  44-18   44-21   44-23
COMMEN    1-301#    7-278#
COMND     7-100#    48-59   50-26   51-25
DELAY     1-322#    7-278#
DESCRI    1-317#    7-278#  16-27
DEVTYP    1-341#    7-278#  16-17
DISPAT    1-346#    7-278#   8-8
DISPLA    1-360#    7-278#
DO        7-116#    29-24   42-138  48-63   48-64   49-19   49-26   50-47   50-63   51-42   51-59   52-28   52-31   52-43
          52-46     52-58   52-61   53-16   53-19
DOCLN     1-376#    7-278#  28-45   42-102  62-34
DODTA     7-129#    58-33   60-20   60-29   61-31   62-38   62-44   62-57   63-40   63-44   63-46   63-65   63-69   63-71
DODU      1-380#    7-278#
DORPT     1-385#    7-278#
DRV.IN    7-72#     54-113  55-103  56-85   57-80   61-151  65-215
ENDAU     1-389#    7-278#  46-34
ENDAUT    1-401#    7-278#  43-17
ENDCLN    1-413#    7-278#  44-26
ENDCOM    1-425#    7-278#
ENDDU     1-441#    7-278#  45-33
ENDHRD    1-453#    7-278#  67-62
ENDHW     1-465#    7-278#   9-21
ENDINI    1-475#    7-278#  42-180
ENDMOD    1-487#    7-278#  10-40   39-1    46-35   66-2    68-123
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CROSS REFERENCE TABLE (CREF V04.00)

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ENDMSG   1-500#   7-278#  17-27   17-36   17-42   17-48
ENDPRO   1-512#   7-278#  41-12
ENDPTA   1-520#   7-278#  69-21
ENDRPT   1-529#   7-278#  40-76
ENDSEG   1-541#   7-278#  65-203
ENDSET   1-555#   7-278#  69-22
ENDSFT   1-568#   7-278#  68-71
ENDSRV   1-580#   7-278#  24-115  24-133  24-168  30-36   36-15
ENDSUB   1-596#   7-278#  48-67   49-20   49-27   50-48   50-64   51-43   51-60   52-29   52-32   52-44   52-47   52-59
        52-62    53-17   53-20   54-57   54-89   55-27   55-55   55-83   56-46   56-66   57-43   57-63   58-44   59-25
        59-36    60-25   60-34   61-32   61-93   61-135  62-39   62-45   62-58   63-41   63-47   63-66   63-72   64-60
        65-75    65-149  65-191
ENDSW    1-614#   7-278#  10-39
ENDTST   1-624#   7-278#  48-68   49-31   50-71   51-67   52-67   53-25   54-120  55-110  56-92   57-87   58-52   59-45
        60-38    61-166  62-63   63-85   64-83   65-252
EQUALS   1-642#   7-278#  11-57
ER.NDX   7-142#  26-32   26-61   26-101  27-18   30-21
ERRDF    1-714#   7-278#  28-19   28-23   28-27   28-31   28-35   62-33
ERRHRD   1-718#   7-278#  25-27   25-32   25-39   25-44   25-49   25-58   25-63   25-68   25-73   25-84   25-89   25-92
        25-95    25-100  25-105  25-110  25-115  25-120  25-125  25-132  25-137  25-144  25-147  25-152  25-157  25-162
        25-167   25-200  29-22   54-112  55-102  56-84   57-79   59-24   59-35   60-24   60-33   61-150  61-157  65-214
        65-222
ERROR    1-722#   7-278#
ERRSF    1-726#   7-278#
ERRSOF   1-730#   7-278#  61-159  65-224
ERRTBL   1-734#   7-278#
ESCAPE   1-744#   7-278#
EXIT     1-771#   7-278#  40-61   42-91   42-103  42-165  44-24   45-18   46-19   54-26   55-15   55-18   56-18   56-21
        57-17    57-20   60-35   61-35   64-33   65-37   65-78
FEQUAL   1-810#   7-278#
GETBYT   1-824#   7-278#
GETPRI   1-834#   7-278#  34-18   34-145  34-209
GETWOR   1-829#   7-278#
GMANIA   1-839#   7-278#
GMANID   1-848#   7-278#
GMANIL   1-859#   7-278#
GPHARD   1-868#   7-278#  42-39
GPRMA    1-874#   7-278#  67-55   67-57
GPRMD    1-903#   7-278#  67-59   67-61   68-18   68-20   68-22   68-24   68-26   68-28   68-30   68-32   68-34
GPRML    1-934#   7-278#  68-14   68-38   68-44   68-47   68-49   68-51   68-53   68-55   68-57   68-60
HEADFR   1-954#   7-278#   7-323
INLOOP   1-962#   7-278#
IOSETU   1-966#   7-278#
IOSTAR   1-974#   7-278#
KT11     1-982#   7-278#
LASTAD   1-;47#   7-278#  68-122
M$BYTE   1-D00#   7-278#   7-323   7-323   7-323   7-323#
M$CHEC   1-E18#   7-278#  40-61   40-61#  42-91   42-91#  42-103  42-103#  42-165  42-165#  44-24   44-24#  45-18   45-18#
        46-19    46-19#  54-26   54-26#  55-15   55-15#  55-18   55-18#  56-18   56-18#  56-21   56-21#  57-17   57-17#
        57-20    57-20#  60-35   60-35#  61-35   61-35#  64-33   64-33#  65-37   65-37#  65-78   65-78#
M$CNTO   1-E82#   7-278#  67-55   67-55#  67-57   67-57#  67-59   67-59#  67-61   67-61#  68-14   68-14#  68-18   68-18#
        68-20    68-20#  68-22   68-22#  68-24   68-24#  68-26   68-26#  68-28   68-28#  68-30   68-30#  68-32   68-32#
        68-34    68-34#  68-38   68-38#  68-44   68-44#  68-47   68-47#  68-49   68-49#  68-51   68-51#  68-53   68-53#
        68-55    68-55#  68-57   68-57#  68-60   68-60#
M$COUN   1-D66#   7-278#  17-4    17-4#   17-5    17-5#   17-6    17-6#   17-10   17-10   17-10   17-10   17-10#  17-12
        17-12#   17-13   17-13   17-13   17-13   17-13   17-13   17-13   17-13#  17-15   17-15#  17-16   17-16   17-16
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CROSS REFERENCE TABLE (CREF V04.00)

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                17-16    17-16    17-16    17-16    17-16#   17-18    17-18#   17-19    17-19    17-19    17-19    17-19    17-19    17-19
                17-19#   17-23    17-23#   17-24    17-24    17-24#   17-26    17-26#   17-30    17-30#   17-31    17-31    17-31    17-31
                17-31#   17-32    17-32#   17-33    17-33    17-33    17-33    17-33    17-33    17-33#   17-35    17-35#   17-39    17-39#
                17-41    17-41#   17-45    17-45#   17-47    17-47#   30-165   30-165#  30-168   30-168#  30-171   30-171#  30-173   30-173#
                31-29    31-29#   31-32    31-32#   31-34    31-34#   31-39    31-39    31-39#   31-40    31-40#   31-45    31-45    31-45#
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	17-19	17-19	17-19	17-19	17-19	17-19	17-19	17-19	17-19	17-19	17-19	17-19#	17-19#	17-19#
	17-19#	17-19#	17-19#	17-19#	17-19#	17-19#	17-19#	17-19#	17-23	17-23	17-23	17-23	17-23	17-23#
	17-23#	17-23#	17-23#	17-24	17-24	17-24	17-24	17-24	17-24	17-24	17-24#	17-24#	17-24#	17-24#
	17-24#	17-24#	17-26	17-26	17-26	17-26	17-26	17-26#	17-26#	17-26#	17-26#	17-27	17-27#	17-30
	17-30	17-30	17-30	17-30	17-30#	17-30#	17-30#	17-30#	17-31	17-31	17-31	17-31	17-31	17-31
	17-31	17-31	17-31	17-31#	17-31#	17-31#	17-31#	17-31#	17-31#	17-31#	17-31#	17-32	17-32	17-32
	17-32	17-32	17-32#	17-32#	17-32#	17-32#	17-33	17-33	17-33	17-33	17-33	17-33	17-33	17-33
	17-33	17-33	17-33	17-33#	17-33#	17-33#	17-33#	17-33#	17-33#	17-33#	17-33#	17-33#	17-33#	17-35
	17-35	17-35	17-35	17-35	17-35#	17-35#	17-35#	17-35#	17-36	17-36#	17-39	17-39	17-39	17-39
	17-39	17-39	17-39#	17-39#	17-39#	17-39#	17-39#	17-41	17-41	17-41	17-41	17-41	17-41#	17-41#
	17-41#	17-41#	17-42	17-42#	17-45	17-45	17-45	17-45	17-45	17-45	17-45#	17-45#	17-45#	17-45#
	17-45#	17-47	17-47	17-47	17-47	17-47	17-47#	17-47#	17-47#	17-47#	17-48	17-48#	24-16	24-16
	24-16	24-16#	24-16#	24-16#	24-18	24-18#	24-35	24-35	24-35	24-35#	24-35#	24-35#	24-37	24-37#
	24-84	24-84	24-84	24-84	24-84	24-84	24-84#	24-84#	24-84#	24-84#	24-84#	24-84#	24-94	24-94
	24-94	24-94	24-94	24-94	24-94#	24-94#	24-94#	24-94#	24-94#	24-94#	24-115	24-115#	24-126	24-126
	24-126	24-126	24-126	24-126	24-126#	24-126#	24-126#	24-126#	24-126#	24-126#	24-133	24-133#	24-135	24-135
	24-135	24-135	24-135	24-135	24-135#	24-135#	24-135#	24-135#	24-135#	24-135#	24-155	24-155	24-155	24-155
	24-155	24-155	24-155#	24-155#	24-155#	24-155#	24-155#	24-155#	24-168	24-168#	24-170	24-170	24-170	24-170
	24-170	24-170	24-170#	24-170#	24-170#	24-170#	24-170#	24-170#	25-27	25-27	25-27	25-27	25-27#	25-27#
	25-27#	25-27#	25-27#	25-32	25-32	25-32	25-32	25-32#	25-32#	25-32#	25-32#	25-32#	25-39	25-39
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	25-44#	25-44#	25-49	25-49	25-49	25-49	25-49#	25-49#	25-49#	25-49#	25-49#	25-58	25-58	25-58
	25-58	25-58#	25-58#	25-58#	25-58#	25-58#	25-63	25-63	25-63	25-63	25-63#	25-63#	25-63#	25-63#
	25-63#	25-68	25-68	25-68	25-68	25-68#	25-68#	25-68#	25-68#	25-68#	25-73	25-73	25-73	25-73
	25-73#	25-73#	25-73#	25-73#	25-73#	25-84	25-84	25-84	25-84	25-84#	25-84#	25-84#	25-84#	25-84#
	25-89	25-89	25-89	25-89	25-89#	25-89#	25-89#	25-89#	25-89#	25-92	25-92	25-92	25-92	25-92#
	25-92#	25-92#	25-92#	25-92#	25-95	25-95	25-95	25-95	25-95#	25-95#	25-95#	25-95#	25-95#	25-100
	25-100	25-100	25-100	25-100#	25-100#	25-100#	25-100#	25-100#	25-105	25-105	25-105	25-105	25-105#	25-105#
	25-105#	25-105#	25-105#	25-110	25-110	25-110	25-110	25-110#	25-110#	25-110#	25-110#	25-110#	25-115	25-115
	25-115	25-115	25-115#	25-115#	25-115#	25-115#	25-115#	25-120	25-120	25-120	25-120	25-120#	25-120#	25-120#
	25-120#	25-120#	25-125	25-125	25-125	25-125	25-125#	25-125#	25-125#	25-125#	25-125#	25-132	25-132	25-132
	25-132	25-132#	25-132#	25-132#	25-132#	25-132#	25-137	25-137	25-137	25-137	25-137#	25-137#	25-137#	25-137#
	25-137#	25-144	25-144	25-144	25-144	25-144#	25-144#	25-144#	25-144#	25-144#	25-147	25-147	25-147	25-147
	25-147#	25-147#	25-147#	25-147#	25-147#	25-152	25-152	25-152	25-152	25-152#	25-152#	25-152#	25-152#	25-152#

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25-157	25-157	25-157	25-157	25-157#	25-157#	25-157#	25-157#	25-157#	25-162	25-162	25-162	25-162	25-162#
25-162#	25-162#	25-162#	25-162#	25-167	25-167	25-167	25-167	25-167#	25-167#	25-167#	25-167#	25-167#	25-200
25-200	25-200	25-200	25-200#	25-200#	25-200#	25-200#	25-200#	28-19	28-19	28-19	28-19	28-19#	28-19#
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28-27	28-27	28-27#	28-27#	28-27#	28-27#	28-27#	28-31	28-31	28-31	28-31	28-31#	28-31#	28-31#
28-31#	28-31#	28-35	28-35	28-35	28-35	28-35#	28-35#	28-35#	28-35#	28-35#	28-45	28-45#	29-22
29-22	29-22	29-22	29-22#	29-22#	29-22#	29-22#	29-22#	30-36	30-36#	30-165	30-165	30-165	30-165
30-165	30-165#	30-165#	30-165#	30-165#	30-168	30-168	30-168	30-168	30-168	30-168	30-168#	30-168#	30-168#
30-168#	30-168#	30-171	30-171	30-171	30-171	30-171	30-171	30-171#	30-171#	30-171#	30-171#	30-171#	30-173
30-173	30-173	30-173	30-173	30-173#	30-173#	30-173#	30-173#	31-29	31-29	31-29	31-29	31-29	31-29#
31-29#	31-29#	31-29#	31-32	31-32	31-32	31-32	31-32	31-32#	31-32#	31-32#	31-32#	31-34	31-34
31-34	31-34	31-34	31-34	31-34#	31-34#	31-34#	31-34#	31-34#	31-39	31-39	31-39	31-39	31-39
31-39	31-39	31-39#	31-39#	31-39#	31-39#	31-39#	31-39#	31-40	31-40	31-40	31-40	31-40	31-40
31-40#	31-40#	31-40#	31-40#	31-40#	31-45	31-45	31-45	31-45	31-45	31-45	31-45	31-45#	31-45#
31-45#	31-45#	31-45#	31-45#	31-46	31-46	31-46	31-46	31-46	31-46#	31-46#	31-46#	31-46#	31-55
31-55	31-55	31-55	31-55	31-55	31-55#	31-55#	31-55#	31-55#	31-55#	31-62	31-62	31-62	31-62
31-62	31-62	31-62#	31-62#	31-62#	31-62#	31-62#	31-64	31-64	31-64	31-64	31-64	31-64	31-64#
31-64#	31-64#	31-64#	31-64#	31-66	31-66	31-66	31-66	31-66	31-66	31-66#	31-66#	31-66#	31-66#
31-66#	34-18	34-18	34-18#	34-18#	34-20	34-20	34-20#	34-20#	34-36	34-36	34-36	34-36	34-36
34-36	34-36#	34-36#	34-36#	34-36#	34-36#	34-36#	34-45	34-45	34-45#	34-45#	34-145	34-145	34-145#
34-145#	34-147	34-147	34-147#	34-147#	34-199	34-199	34-199#	34-199#	34-209	34-209	34-209#	34-209#	34-254
34-254	34-254#	34-254#	36-15	36-15#	40-61	40-61	40-61#	40-61#	40-76	40-76#	42-10	42-10#	42-16
42-16	42-16#	42-16#	42-18	42-18#	42-20	42-20	42-20#	42-20#	42-22	42-22#	42-25	42-25	42-25#
42-25#	42-27	42-27#	42-29	42-29	42-29	42-29	42-29	42-29#	42-29#	42-29#	42-29#	42-39	42-39
42-39	42-39#	42-39#	42-39#	42-40	42-40#	42-71	42-71	42-71	42-71	42-71	42-71	42-71#	42-71#
42-71#	42-71#	42-71#	42-73	42-73	42-73	42-73	42-73	42-73	42-73#	42-73#	42-73#	42-73#	42-73#
42-75	42-75	42-75	42-75	42-75	42-75	42-75#	42-75#	42-75#	42-75#	42-75#	42-77	42-77	42-77
42-77	42-77	42-77	42-77#	42-77#	42-77#	42-77#	42-77#	42-85	42-85	42-85	42-85	42-85	42-85#
42-85#	42-85#	42-85#	42-89	42-89	42-89	42-89	42-89	42-89	42-89#	42-89#	42-89#	42-89#	42-89#
42-89#	42-91	42-91	42-91#	42-91#	42-98	42-98	42-98#	42-98#	42-100	42-100	42-100#	42-100#	42-101
42-101	42-101#	42-101#	42-102	42-102#	42-103	42-103	42-103#	42-103#	42-114	42-114	42-114	42-114	42-114
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42-127#	42-127#	42-127#	42-132	42-132	42-132	42-132	42-132	42-132#	42-132#	42-132#	42-132#	42-165	42-165
42-165#	42-165#	42-180	42-180#	43-17	43-17#	44-10	44-10	44-10#	44-10#	44-18	44-18	44-18#	44-18#
44-21	44-21	44-21#	44-21#	44-23	44-23	44-23#	44-23#	44-24	44-24	44-24#	44-24#	44-26	44-26#
45-18	45-18	45-18#	45-18#	45-33	45-33#	46-19	46-19	46-19#	46-19#	46-34	46-34#	48-62	48-62#
48-67	48-67#	48-68	48-68#	49-18	49-18#	49-20	49-20#	49-25	49-25#	49-27	49-27#	49-31	49-31#
50-46	50-46#	50-48	50-48#	50-49	50-49#	50-64	50-64#	50-71	50-71#	51-41	51-41#	51-43	51-43#
51-44	51-44#	51-60	51-60#	51-67	51-67#	52-27	52-27#	52-29	52-29#	52-30	52-30#	52-32	52-32#
52-42	52-42#	52-44	52-44#	52-45	52-45#	52-47	52-47#	52-57	52-57#	52-59	52-59#	52-60	52-60#
52-62	52-62#	52-67	52-67#	53-15	53-15#	53-17	53-17#	53-18	53-18#	53-20	53-20#	53-25	53-25#
54-26	54-26	54-26#	54-26#	54-37	54-37	54-37	54-37	54-37	54-37	54-37#	54-37#	54-37#	54-37#
54-37#	54-37#	54-39	54-39	54-39	54-39	54-39	54-39	54-39#	54-39#	54-39#	54-39#	54-39#	54-39#
54-44	54-44#	54-57	54-57#	54-60	54-60	54-60	54-60	54-60	54-60#	54-60#	54-60#	54-60#	54-61
54-61	54-61	54-61	54-61	54-61#	54-61#	54-61#	54-61#	54-73	54-73	54-73	54-73	54-73	54-73#
54-73#	54-73#	54-73#	54-74	54-74	54-74	54-74	54-74	54-74#	54-74#	54-74#	54-74#	54-76	54-76#
54-89	54-89#	54-110	54-110	54-110#	54-110#	54-112	54-112	54-112	54-112	54-112#	54-112#	54-112#	54-112#
54-112#	54-119	54-119	54-119	54-119	54-119	54-119	54-119#	54-119#	54-119#	54-119#	54-119#	54-119#	54-120
54-120#	55-15	55-15	55-15#	55-15#	55-18	55-18	55-18#	55-18#	55-25	55-25#	55-27	55-27#	55-32
55-32	55-32	55-32	55-32	55-32	55-32#	55-32#	55-32#	55-32#	55-32#	55-32#	55-34	55-34	55-34
55-34	55-34	55-34	55-34#	55-34#	55-34#	55-34#	55-34#	55-34#	55-41	55-41#	55-55	55-55#	55-69
55-69#	55-83	55-83#	55-86	55-86	55-86	55-86	55-86	55-86#	55-86#	55-86#	55-86#	55-100	55-100
55-100#	55-100#	55-102	55-102	55-102	55-102	55-102#	55-102#	55-102#	55-102#	55-102#	55-109	55-109	55-109
55-109	55-109	55-109	55-109#	55-109#	55-109#	55-109#	55-109#	55-109#	55-110	55-110#	56-18	56-18	56-18#
56-18#	56-21	56-21	56-21#	56-21#	56-27	56-27	56-27	56-27	56-27	56-27	56-27#	56-27#	56-27#
56-27#	56-27#	56-27#	56-29	56-29	56-29	56-29	56-29	56-29	56-29#	56-29#	56-29#	56-29#	56-29#

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CROSS REFERENCE TABLE (CREF V04.00)

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                62-56    62-56#   63-38    63-38#   63-42    63-42#   63-63    63-63#   63-67    63-67#   64-52    64-52#   65-70    65-70#
                65-125   65-125#  65-177   65-177#
M$GNTA           1-B90#   7-278#   9-21     9-21#    10-39    10-39#   17-27    17-27#   17-36    17-36#   17-42    17-42#   17-48    17-48#
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                43-17    43-17#   44-26    44-26#   45-33    45-33#   46-34    46-34#   48-67    48-67#   48-68    48-68#   49-20    49-20#
                49-27    49-27#   49-31    49-31#   50-48    50-48#   50-64    50-64#   50-71    50-71#   51-43    51-43#   51-60    51-60#
                51-67    51-67#   52-29    52-29#   52-32    52-32#   52-44    52-44#   52-47    52-47#   52-59    52-59#   52-62    52-62#
                52-67    52-67#   53-17    53-17#   53-20    53-20#   53-25    53-25#   54-57    54-57#   54-89    54-89#   54-120   54-120#
                55-27    55-27#   55-55    55-55#   55-83    55-83#   55-110   55-110#  56-46    56-46#   56-66    56-66#   56-92    56-92#
                57-43    57-43#   57-63    57-63#   57-87    57-87#   58-44    58-44#   58-52    58-52#   59-25    59-25#   59-36    59-36#
                59-45    59-45#   60-25    60-25#   60-34    60-34#   60-38    60-38#   61-32    61-32#   61-93    61-93#   61-135   61-135#
                61-166   61-166#  62-39    62-39#   62-45    62-45#   62-58    62-58#   62-63    62-63#   63-41    63-41#   63-47    63-47#
                63-66    63-66#   63-72    63-72#   63-85    63-85#   64-60    64-60#   64-83    64-83#   65-75    65-75#   65-149   65-149#
                65-191   65-191#  65-252   65-252#  67-62    67-62#   68-71    68-71#   69-16    69-16#   69-21    69-21#
M$GNTE           1-B94#   7-278#   48-57    48-57#   49-14    49-14#   50-23    50-23#   51-22    51-22#   52-17    52-17#   53-8     53-8#
                54-23    54-23#   55-12    55-12#   56-15    56-15#   57-14    57-14#   58-20    58-20#   59-9     59-9#    60-10    60-10#
                61-17    61-17#   62-19    62-19#   63-18    63-18#   64-25    64-25#   65-29    65-29#
M$HAPT           1-A39#   7-278#   7-323    7-323#
M$HNAP           1-B24#   7-278#   7-323    7-323#
M$INCR           1-D26#   7-278#   7-304    7-304#   9-9      9-9      9-9#     9-9#     10-8     10-8     10-8#    10-8#    11-51    11-51#
                17-3     17-3     17-3#    17-3#    17-4#    17-5#    17-6#    17-10#   17-12#   17-13#   17-15#   17-16#   17-18#   17-19#
                17-23#   17-24#   17-26#   17-27#   17-29    17-29    17-29#   17-29#   17-30#   17-31#   17-32#   17-33#   17-35#   17-36#
                17-38    17-38    17-38#   17-38#   17-39#   17-41#   17-42#   17-44    17-44    17-44#   17-44#   17-45#   17-47#   17-48#
                24-16#   24-35#   24-84#   24-94#   24-112   24-112   24-112#  24-112#  24-126#  24-130   24-130   24-130#  24-130#  24-135#
                24-155#  24-165   24-165   24-165#  24-165#  24-170#  25-27#   25-32#   25-39#   25-44#   25-49#   25-58#   25-63#   25-68#
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                25-147#  25-152#  25-157#  25-162#  25-167#  25-200#  28-19#   28-23#   28-27#   28-31#   28-35#   28-45#   29-22#   30-34
                30-34    30-34#   30-34#   30-165#  30-168#  30-171#  30-173#  31-29#   31-32#   31-34#   31-39#   31-40#   31-45#   31-46#
                31-55#   31-62#   31-64#   31-66#   34-18#   34-20#   34-36#   34-45#   34-145#  34-147#  34-199#  34-209#  34-254#  36-4
                36-4     36-4#    36-4#    40-41    40-41#   40-47    40-47    40-47#   40-47#   40-76#   41-8     41-8     41-8#    41-8#
                42-8     42-8     42-8#    42-8#    42-10#   42-16#   42-20#   42-25#   42-29#   42-39#   42-71#   42-73#   42-75#   42-77#
                42-85#   42-89#   42-91#   42-98#   42-100#  42-101#  42-102#  42-103#  42-114#  42-127#  42-132#  42-165#  42-180#  43-10
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CROSS REFERENCE TABLE (CREF V04.00)

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	65-194#	65-199#	65-201	65-201	65-201	65-201#	65-201#	65-201#	65-201#	65-203#	65-207#	65-212#	65-214#	65-222#
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