IDENTIFICATION

Product Code:	MAINDEC-08-D5CE-D
Product Name:	DF32/DF32D Disk Data Mini Disk, Interface Address, Data Test
Date:	June 15, 1970
Maintainer:	Diagnostic Group
Author:	John L. Mittell/Bill LaFlamme

ADDENDUM

1. With 50 cycle power, change memory location 1772 to 0064.

2. With an ASR37 (15 CPS TTY) change following locations

   loc 5773 from 7635 to 7553
   loc 3155 from 4611 to 3133
   loc 3156 from 32ØØ to 4652

1. ABSTRACT

The DF32/DF32D Disk Data is a complete test of the disk system. Also included is a short processor test that is executed while waiting for interrupts, and during data breaks.

2. REQUIREMENTS

2.1 Equipment

PDP-8, PDP-8/S, PDP-8/I or PDP-8/L

If PDP-8/S, DATA BREAK INTERFACE

DF32 or DF32D DISK LOGIC

1 to 4 disks.

2.2 Storage

2.2.1 Program Storage - The program uses most of memory-

0000 through 7400

7000 to 7177 is the out buffer storage.

7200 to 7377 is the in buffer storage.

3. LOADING PROCEDURES

3.1 Method

Procedures for normal binary tapes should be followed.

4. STARTING PROCEDURES

4.1 Control Switch Settings

For normal operation, all switches should be 0s (down)

4.2 Starting Address

100 is the starting address for DF32/DF32D Disk Data,

(cont)
the program will print an initial printout of "RPM XXXX SYNC TIME = XXXX MICRO SECS", and upon completion of a pass, "PCXX", then will loop to start of program

4.3 Program and/or Operation Action

Load Disk Data Test into memory.

Select EMO (All other units to OFF)

Write inhibit switches OFF

Set the SWITCH REGISTER to 100. (77 for the PDP-8/s)

Load Address

Set the SWITCH REGISTER to all 0s (down)

Press START

Program will run and loop upon completion. The only printout that should occur are "RPMXXXX SYNC TIME = XXXX MICRO SECS" and "PCXX".

5. OPERATING PROCEDURE

5.1 Operational Switch Settings

SW0	UP	Delete Printouts
SW1	UP	Halt after error.
SW2	UP	Subtest scope loop.
SW3	UP	Do not exit section.
SW11	UP	Trace (Type starting address of each TEST as the program enters it)

5.1.1 Special Entrance Address

101	Address Test (slow)
102	Track Decode Test
103	Track Error Ratio Test
104	Data Break Test.

105 Data Test.

106 Read Recovery Time Test. (NOT USED ON IDP-8/S)

107 Disk Write Current Saturation Test.

110 Random, Disk, Track, Address and Data Test.

5.1.2 Special Scope Loops

111 Scope loop for Data Failure, automatic setup.

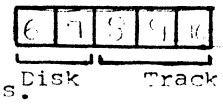
112 Write one word - SR = Disk Address. (Address Test)

113 Read one word - SR = Disk Address. (Address Test)

114 Address loop with bell on error - SR = Disk Address. (Address Test)

115 Data Test.

1st halt SR 6 to 10 = disk and track selections.



2nd halt SR = Disk Address.

3rd halt SR = Data with bell on error.

Routine will monitor SR for data.

5.1.3 Track Scope Loops

116 Writes track. Press START.

1st halt Load data for out buffer in SR, press CONTINUE

2nd halt Set SR 6 to 11 = disk and track selection, press CONTINUE.

117 Read track - SR 6 to 11 = Disk and track selection, SR 0 = 1 to inhibit Printouts

120 Write/Read track.

1st halt Load data in SR. Press CONTINUE.

2nd halt SR 6 to 11 = disk and track selection.

121 Read amplifier adjustment program. SRO should be up to inhibit printouts.

(Another method of adjusting the read amplifier is to use entrance address 116 to write known data on a track, then use entrance address 117 to continuously read that track)

122 All data patterns on a page basic. All switches down.

123 A quick test of each track to be used for margins.

124 Routine to test extended memory banks with data. Bits 9, 10 and 11 select the bank, (Bank 0 is not extended Memory.

5.2 Subroutine Abstracts

Reference Diagram 11.1

5.2.1 Disk RPM Test

Using the teletype clock, gaps are counted for 10 seconds and multiplied by six to compute RPM. Using the computer clock the duration of one gap is computed. Both numbers are typed out in decimal. Because of the cycle time of the PDP-8/s, the sync time is not computed. ???? will be typed for sync time when running on a PDP-8/s.
Because of the tolerances of the teletype and computer clocks these typeouts are not absolutely accurate. If a typeout occurs outside of the specified ranges, a scope should be used to check the time or speed accurately.

Ranges

	DF32		DF32D	
	50Hz	60Hz	50Hz	60Hz
RPM	1450-1550	1750-1850	1450-1550	1750-1850
SYNC TIME	170-230	170-230	1000-3000	1000-3000

5.2.2 Interface Test (BEGIN)

This is an incremental test of flags, interrupts, error condition and status register (Located in core from 425 through 1117)

5.2.3 Disk Address Test - Reference Diagram 11.5

a. Using a write instruction test each address at sync time. (4000 to 7777)

b. Using a read instruction test each address at sync time. (0000 to 4000)

c. Using a write instruction test for incrementing address comparison at transfer complete time.

d. Write different data on each track, read and compare data to make sure that each track address can be decoded properly.

e. Test that no address is found more than once per disk cycle. These are located from 1120 through 1777.

5.2.4 Track Error Ratio Test - Reference Diagram 11.4. This is a bad track detector test. Each track is sequentially tested for a high error ratio. If the ratio is high, the count is printed. If the ratio is low there is no print-out. The purpose of this test is to detect a shoe not flying correctly.

5.2.5 Data Break Processor Test (DBTST) - This is a small test of JMS, ROTATES, TAD and ISZ instruction while doing a continuous write on the disk; interrupts are also tested.

5.2.6 Data Test (DISKO) - Reference Diagram 11.6. The disk is tested with fixed and random numbers. The tracks are

(cont)
tested from outside to inside, the test sequence is write a track, then read the track. Advance to the next inside track, and repeat until the inside track is tested. Then do a check read from out to in (the second read is a test of the guard band).

5.2.7 Read Recovery Time (RDREC) - This is a test of the turn on time of the readers.

5.2.8 Disk Current Saturation Test (DKI) - Writes all 7s on the disk 10 times. Then, the magnetic complement is written once, and read back. This test makes sure that each write saturates the disk.

5.2.9 Random Selection Test (RANDSK) - This routine randomly selects, data words, disk address and track. Then write and read one word only at these locations.

5.2.10 Margin Test (MARGIN)- 200_8 locations on each track are tested with random data.

5.2.11 Data Breaks to Extended Memory (XBANK)

a. Bank 0 writes (7s) to the disk
b. Disk transfers (7s) to extended memory
c. Bank 0 erases the disk area
d. Extended memory writes back to the disk
e. Disk data is transferred to Bank 0 and compared with Step 1. (Extended memory locations 7200 through 7377 are the storage area.)

5.3 Program and/or Operator Action

6. ERRORS

6.1 Error Printout and Description

6.1.1 Disk RPM Test

See paragraph 5.2.1.

6.1.2 Interface and Logic (Halt on Error SW1 = 1)

(For more detailed information refer to the listing)

Address Tag	Function Tested?
0433	DOES START KEY CLEAR (TRC) TRANSFER COMPLETE FF
0440	DOES START KEY CLEAR THE (DRL) DATA REQUEST LATE FF
0444	DOES START KEY CLEAR THE (ADC) ADDRESS CONFIRMED FF
0451	DOES START KEY CLEAR THE COMPUTER AND DISK EXT ADDRESS REGISTER
0457	NO INTERRUPT BOTH (TRC) AND (NED) ARE CLEARED
0470	DOES THE DCMA INSTRUCTION CLEAR NED?
0476	DOES START KEY CLEAR THE PARITY FF, STATUS IS TESTED
0507	FLAG UP TOO SOON ON A (DMAW) INSTRUCTION
0520	WILL A WRITE INSTRUCTION RAISE THE (TRC) FLAG
0531	DOES A WRITE INSTRUCTION CLEAR THE AC
0534	SKIP ON NO ERROR, ALL ERROR STATUS BITS ARE DOWN
0545	FLAG UP TOO SOON ON A (DMAR) CLEAR THE INSTRUCTION
0555	WILL A READ INSTRUCTION (DMAR) RAISE THE (TRC) FLAG
0610	DOES A READ INSTRUCTION (DMAR) CLEAR THE AC
0615	A DEAL INSTRUCTION SHOULD NOT CHANGE THE AC
0622	A DEAL INSTRUCTION SHOULD NOT CHANGE THE AC
0632	RAISE NED BY SELECTING EM3 WITH THE COMPUTER
0640	DOES THE DSAC INSTRUCTION CLEAR THE AC
0653	CAN (ADC) BE RAISED, TESTED BY SKIPPING ON (ADC) DSAC
0662	HAS (WLO) ON NED RAISED (PSM) STATUS
0675	TEST FOR NO WLO STATUS BIT
1014	DOES WC BREAK TO 7750
1017	DOES CA BREAK TO 7751
1033	THE SYNC MARK FOUND
1036	NED IS RAISED
1045	ADC IS UP WITH TRC SET (SHOULD ONLY BE UP DURING DATA BREAKS)
1062	DMAC DOES NOT SKP ON "TRC"
1076	WILL THE DISK INTERRUPT ON "TRC"
1110	WILL THE DISK INTERRUPT ON "NED"

6.1.3 Address Test

6.1.3.1 Address Test at Sync Time

```
GA  0002  Sync  0040  /"TTA" OR "TTB" NOT SHIFTING CORRECTLY
GA  0012  Sync  0011  /ADDRESS NOT INCREMENTED CORRECTLY
GA  0014  Sync  0013  /ADDRESS NOT INCREMENTED CORRECTLY
GA  5076  Sync  5066  /BIT BEING DROPPED ON TRANSFER BETWEEN
                       DISK AND COMPUTER
```

GA = Address that is being tested.

Sync = Contents of Disk Memory Address Register at Sync (Photo Cell) Time.

6.1.3.2 Address Test at TRC Time

1303 GA 2777 BA 3000
Extra Increment of the Address Register

6.1.3.3 Track Address Test

1424 GTXX BTXX

GT = GOOD TRACK
BT = BAD TRACK

6.1.3.4 Track Address Increment and Decode Test

1526 GTXX BTXX

GT = TRACK ADDRESSED
BT = DATA READ

6.1.3.5 Test for False Compare of Address

```
FALCOM  0005
FALCOM  0006
FALCOM  0007
FALCOM  0013
FALCOM  0013
FALCOM  0017
FALCOM  0021
```

These addresses were found twice in one disk cycle.

6.1.4 Track Error Ratio Test

TK XX BAD XXX_8

TK XX = the track being tested
BAD XX = number of errors found on track
Maximum error count = 4020

6.1.5 Processor Instruction and Data Break Test, Reference 11

Halt (PC)	Function Tested
2260	ISZ AND DATA BREAKS
2264	ISZ AND DATA BREAKS
2406	ROTATES AND DATA BREAKS
2412	ROTATES AND DATA BREAKS
2424	ROTATES AND DATA BREAKS
2430	ROTATES AND DATA BREAKS
2456	TAD AND DATA BREAKS
2633	JMS AND DATA BREAKS
2654	INTERRUPT (NOT GENERATED BY DISK)

Any of the above halts represent a failure of the processor, while data breaks are occurring.

6.1.6 Read Recovery Time Test (Not used on PDP-8/S)

5200 GD7777 BDXXXX

Read recovery time too slow, replace reader.

6.1.7 Disk Current Saturation Test

Replace Writer

6.1.8 Random Selector Test

5303 XXXX = Error /ERROR CONDITION
5322 GD XXXX BD XXXX /COMPARISON ERROR

6.1.9 Data Test

Status Error Printout

STAT ERR WRITE SA = TKXX DAXXXX
READ
PE = X NED or WLO = X DRL = X

(SA = Starting Address, TK = Track, DA = Disk Address, PE = Parity Error)

Data Error Printout

XXXX TK XX DAXXXX GDXXXX BDXXXX

7. RESTRICTIONS

None

8. MISCELLANEOUS

8.1 Execution Time

Approximately 30 minutes for PDP-8 or 8/1	60 cycles
Approximately 40 minutes for PDP-8/S	60 cycles
Approximately 55 minutes for PDP-8/S	50 cycles

9. PROGRAM DESCRIPTION

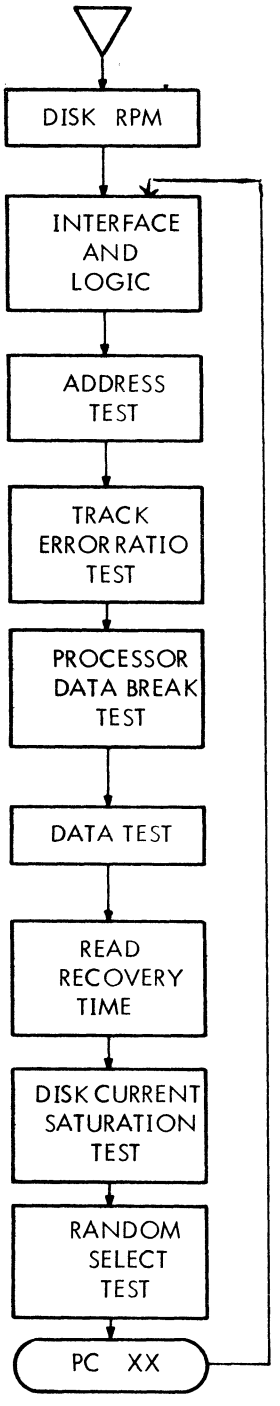
9.1 Discussion

The DF32/DF32D Disk Data Test can be broken down into three sections. Section 1 is an interface test between the disk logic and the computer, testing the disk instructions, error detection interrupts and data break. Section 2 is an address test of the disk using both read and write instructions to verify that all addresses exist on the disk and that maximum access time is not greater than specified, also tested is that no address is found twice in one revolution. Section 3 is data test of the disk. A 200 word outbuffer is filled with a data pattern, this data is written on the track in 200 word segments until the track is full. Then the track is read in segments into a 200 word inbuffer. During the read, the disk error flag is being tested. If an error occurs, the disk address and status register at the time of the error is recorded and printed. After the transfer complete flag is set, comparison is made between the inbuffer and out buffer area. If the comparisons test fails the disk address, the good data and the bad data are printed out.

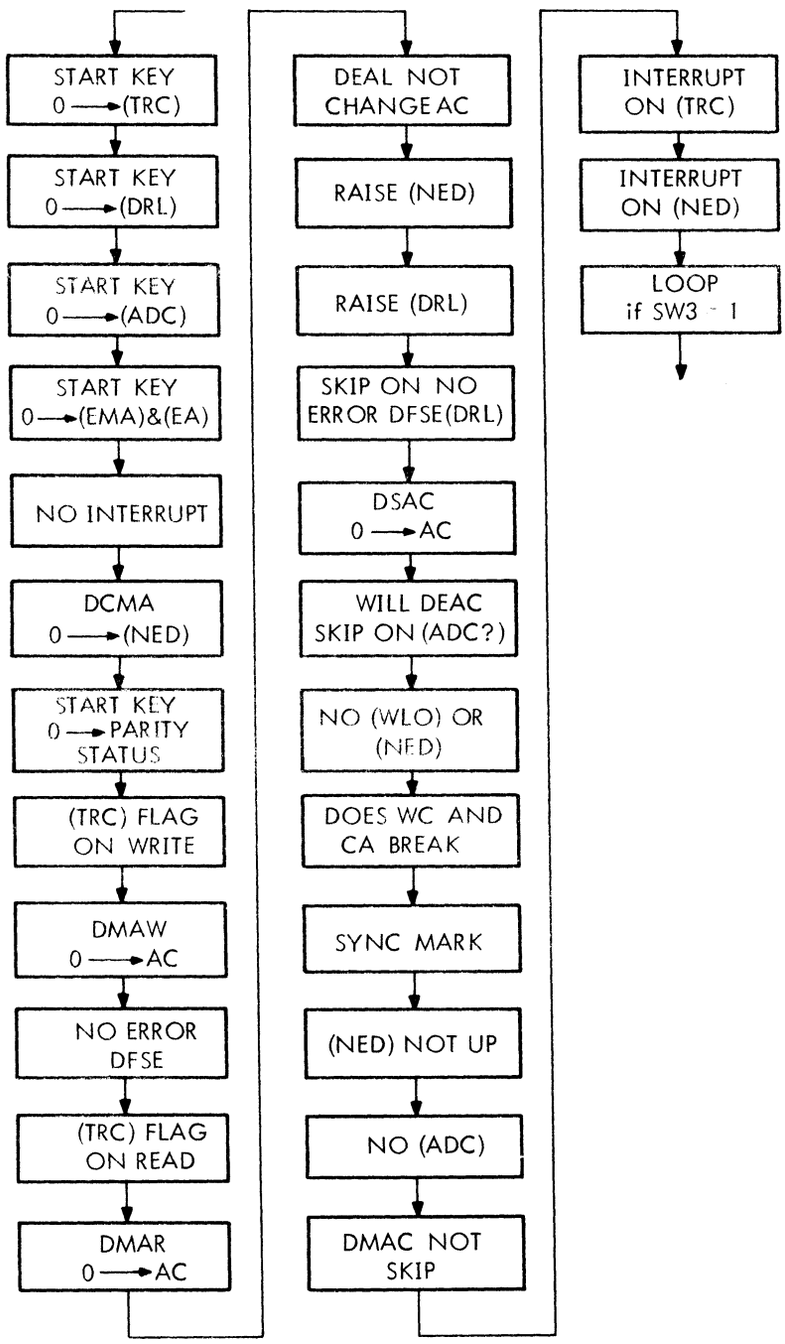
10. LISTINGS

11.2 FLOW DIAGRAMS

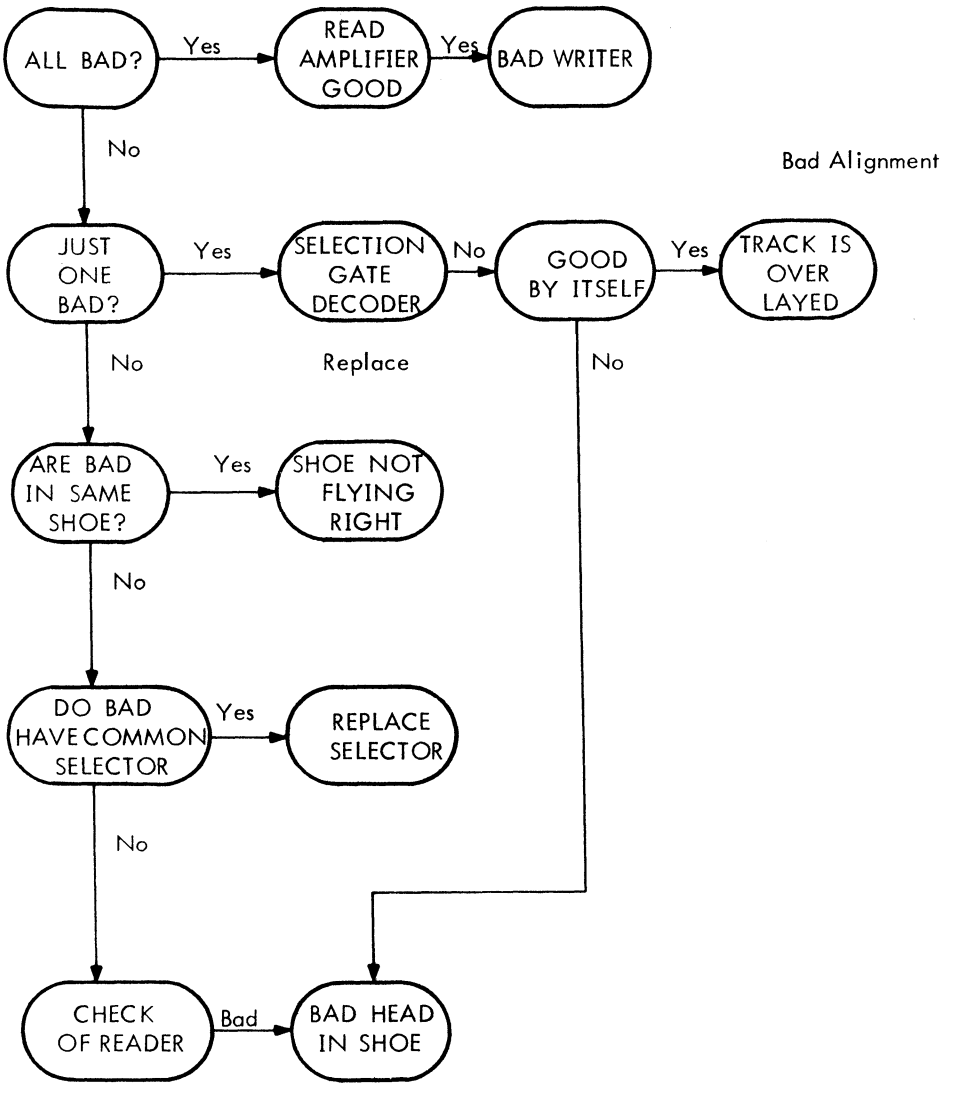
11.1 Basic System Flow



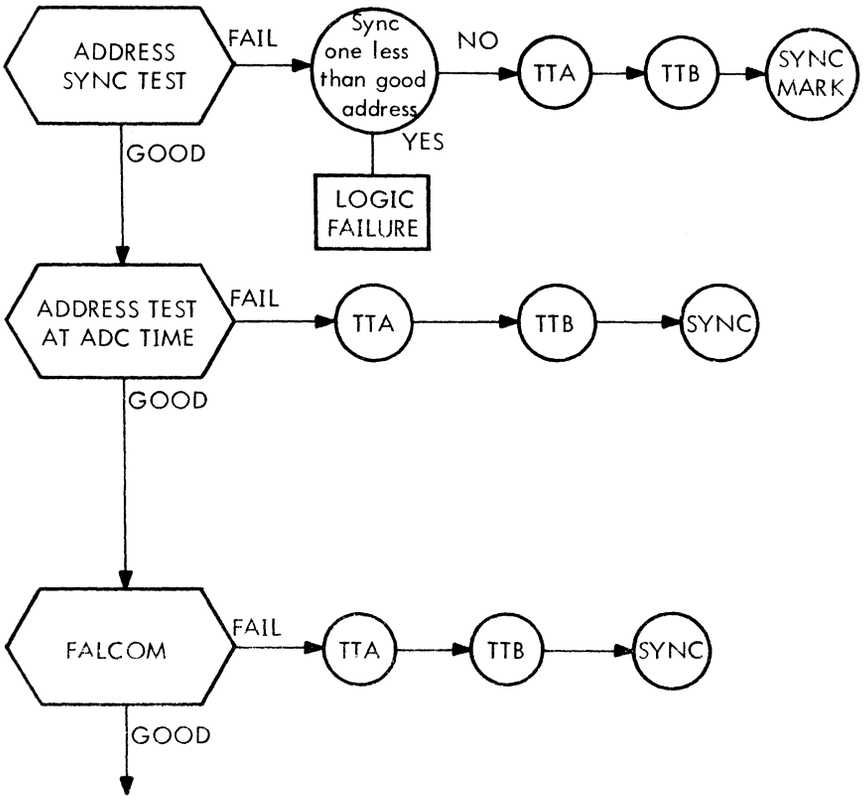
11.3 DF32 Data Disk Interface Flow



11.4 Track Error Ratio Test Trouble Flow

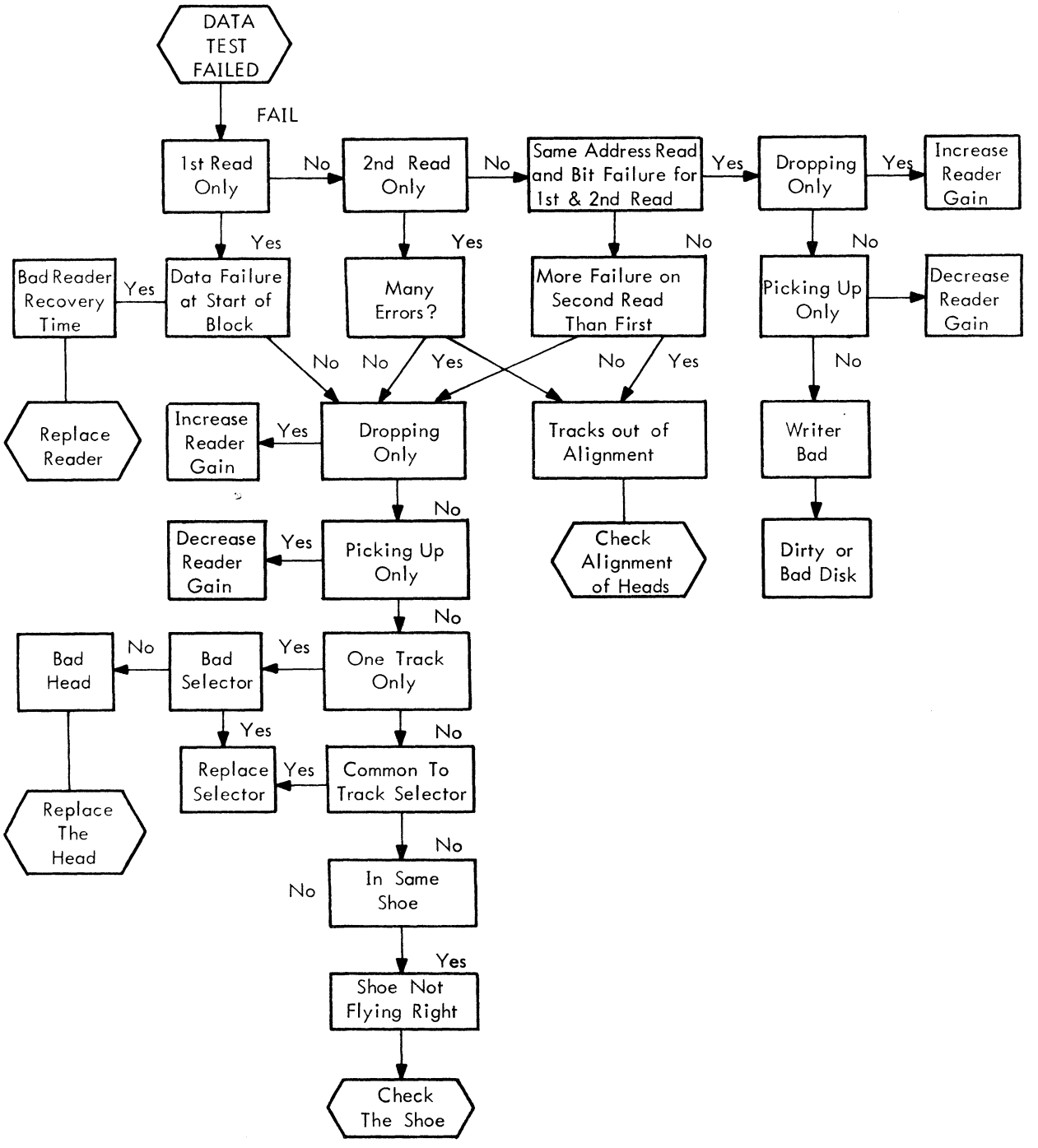


11.5 Disk Data Test (Address) Trouble Flow



TO TRACK ERROR RATIO TEST

11.6 DF32 Data Test Trouble Flow



```
/DF32/DF32D DISK DATA TEST
/
/
/SWITCH CONTROLS
/SWITCH0=1  - DELETE PRINTOUTS
/SWITCH1=1  - HALT AFTER ERROR
/SWITCH2=1  - SUBTEST SCOPE LOOP
/SWITCH3=1  - DO NOT EXIT SECTION
/SWITCH11=1 - TRACE (TYPE STARTING ADDRESS OF EACH TEST
/                    AS THE PROGRAM ENTERS IT)
/
/STARTING ADDRESSES
/0077 -- 8/S ENTRANCE ADDRESS
/0100 -- START TEST
/0101 -- ADDRESS TEST
/0102 -- TRACK DECODE TEST
/0103 -- TRACK ERROR RATIO TEST
/0104 -- DATA BREAK TEST
/0105 -- DATA TEST
/0106 -- READ RECOVERY TEST
/0107 -- DISK CURRENT SATURATION TEST
/0110 -- RANDOM SELECTION
/
/SPECIAL STARTING ADDRESSES FOR SCOPE LOOPS
/0111 -- AUTOMATIC SCOPE SETUP
/0112 -- WRITE
/0113 -- READ
/0114 -- ADDRESS WITH BELL ON ERROR
/0115 -- DATA SCOPE LOOP
/0116 -- WRITE TRACK
/0117 -- READ TRACK
/0120 -- WRITE READ TRACK
/0121 -- READ AMPLIFIER ADJUSTMENT
/0122 -- ALL DATA PATTERNS ON A PAGE BASIC
/0123 -- QUICK TEST OF EACH TRACK
/0124 -- SR9,10,11 = EXT MEMORY BANK
/
/
/
/7600 -- RESTART BINARY LOADER (BIN)
/
/
/
```

```
                0020    *20
                        /DISPATCH TABLE
0020    2132    DISPAT, DISK7A+53
0021    4777'           JMS RDREC       /READ RECOVERY TEST
0022    7604            LAS
0023    0176            AND (400        /PDP8 ONLY
0024    7640            SZA CLA
0025    5021            JMP .-4
0026    7000            NOP
0027    7604            LAS
0030    0176            AND (400
0031    7640            SZA CLA
0032    5026            JMP .-4
0033    7000            NOP
0034    7604            LAS
0035    0176            AND (400
0036    7640            SZA CLA
0037    5033            JMP .-4
0040    4775'           JMS DKI         /DISC CURRENT SATURATION TEST
0041    7604            LAS
0042    0176            AND (400
0043    7640            SZA CLA
0044    5040            JMP .-4
0045    4774'           JMS RANDSK      /RANDOM SELECTION
0046    2055            ISZ .+7
0047    5045            JMP .-2
0050    7604            LAS
0051    0176            AND (400
0052    7640            SZA CLA
0053    5045            JMP .-6
0054    5420            JMP I DISPAT    /EXIT
0055    0000            0
0056    7402    RL6,    XX
0057    7106            CLL RTL
0060    7006            RTL
0061    7006            RTL
0062    5456            JMP I RL6

0063    7402    SLOW8,  XX
0064    1173            TAD (JMP DISPAT+20
0065    3021            DCA DISPAT+1
0066    1172            TAD (CLA CMA
0067    3771'           DCA DSTST+5
0070    1170            TAD (KSP
0071    3767'           DCA NOSYNC
0072    5463            JMP I SLOW8
```

```
                0077    *77
                        /JUMP OFF POINT
0077    4063            JMS SLOW8       /BS ENTRANCE ADDRESS
0100    5776'           JMP RPM         /START OF TEST IE, DISC RPM
0101    5766'           JMP ATEST       /ADDRESS TEST SLOW
0102    5765'           JMP TKDEC       /TRACK DECODE TEST
0103    5764'           JMP RATIO       /TRACK ERROR RATIO TEST
0104    5763'           JMP DBTST-6     /DATA BREAK TEST
0105    5762'           JMP DISK0       /DATA TEST
0106    5021            JMP DISPAT+1    /READ RECOVERY TEST
0107    5040            JMP DISPAT+20   /DISC CURRENT SATURATION TEST
0110    5045            JMP DISPAT+25   /RANDOM SELECTION
                        /
                        /SPECIAL SCOPE LOOPS
0111    5761'           JMP SCOPE       /AUTOMATIC SCOPE SETUP
0112    5760'           JMP SAWD        /WRITE
0113    5757'           JMP SARD        /READ
0114    5756'           JMP DBELL+41    /ADDRESS WITH BELL ON ERROR
0115    5755'           JMP DBELL       /DATA SCOPE LOOP
0116    5754'           JMP FILLX-11    /WRITE TRACK
0117    5753'           JMP FILLX-6     /READ TRACK
0120    5752'           JMP FILLX-4     /WRITE/READ TRACK
0121    5751'           JMP RDADJ       /READ AMPLIFIER ADJUSTMENT PROGRAM
0122    5750'           JMP WRCX        /ALL DATA PATTERNS ON A PAGE BASIC
0123    5747'           JMP MARGIN      /QUICK TEST OF EACH TRACK
0124    5746'           JMP XBANK       /BR 9,10,11=EXT MEMORY BANK

                        /DIGITAL 8-18-U
                        /MESSAGE TYPE-OUT
                        /CALL WITH A JMS MESAGE
                        /WITH DATA FOLLOWING
                        /RETURN FOLLOWING END OF MESSAGE
                        /CODE(00)
```

```
                0200    *200
0200    0000    MESAGE, 0
0201    7240            CLA CMA                 /SET C(AC)=-1
0202    1200            TAD MESAGE                /ADD LOCATION
0203    3010            DCA 10                  /AUTO-INDEX REGISTTER
0204    1410            TAD I 10                /FETCH FIRST WORD
0205    3216            DCA MSRGHT              /SAVE IT
0206    1216            TAD MSRGHT
0207    7012            RTR
0210    7012            RTR                     /ROTATE 6 BITS RIGHT
0211    7012            RTR
0212    4217            JMS TYPECH              /TYPE IT
0213    1216            TAD MSRGHT              /GET DATA AGAIN
0214    4217            JMS TYPECH              /TYPE RIGHT HALF
0215    5204            JMP MESAGE+4            /CONTINUE
0216    0000    MSRGHT, 0                       /TEMPORARY STORAGE

0217    0000    TYPECH, 0                       /TYPE CHARACTER IN C(AC)6-11
0220    0250            AND MASK77
0221    7450            SNA                     /IS IT END OF MESSAGE?
0222    5410            JMP I 10                /YES; EXIT
0223    1251            TAD M40                 /SUBTRACT 40
0224    7500            SMA                     /<40?
0225    5230            JMP .+3                 /NO
0226    1252            TAD C340                /YES; ADD 300
0227    5243            JMP MTP                 /TO CODES <40
0230    1253            TAD M3                  /SUBTRACT 3
0231    7440            SZA                     /IS IT ZERO?
0232    5235            JMP .+3                 /NO
0233    1254            TAD C212                /YES; CODE 43 IS
0234    5243            JMP MTP                 /LINE-FEED (212)
0235    1255            TAD M2                  /SUBTRACT 2
0236    7440            SZA                     /IS IT ZERO?
0237    5242            JMP .+3                 /NO
0240    1256            TAD C215                /YES; CODE 45 IS
0241    5243            JMP MTP                 /CARRIAGE-RETURN (215)
0242    1257            TAD C245                /ADD 200 TO OTHERS >40
0243    6046    MTP,    TLS                     /TRANSMIT CHARACTER
0244    6041            TSF                     /WAIT FOR FLAG
0245    5244            JMP .-1                 /NOT SET YET
0246    7200            CLA                     /SET; CLEAR C(AC)
0247    5617            JMP I TYPECH            /RETURN
                /CONSTANTS
0250    0077    MASK77, 77
0251    7740    M40,    -40
0252    0340    C340,   340
0253    7775    M3,     -3
0254    0212    C212,   212
0255    7776    M2,     -2
0256    0215    C215,   215
0257    0245    C245,   245
```

```
02:0  7402    SIXTY,  HLT
0201  7000            NOP
0202  7000            NOP                     /STORE INIT NEXT TIME
0203  7200            CLA
0204  1660            TAD I ,-4               /ADDRESS OF OPERAND
0205  3267            DCA ,+2
0206  5670            JMP I ,+2
0207  0000            0                       /ADDRESS OF OPERAND
0270  0272            SIXTY+12                /CHANGING REFERENCE (P)
0271  5263            JMP SIXTY+3
0272  1667            TAD I SIXTY+7           /AC (OPERAND)
0273  0377            AND (0007
0274  3340            DCA MASKA               /000X
0275  1667            TAD I SIXTY+7           /AC (OPERAND)
0276  0376            AND (0070
0277  3341            DCA MASKB               /00X0
0300  1667            TAD I SIXTY+7           /AC (OPERAND)
0301  0375            AND (0700
0302  3342            DCA MASKC               /0X00
0303  1667            TAD I SIXTY+7           /AC (OPERAND)
0304  0374            AND (7000
0305  3343            DCA MASKD               /X000
0306  1342            TAD MASKC               /0X00
0307  7112            RTR CLL
0310  7010            RAR                     /0X00 RS3 00X0
0311  1343            TAD MASKD               /X0X0
0312  7012            RTR
0313  7010            RAR
0314  1344            TAD MASKD+1             /X0X0 RS3 0X0X
0315  3342            DCA MASKC               /TEMP STORAGE
0316  2260            ISZ SIXTY               /INCREMENT FOR STORAGE
0317  4270            JMS SIXTY+10            /FIND STORAGE ADDRESS
0320  1342            TAD MASKC               /6X6X
0321  3667            DCA I SIXTY+7           /STORE OPERAND AS SPECIFIED
0322  1341            TAD MASKB               /00X0
0323  7004            RAL
0324  7006            RTL                     /00X0 SL3 0X00
0325  1340            TAD MASKA               /0X00+000X=0X0X
0326  1344            TAD MASKD+1             /0X0X+6060=6X6X
0327  3343            DCA MASKD               /TEMP STORAGE
0330  2260            ISZ SIXTY               /INCREMENT FOR STORAGE
0331  4270            JMS SIXTY+10            /FIND STORAGE ADDRESS
0332  1343            TAD MASKD               /6X6X
0333  3667            DCA I SIXTY+7           /STORE OPERAND AS SPECIFIED
0334  1373            TAD (SIXTY+12           /HOUSE KEEPING
0335  3270            DCA SIXTY+10
0336  2260            ISZ SIXTY               /INCREMENT FOR RETURN
0337  5667            JMP I SIXTY             /RETURN

0340  0000    MASKA,  0
0341  0000    MASKB,  0
0342  0000    MASKC,  0
0343  0000    MASKD,  0
0344  6060            6060
```

```
                    /PDP-8 DISK MEMORY INTERFACE TEST

0373  0272
0374  7000
0375  0700
0376  3070
0377  0007
      0400      PAGE
                /RMX5 DISC TEST
                /DISK MOTOR SPEED CHECK USING SYNC MARK
                /DISK RPM XXXX RMX5  3/31/67

0400  7200      RPM,    CLA
0401  1377                TAD (ADDR&177 200 !SZ
0402  3776'               DCA ADDINC
0403  1375                TAD (-23
0404  3774'               DCA CTC
0405  1373                TAD (TABL
0406  3772'               DCA ADDR
0407  4771'               JMS SPEED
0410  4770'               JMS SYNCT
0411  4767'               JMS CONV
0412  7200                CLA
0413  3766'               DCA END
0414  7604                LAS
0415  0365                AND (400
0416  7640                SZA CLA
0417  5200                JMP RPM
0420  5223                JMP BEGIN+2
```

```
                    DEFINE NPAGE
                    <JMP I (.+200&7600>
                    DEFINE HALT
                            <JMS ERADD>
                    /
                    /FLAG TEST (CLEAR)
0421  6601  BEGIN,  DCMA                    /CLEAR MAR, PE DONE, NED
0422  6611          DCEA                    /CLEAR EXT ADDRESS REGISTER
0423  4764'         JMS SCOPEA
0424  6622          DFSC                    /SKIP ON FLAG
0425  7410          SKP
                    HALT                    /FLAG SHOULD BEEN CLEARED BY START
0426  4763'  JMS ERADD
0427  4764'         JMS SCOPEA
                    /
                    /TEST NO DRL
0430  6616          DEAC
0431  0362          AND (4
0432  7440          SZA
                    HALT
0433  4763'  JMS ERADD
0434  4764'         JMS SCOPEA
                    /
                    /TEST NO ADC
0435  6612          DSAC
0436  7410          SKP
                    HALT                    /START NOT CL ADC
0437  4763'  JMS ERADD
0440  4764'         JMS SCOPEA
                    /
                    /EXT ADDRESS CL BY START KEY
0441  6616          DEAC
0442  0361          AND (3770
0443  7440          SZA
                    HALT
0444  4763'  JMS ERADD
0445  4764'         JMS SCOPEA
                    /
                    /INTERRUPT TEST
0446  4760'         JMS CLFLAG              /CLEAR PD FLAGS
```

```
0447  6001            ION                     /INTERRUPT ON
0450  5253            JMP .+3
0451  6002            IOF                     /INTERRUPT UP
                      HALT                    /INTERRUPT
0452  4763'     JMS ERADD
0453  6002            IOF
0454  4764'           JMS SCOPEA
0455  6611            DCEA
                /
                /WILL DCMA CL NED
0456  6601            DCMA
0457  6616            DEAC
0460  7000            NOP
0461  0357            AND (2
0462  7440            SZA
                      HALT                    /NED OR WLO SET
0463  4763'     JMS ERADD
0464  4764'           JMS SCOPEA
                /
                /NO PARITY STATUS BIT
0465  6616            DEAC
0466  7000            NOP
0467  0356            AND (1
0470  7440            SZA
                      HALT                    /PARITY STATUS BIT UP
0471  4763'     JMS ERADD
0472  4764'           JMS SCOPEA
                /
                /DISK MEMORY ADDRESS WRITE
                /         (DMAW)(DFSC)
0473  7240            CLA CMA
0474  3755'           DCA IACW                /MEMORY LOCATION ZERO
0475  7240            CLA CMA                 /AC=7777
0476  3754'           DCA WC                  /WORD COUNT=7777
0477  6605            DMAW                    /START WRITE ONE WORD
0500  6622            DFSC                    /SKIP ON FLAG
0501  7410            SKP
                      HALT                    /FLAG UP TOO SOON
0502  4763'     JMS ERADD
0503  7000            NOP
0504  2753'           ISZ CTD
0505  5304            JMP .-1                 /18 MILL SEC
0506  2753'           ISZ CTD
0507  5306            JMP .-1                 /36 MILL SEC
0510  2753'           ISZ CTD
0511  5310            JMP .-1                 /54 MILL SEC
0512  6622            DFSC                    /SKIP ON FLAG
                      HALT                    /FLAG UP NOT AFTER 54 MILL. SEC.
0513  4763'     JMS ERADD
0514  4764'           JMS SCOPEA
```

```
                    /IS AC CLEARED BY DMAW?
0515  7240          CLA CMA
0516  3754'         DCA WC          /ONE WORD
0517  7240          CLA CMA
0520  6605          DMAW            /IOT SHOULD CLEAR AC
0521  6622          DFSC
0522  5321          JMP .-1         /WAIT FOR FLAG
0523  7440          SZA
                    HALT            /AC NOT CLEARED
0524  4763'   JMS ERADD
                    /
                    /IS ERROR STILL CLEARED?
0525  4764'         JMS SCOPEA
0526  6621          DFSE
                    HALT            /PARITY ERROR FLAG UP
0527  4763'   JMS ERADD
0530  4764'         JMS SCOPEA
                    /
                    /DISK MEMORY ADDRESS READ
0531  7240          CLA CMA
0532  3754'         DCA WC          /READ ONE WORD
0533  7240          CLA CMA
0534  3755'         DCA IACW        /MEMORY LOCATION ZERO
0535  6603          DMAR            /START READ ONE WORD
0536  6622          DFSC            /SKIP ON FLAG
0537  7410          SKP
                    HALT            /FLAG UP TOO SOON
0540  4763'   JMS ERADD
0541  2753'         ISZ CTD
0542  5341          JMP .-1         /18 MILL SEC
0543  2753'         ISZ CTD
0544  5343          JMP .-1         /36 MILL SEC
0545  2753'         ISZ CTD
0546  5345          JMP .-1         /54 MILL SEC
0547  6622          DFSC            /SKIP ON FLAG
                    HALT            /FLAG NOT UP AFTER 54 MILL SEC
0550  4763'   JMS ERADD
```

```
                    NPAGE
0551  5752          JMP I (.+200&7600
0552  0600
0553  6611
0554  7750
0555  7751
0556  0001
0557  0002
0560  4600
0561  3770
0562  0004
0563  5600
0564  5055
0565  0400
0566  6617
0567  4271
0570  4235
0571  5701
0572  5754
0573  6733
0574  6603
0575  7755
0576  5746
0577  2354
      0600          PAGE
                    /IS AC CLEARED BY DMAR
0600  4777'               JMS SCOPEA
0601  7240                CLA CMA
0602  3776'               DCA WC              /ONE WORD
0603  7240                CLA CMA
0604  6603                DMAR                /IOT SHOULD CLEAR AC
0605  6622                DFSC
0606  5205                JMP .-1             /WAIT FOR FLAG
0607  7440                SZA
                          HALT                /AC NOT CLEARED
0610  4775'         JMS ERADD
0611  4777'               JMS SCOPEA
```

```
                /LOAD EXTENDED ADDRESS
                /DOES "DEAL" CHANGE THE AC?
0612  6601              DCMA
0613  6615              DEAL              /IOT SHOULD NOT CHANGE AC
0614  7440              SZA
                        HALT              /AC SHOULD BE ZERO
0615  4775'     JMS ERADD
0616  7240              CLA CMA           /AC=7777
0617  6615              DEAL              /SHOULD NOT CHANGE AC
0620  7040              CMA
0621  7440              SZA
                        HALT              /AC SHOULD BE ZERO
0622  4775'     JMS ERADD
0623  4777'             JMS SCOPEA
                /
                /RAISE NED (NON EXISTANT DISC)
0624  7200              CLA
0625  1374              TAD (3000         /EM3
0626  6615              DEAL              /SELECT EM3
0627  6616              DEAC
0630  0373              AND (2            /NED STATUS
0631  7450              SNA
                        HALT              /EM3 DID NOT RAISE NED
0632  4775'     JMS ERADD
0633  4777'             JMS SCOPEA
                /
```

```
                    /DOES 6612 CLEAR THE AC? (DSAC)
0634  6611          DCEA
0635  7240          CLA CMA           /SET AC TO SEVENS
0636  6612          DSAC
0637  7440          SZA
                    HALT              /HALT BECAUSE AC NOT ZERO OR ADC UP
0640  4775'   JMS ERADD
0641  4777'         JMS SCOPEA
                    /
                    /WILL DEAC SKIP DURING DATA BREAK?
0642  6611          DCEA
0643  3776'         DCA WC
0644  3772'         DCA IACW          /ONE WORD
0645  6605          DMAW
0646  6616          DEAC
0647  7410          SKP
0650  5254          JMP .+4
0651  6622          DFSC
0652  5246          JMP .-4           /DID NOT SEE ADC PULSE
                    HALT
0653  4775'   JMS ERADD
0654  4777'         JMS SCOPEA
                    /
                    /CHECK TO SEE IF WRITE LOCK OR NED = (1)
0655  6611          DCEA
0656  6616          DEAC              /READ STATUS
0657  7000          NOP
0660  7006          RTL
0661  7430          SZL
                    HALT              /AC1 UP WRITE LOCK OUT SWITCH
0662  4775'   JMS ERADD
0663  4777'         JMS SCOPEA
                    /
                    /TEST WRITE LOCK OUT
0664  7240          CLA CMA
0665  3776'         DCA WC
0666  6605          DMAW
0667  6622          DFSC
0670  5267          JMP .-1
0671  6616          DEAC
0672  7000          NOP
0673  0373          AND (2
0674  7440          SZA
                    HALT
0675  4775'   JMS ERADD
                    NPAGE
0676  5771    JMP I (.+20007600
```

```
0771  1000
0772  7751
0773  0002
0774  3000
0775  5600
0776  7750
0777  5055
      1000    PAGE

              /DOES DISK BREAK TO RIGHT LOC
1000  4777'           JMS SCOPEA
1001  6611            DCEA
1002  7240            CLA CMA
1003  3776'           DCA WC
1004  7240            CLA CMA
1005  3775'           DCA IACW          /WRITE ONE WORD
1006  6605            DMAW
1007  6622            DFSC
1010  5207            JMP .-1
1011  7200            CLA
1012  1776'           TAD WC
1013  7640            SZA CLA
1014  4774'           JMS ERADD         /WORD COUNT NOT CORRECT
1015  1775'           TAD IACW
1016  7440            SZA
1017  4774'           JMS ERADD         /ADDRESS CONTROL WORD NOT CORRECT
1020  4777'           JMS SCOPEA
              /
              /DEAC READ DISK EXTENDED ADDRESS
              /CHECK FOR SYNC MARK
              /CHECK FOR ADDRESS COMPAR
1021  6611            DCEA
1022  7300            CLA CLL
1023  3773'           DCA CTD
1024  6616            DEAC
1025  7000            NOP
1026  7700            SMA CLA           /SYNC?
1027  7410            SKP               /NO
1030  5234            JMP .+4           /YES
1031  2773'           ISZ CTD           /LOOP
1032  5224            JMP .-6
                      HALT              /NO SYNC PULSE
1033  4774'   JMS ERADD
1034  1773'           TAD CTD
1035  7450            SNA
                      HALT              /SYNC OR NED ALWAYS UP
1036  4774'   JMS ERADD
1037  4777'           JMS SCOPEA
              /
              /CHECK FOR NO ADDRESS COMPARE PULSE
1040  6611            DCEA
1041  7200            CLA
1042  3773'           DCA CTD
1043  6616            DEAC              /SKIP ON ADC
```

```
1044  7410          SKP
                    HALT              /ADC PULSE
1045  4774'   JMS ERADD
1046  2773'         ISZ CTD
1047  5243          JMP .-4
1050  4777'         JMS SCOPEA
```

```
                        /CHECK THAT DMAC DOES NOT SKIP ON DONE FLAG
1051  6611              DCEA
1052  7240              CLA CMA
1053  3776'             DCA WC              /ONE WORD
1054  3775'             DCA IACW
1055  6605              DMAW
1056  6622              DFSC
1057  5256              JMP .-1
1060  6626              DMAC                /FLAG IS SET
1061  7410              SKP
                        HALT                /DMAC SKIPPED
1062  4774'   JMS ERADD
1063  4777'             JMS SCOPEA
                        /
                        /WILL THE DISK HONOR AN INTERRUPT ON DONE
1064  6611              DCEA
1065  4772'             JMS CLFLAG
1066  1371              TAD (JMP I .+11
1067  3001              DCA 0001
1070  7240              CLA CMA
1071  3776'             DCA WC
1072  6605              DMAW
1073  6001              ION
1074  6622              DFSC
1075  5274              JMP .-1             /DONE FLAG
                        HALT
1076  4774'   JMS ERADD
1077  4777'             JMS SCOPEA
                        /
                        /INTERRUPT ON NED
1100  4772'             JMS CLFLAG
1101  1370              TAD (3000
1102  6615              DEAL
1103  7200              CLA
1104  1367              TAD (JMP I .+5
1105  3001              DCA 0001            /INSTRUCTION TO BE EXECUTED ON INTERRUPT
1106  6001              ION
1107  7000              OPR
                        HALT                /NO INTERRUPT ON NED
1110  4774'   JMS ERADD
1111  4777'             JMS SCOPEA
1112  6611              DCEA
1113  6601              DCMA
1114  7604              LAS
1115  0366              AND (400            /SWITCH 3
1116  7640              SZA CLA
1117  5765'             JMP BEGIN           /LOOP ON INTERFACE TEST
                        PAUSE
```

```
                    /TAPE 2
                    /CHECK FOB ALL ADDRESS - SYJC WRITE
                    /NOT USING DATA BREAK 4000-7777
1120  7000  ATEST,  OPR
1121  4777'         JMS SCOPEA
1122  6611          DCEA
1123  1364          TAD (4000
1124  3763'         DCA GA
1125  7200          CLA
1126  1763'         TAD GA              /IACW=1
1127  4762'         JMS WONEW7
1130  6616          DEAC
1131  7500          SMA                 /SYNC PULSE
1132  5330          JMP .-2             /NO
1133  6626          DMAC                /YES - READ MAC
1134  3761'         DCA BA
1135  1761'         TAD BA
1136  7041          CIA
1137  1763'         TAD GA
1140  7450          SNA
1141  5347          JMP .+6
1142  4760'         JMS ERSYNC          /A=GOOD BA=BAD
1143  7604          LAS
1144  0357          AND (1000
1145  7440          SZA
1146  5325          JMP .-21
1147  2763'         ISZ GA
1150  5325          JMP .-23
                    NPAGE
1151  5756    JMP I (.+200&7600
```

```
1156  1200
1157  1000
1160  6100
1161  6621
1162  5000
1163  6622
1164  4000
1165  0421
1166  0400
1167  5544
1170  3000
1171  5545
1172  4600
1173  6611
1174  5600
1175  7751
1176  7750
1177  5055
      1200    PAGE

              /CHECK ALL ADDRESS SYNC READ
              /NOT USING DATA BREAK 0000 TO 3777
1200  4777'           JMS SCOPEA
1201  6611            DCEA
1202  1376            TAD (4000
1203  3775'           DCA KA          /TIMES COUNTER
1204  3774'           DCA GA          /INITIAL ADDRESS=0000
1205  7200            CLA
1206  3773'           DCA CTC
1207  1774'           TAD GA          /ADDRESS ON DISK
1210  3000            DCA 0000        /STORE IN ZERO
1211  7240            CLA CMA
1212  3772'           DCA WC          /ONE WORD
1213  7240            CLA CMA
1214  3771'           DCA IACW
1215  1000            TAD 0000
1216  6603            DMAR            /START READ
1217  6622            DFSC            /SKIP ON FLAG
1220  7410            SKP             /NO
1221  5224            JMP .+3         /YES
1222  2773'           ISZ CTC
1223  5217            JMP .-4
1224  6616            DEAC            /READ STATUS
1225  7000            OPR
1226  7500            SMA             /SYNC PULSE
1227  5224            JMP .-3         /NO
1230  6626            DMAC            /YES - READ ADDRESS
1231  3770'           DCA BA
1232  1770'           TAD BA
1233  7041            CIA
1234  2774'           ISZ GA
1235  1774'           TAD GA
1236  7450            SNA             /COMPARE WITH GOOD
1237  5252            JMP .+13        /NO
```

```
1240  4767'          JMS ERSYNC
1241  7604           LAS
1242  0366           AND (1000
1243  7450           SNA
1244  5252           JMP .+6
1245  7200           CLA
1246  1774'          TAD GA
1247  1365           TAD (-1
1250  3774'          DCA GA
1251  5205           JMP .-44
1252  2775'          ISZ KA          /YES - HAVE WE CHECKED ALL
1253  5205           JMP .-46        /NO - LOOP
1254  4777'          JMS SCOPEA      /YES
```

```
                /CHECK FOR ALL ADDRESS INCREMENTS USING DATA BREAK
                /TRACKS 0000 TO 7777
                /
1255  6601              DCMA                    /CLEAR DISC ADDRESS AND FLAGS
1256  6611              DCEA                    /CLEAR DISC EXTENDED ADDRESS
1257  7200              CLA
1260  3774'             DCA GA                  /SET ADDRESS TO 0
1261  7200              CLA
1262  1364              TAD (-2
1263  3772'             DCA WC                  /WORD COUNT=2
1264  3771'             DCA IACW
1265  1774'             TAD GA                  /FETCH DISC ADDRESS
1266  6605              DMAW                    /WRITE 2 WORDS
1267  6622              DFSC                    /WRITE COMPLETE?
1270  5267              JMP .-1                 /NO WAIT
1271  2774'             ISZ GA                  /INCREMENT GOOD ADDRESS FOR COMPARE
1272  7000              NOP
1273  6626              DMAC                    /READ DISC ADDRESS
1274  3770'             DCA BA                  /SAVE DISC ADDRESS
1275  1770'             TAD BA                  /BRING UP DISC ADDRESS
1276  7041              CIA
1277  1774'             TAD GA                  /SUBTRACT DISC ADDRESS FROM GOOD ADDRESS
1300  7450              SNA                     /DO ADDRESSES COMPARE
1301  5314              JMP .+13                /NO, GO TO ERROR
1302  4763'             JMS BADADD
1303  7604              LAS
1304  0366              AND (1000
1305  7450              SNA
1306  5314              JMP .+6
1307  7200              CLA
1310  1774'             TAD GA
1311  1365              TAD (-1
1312  3774'             DCA GA
1313  5261              JMP .-32
1314  1774'             TAD GA                  /YES, LOAD ADDRESS
1315  7440              SZA                     /END?
1316  5261              JMP .-35                /NO, RETURN
1317  4777'             JMS SCOPEA              /YES, EXIT
```

```
                    NPAGE
1320  5762          JMP I (.+20087600

1362  1400
1363  6316
1364  7776
1365  7777
1366  1000
1367  6100
1370  6621
1371  7751
1372  7750
1373  6603
1374  6622
1375  6600
1376  4000
1377  5055
      1400          PAGE

                    /TRACK INCREMENT ADDRESS TEST

1400  4777'         TKING,  JMS SCOPEA
1401  7000                  NOP
1402  6611                  DCEA
1403  7200                  CLA
1404  1376                  TAD (-7
1405  3775'                 DCA CTA
1406  3774'                 DCA GT          /GOOD TRACK
1407  7200                  CLA
1410  1774'                 TAD GT
1411  6615                  DEAL            /LOAD TRACK ADDRESS
1412  7240                  CLA CMA
1413  4773'                 JMS WONEW7      /WRITE ONE WORD
1414  6616                  DEAC            /READ TRACK ADDRESS
1415  0372                  AND (3700       /TRACK MASK
1416  3771'                 DCA BT          /BAD TRACK
1417  1771'                 TAD BT
1420  7041                  CIA
1421  1774'                 TAD GT
1422  7640                  SZA CLA         /COMPARISON ERROR
1423  4770'                 JMS ETRACK
1424  1774'                 TAD GT
1425  1367                  TAD (100
1426  2775'                 ISZ CTA
1427  5206                  JMP TKING+5     /LOOP TILL DONE
1430  4777'                 JMS SCOPEA
```

```
                        /CHECK TO SEE THAT ALL TRACK ADDRESSES CAN BE DECODED
                        /THIS ROUTINE WRITES THE TRACK ADDRESS IN THE FIRST
                        /AND LAST WORDS ON EACH TRACK THEN READS THEM BACK
                        /AND COMPARES THEM
                        /IF AN ERROR PRINT OUT OCCURS GT IS THE ADDRESS EXPECTED
                        /AND BT IS THE ADDRESS READ
                        /
                        /
1431  6611    TKDEC,    DCEA                    /CLEAR TRACK ADDRESS
1432  6601              DCMA                    /CLEAR DISC ADDRESS
1433  1366              TAD (-20
1434  3775'             DCA CTA                 /SET TRACK COUNT
1435  3765'             DCA OUTBUF              /FIRST DATA WORD=0
1436  7001              IAC
1437  3764'             DCA OUTBUF+1            /SECOND DATA WORD=1
1440  1363    TKWT,     TAD (-2
1441  3762'             DCA WC                  /SET WORD COUNT FOR 2 WORDS
1442  1361              TAD (OUTBUF-1
1443  3760'             DCA IACW                /SET BEGINNING ADDRESS
1444  6626              DMAC
1445  1357              TAD (3777               /BRING IN DISC ADDRESS AND MODIFY
1446  6605              DMAW                    /WRITE THE LAST WORD OF
1447  6622              DFSC                    /ONE TRACK AND THE FIRST
1450  5247              JMP .-1                 /WORD OF THE NEXT TRACK
1451  2765'             ISZ OUTBUF              /INCREMENT DATA
1452  2764'             ISZ OUTBUF+1
1453  2775'             ISZ CTA                 /INCREMENT TRACK COUNTER
1454  5240              JMP TKWT
1455  6611              DCEA                    /CLEAR TRACK ADDRESS
1456  1366              TAD (-20
1457  3775'             DCA CTA                 /SET TRACK COUNT
1460  3774'             DCA GT                  /SET COMPARE WORD=0
1461  6601              DCMA                    /CLEAR DISC ADDRESS
1462  7300              CLA CLL
1463  3756'             DCA CTADC
```

```
1464  2756'   TKRD,   ISZ CTADC
1465  7200            CLA
1466  1756'           TAD CTADC
1467  7420            SNL
1470  1355            TAD (3776
1471  3756'           DCA CTADC
1472  1361            TAD (OUTBUF-1
1473  3760'           DCA IACW
1474  7040            CMA
1475  3762'           DCA WC
1476  1756'           TAD CTADC
1477  6603            DMAR
1500  6622            DFSC
1501  5300            JMP .-1
1502  7210            CLA RAR
1503  3754'           DCA CTB
1504  1765'           TAD OUTBUF
1505  7041            CIA
1506  1774'           TAD GT
1507  7440            SZA
1510  5323            JMP TKERR
1511  7300            CLA CLL
1512  1754'           TAD CTB
1513  7004            RAL
1514  7020            CML
1515  7420            SNL
1516  5264            JMP TKRD
1517  2774'           ISZ GT
1520  2775'           ISZ CTA
1521  5264            JMP TKRD
1522  5330            JMP .+6
1523  7200    TKERR,  CLA
1524  1765'           TAD OUTBUF
1525  3771'           DCA BT
1526  4770'           JMS ETRACK
1527  5312            JMP .-15
                      NPAGE
1530  5753    JMP I (.+2003?600
```

```
1553  1600
1554  3661
1555  3776
1556  6627
1557  3777
1560  7751
1561  6777
1562  7750
1563  7776
1564  7001
1565  7000
1566  7760
1567  0100
1570  6000
1571  6624
1572  3700
1573  5000
1574  6623
1575  6610
1576  7771
1577  5055
      1600          PAGE

                    /CHECK FOR NO MORE THAN ONE ADC PER REV
                    /DETECT FALSE ADDRESS COMPARE
                    /THIS ROUTINE FINDS ITS OWN ISZ TIME AND SHOULD WORK IN ANY MACHINE
1600  4777'         JMS SCOPEA
1601  7000    FCOM, NOP
1602  6611          DCEA
1603  7200          CLA             /SET UP TO FIND ISZ
1604  3776'         DCA GA          /TIME
1605  7200          CLA
1606  1776'         TAD GA
1607  4775'         JMS WONE        /START-REFERENCE
1610  6622          DFSC            /DONE FLAG
1611  5210          JMP .-1         /FOUND REFERENCE
1612  7200          CLA
1613  1776'         TAD GA
1614  4775'         JMS WONE        /LOOK AGAIN
1615  7200          CLA
1616  3774'         DCA CTC         /CTC=HOW LONG
1617  6622          DFSC
1620  7410          SKP
1621  5225          JMP .+4         /FOUND SECOND TIME
1622  2774'         ISZ CTC
1623  5217          JMP .-4
                    HALT            /TOOK OVER 40 MILLISEC /REF
1624  4773'   JMS ERADD
1625  7200          CLA
1626  1774'         TAD CTC         /HOW LONG
1627  7040          CMA
1630  1372          TAD (6          /ADD
1631  3371          DCA (XX         /TEM STORAGE
```

```
1632  7200    FALCOM, CLA
1633  1776'            TAD GA          /ADDRESS
1634  4775'            JMS WONE        /WRITE IN
1635  6622             DFSC
1636  5235             JMP .-1         /FLAG - DID IT
1637  7200             CLA
1640  1776'            TAD GA
1641  4775'            JMS WONE        /DO IT AGAIN
1642  1371             TAD (XX
1643  3774'            DCA CTC
1644  6622             DFSC
1645  5250             JMP .+3
1646  4770'            JMS TEXTE       /FALSE COMPARE, FLAG BEFORE ISZ OUT
1647  5232             JMP FALCOM
1650  2774'            ISZ CTC
1651  5244             JMP .-5         /ISZ AND CHECK FOR FLAG
1652  6622             DFSC
1653  5252             JMP .-1
1654  2776'            ISZ GA          /INCREMENT ADDRESS
1655  5232             JMP FALCOM      /TRY ALL ADDRESS
1656  7604             LAS
1657  0367             AND (400
1660  7640             SZA CLA
1661  5766'            JMP ATEST       /LOOP ON ADDRESS TEST
```

```
                NPAGE
1662  5765      JMP I (,+20087600

1765  2000
1766  1120
1767  0400
1770  6130
1771  7402
1772  0006
1773  5600
1774  6603
1775  2665
1776  6622
1777  5055
      2000      PAGE
                /
                /ROUTINE TO DETECT TRACK WITH HIGH ERROR RATIO
                /
2000  4777'     RATIO,  JMS SCOPEA
2001  7200              CLA
2002  1376              TAD (RPAGE+12&377 200 JMP       /EQUAL TO (JMP RPAGE+12=JMP .-1)
2003  3775'             DCA RPAGE+13            /SKIP ON DONE
2004  1374              TAD (JMS I 0000         /TO CORRECT TRACK COUNT ON NO ERRORS
2005  3773'             DCA RPAGE+11            /READ ROUTINE
2006  1372              TAD (ISZ I CKA          /INS ERROR CT
2007  3771'             DCA COMA+11             /COMPARE ROUTINE
2010  1370              TAD (NOP
2011  3767'             DCA RPAGE+10
2012  1366              TAD (TKTST              /INCREMENT KA ON ERROR
2013  3000              DCA 0000
2014  3765'             DCA ERRTK               /TRACK COUNTER
2015  3764'             DCA KA                  /ERROR COUNT PER TRACK
2016  7240              CLA CMA
2017  4763'             JMS FILL
2020  7777              7777
2021  4762'             JMS WDISK               /WRITE THE DISC
2022  4761'             JMS CKRDOI              /READ AND INCREMENT ON ERROR
2023  1360              TAD (JMS I CSTATUS
2024  3773'             DCA RPAGE+11            /RESTORE
2025  1357              TAD (DFSE
2026  3767'             DCA RPAGE+10
2027  1356              TAD (JMS I CERRCOM
2030  3771'             DCA COMA+11             /RESTORE
2031  1355              TAD (RPAGE+10&377 200 JMP       /JMP .-3
2032  3775'             DCA RPAGE+13
2033  4777'             JMS SCOPEA
2034  7604              LAS
2035  0354              AND (400                /SW3
2036  7640              SZA CLA
2037  5200              JMP RATIO               /LOOP ON RATIO TEST
2040  4753'             JMS DBTST               /3 CYCLE BREAK TEST
2041  7604              LAS
2042  0354              AND (400
2043  7640              SZA CLA
```

```
2044  5240            JMP .-4          /DATA BREAK TEST
                /ROUTINE TO WRITE READ COMPARE AND CHECK READ DISK

2045  4777'   DISK0,  JMS SCOPEA
2046  7200            CLA
2047  4763'           JMS FILL
2050  0000            0000
2051  4752'           JMS DISK
```

```
2052  4777'   DISK7,  JMS SCOPEA
2053  1255           TAD DISK7+3
2054  4763'          JMS FILL
2055  7777           7777
2056  4752'          JMS DISK

2057  4777'   DISK7A, JMS SCOPEA
2060  1255           TAD DISK7+3
2061  4763'          JMS FILL
2062  0000           0000
2063  4752'          JMS DISK
2064  4777'          JMS SCOPEA
2065  1267           TAD .+2
2066  4763'          JMS FILL
2067  7070           7070
2070  4752'          JMS DISK
2071  4777'          JMS SCOPEA
2072  1267           TAD .-3
2073  4763'          JMS FILL
2074  0707           0707
2075  4752'          JMS DISK
2076  4777'          JMS SCOPEA
2077  1351           TAD (5252
2100  4763'          JMS FILL
2101  2525           2525
2102  4752'          JMS DISK
2103  4777'          JMS SCOPEA
2104  1306           TAD .+2
2105  4763'          JMS FILL
2106  0002           0002
2107  4752'          JMS DISK
2110  4777'          JMS SCOPEA
2111  1350           TAD (3776
2112  4763'          JMS FILL
2113  4001           4001
2114  4752'          JMS DISK
2115  4777'          JMS SCOPEA
2116  1347           TAD (-20
2117  3346           DCA (XX
2120  4777'          JMS SCOPEA
2121  4745'          JMS RANFIL
2122  4752'          JMS DISK
2123  2346           ISZ (XX
2124  5321           JMP .-3
2125  7604           LAS
2126  0354           AND (400
2127  7440           SZA
2130  5245           JMP DISK0       /LOOP ON DATA TEST
2131  4020           JMS DISPAT
2132  4744'          JMS ENDCT
2133  2743'          ISZ END
2134  6611           DCEA
2135  6601           DCMA
2136  5742'          JMP BEGIN
```

```
2137  7000            NOP             /COMPLETED DISK TEST
2142  0421
2143  6617
2144  5657
2145  4627
2146  7402
2147  7760
2150  3776
2151  5252
2152  2200
2153  2205
2154  0400
2155  5225
2156  4541
2157  6621
2160  4542
2161  3504
2162  5100
2163  5033
2164  6600
2165  6606
2166  4504
2167  3625
2170  7000
2171  3655
2172  2543
2173  3626
2174  4400
2175  3630
2176  5227
2177  5055
      2200    PAGE
```

```
2200  7000    DISK,   NOP
2201  4777'           JMS DWRCOI              /DISK WRITE READ OUT IN
2202  4776'           JMS CKRDOI              /CHECK READ DISK OUT IN
2203  5600            JMP I DISK
2204  7000            NOP
                /DATA BREAK TEST FOR DISK

2205  7402    DBTST,  XX
2206  6611            DCEA
2207  4775'           JMS CLFLAG
2210  4774'           JMS WONEW7              /SET FLAG
2211  7200            CLA
2212  1373            TAD (7760               /CLA CMA FOR PDP8S
2213  3772'           DCA KA
2214  1371            TAD (JMS I CWTRK
2215  3001            DCA 1
2216  1370            TAD (JMP I 0000
2217  3002            DCA 0002
2220  4767'           JMS WTRK
2221  4245            JMS ISZTST
2222  4766'           JMS ROT1TS
2223  4765'           JMS ROT2TS
2224  4764'           JMS TADTST
2225  4763'           JMS JMSTST
2226  4245            JMS ISZTST
2227  4245            JMS ISZTST
2230  4766'           JMS ROT1TS
2231  4765'           JMS ROT2TS
2232  4765'           JMS ROT2TS
2233  4764'           JMS TADTST
2234  4764'           JMS TADTST
2235  4763'           JMS JMSTST
2236  4763'           JMS JMSTST
2237  2772'           ISZ KA
2240  5221            JMP DBTST+14
2241  6002            IOF
2242  6622            DFSC
2243  5242            JMP .-1
2244  5605            JMP I DBTST
```

```
                        /PROCESS OR TEST FOR DISK
                        /TESTS ARE RUN WHILE WAITING FOR INT

                        /ISZ TEST ABOUT 61 MILLISECONDS
2245  7402              ISZTST, XX
2246  7040                      CMA
2247  3762'                     DCA TEMP5
2250  3761'                     DCA TEMP2
2251  3760'                     DCA TEMP1
2252  2760'                     ISZ TEMP1
2253  2761'                     ISZ TEMP2
2254  5252                      JMP .-2
2255  1761'                     TAD TEMP2
2256  7440                      SZA
2257  7402                      HLT                 /COMPUTER BAD
2260  7240                      CLA CMA
2261  1760'                     TAD TEMP1
2262  7440                      SZA
2263  7402                      HLT                 /COMPUTER BAD
2264  2762'                     ISZ TEMP5
2265  7410                      SKP
2266  5251                      JMP ISZTST+4
2267  5645                      JMP I ISZTST
2360  2641
2361  2642
2362  2645
2363  2600
2364  2434
2365  2416
2366  2400
2367  2651
2370  5400
2371  4540
2372  6600
2373  7760
2374  5000
2375  4600
2376  3504
2377  3400
      2400              PAGE

                        /ROTATE 1 TEST ABOUT 67 MILLISECONDS
2400  7402              ROT1TS, XX
2401  1777'                     TAD TEMP2
2402  7130                      STL RAR
2403  7004                      RAL
2404  7420                      SNL
2405  7402                      HLT                 /COMPUTER BAD
2406  7041                      CMA IAC
2407  1777'                     TAD TEMP2
2410  7440                      SZA
24    7402                      HLT                 /COMPUTER BAD
24    2777'                     ISZ TEMP2
```

```
2413  5201          JMP ROT1TS+1
2414  7200          CLA
2415  5600          JMP I ROT1TS
```

```
                        /ROTATE 2 TEST ALSO ABOUT 67 MILLISECONDS
2416  7402              ROT2TS, XX
2417  1777'                     TAD TEMP2
2420  7106                      CLL RTL
2421  7012                      RTR
2422  7430                      SZL
2423  7402                      HLT                 /COMPUTER BAD
2424  7041                      CMA IAC
2425  1777'                     TAD TEMP2
2426  7440                      SZA
2427  7402                      HLT                 /COMPUTER BAD
2430  2777'                     ISZ TEMP2
2431  5217                      JMP ROT2TS+1
2432  7200                      CLA
2433  5616                      JMP I ROT2TS

                        /TAD TEST ADD EVERY COM TO RAN NO
                        /ABOUT 86 MILLISECONDS
2434  7402              TADTST, XX
2435  3776'                     DCA TEMP3
2436  1775'                     TAD PRAN1
2437  7104                      CLL RAL
2440  7430                      SZL
2441  7001                      IAC
2442  3775'                     DCA PRAN1
2443  1774'                     TAD PRAN2
2444  1775'                     TAD PRAN1
2445  3774'                     DCA PRAN2
2446  1774'                     TAD PRAN2
2447  3773'                     DCA TEMP4
2450  1774'                     TAD PRAN2
2451  1776'                     TAD TEMP3
2452  7041                      CMA IAC
2453  1773'                     TAD TEMP4
2454  7440                      SZA
2455  7402                      HLT                 /COMPUTER BAD
2456  2773'                     ISZ TEMP4
2457  7000                      NOP
2460  2776'                     ISZ TEMP3
2461  5250                      JMP .+1
2462  7200                      CLA
2463  5634                      JMP I TADTST
```

```
2464  7200    NOT8E,  CLA
2465  1372            TAD     (-11            /CTA,9=NO, OF CYCLES
2466  3771'           DCA     CTD
2467  1770'           TAD     CTA
2470  2771'           ISZ     CTD
2471  5267            JMP     .-2
2472  3770'           DCA     CTA
2473  4767'           JMS     CTIME           /GET CYCLE TIME
2474  3771'           DCA     CTD
2475  3766'           DCA     BD              /MSH
2476  3765'           DCA     GD              /LSH
2477  1770'           TAD     CTA
2500  7041            CIA
2501  3770'           DCA     CTA
2502  7100            CLL
2503  1771'           TAD     CTD             /NO, OF CYCLES,CYCLE TIME
2504  7430            SZL
2505  2766'           ISZ     BD
2506  2770'           ISZ     CTA
2507  5302            JMP     .-5
2510  3765'           DCA     GD
2511  7300            CLA CLL
2512  1765'           TAD     GD
2513  1364            TAD     (-144
2514  3765'           DCA     GD
2515  1766'           TAD     BD
2516  7430            SZL
2517  7001            IAC
2520  7100            CLL
2521  1363            TAD     (-1
2522  3766'           DCA     BD
2523  7420            SNL
2524  5327            JMP     .+3
2525  2770'           ISZ     CTA
2526  5311            JMP     .-15
2527  5762'           JMP     CONVB
```

```
2562  4314
2563  7777
2564  7634
2565  6626
2566  6625
2567  3000
2570  6610
2571  6611
2572  7767
2573  2644
2574  2647
2575  2646
2576  2643
2577  2642
      2600    PAGE

              /JMS TST MAKE 13 PASSES OF 128 CONSECUTIVE JMS ,
              /AND COMPARE RESULTS FOR ABOUT 63 MILLISECONDS
2600  7402    JMSTST, XX
2601  1377            TAD (7763               /NUMBER OF LOOPS
2602  3241            DCA TEMP1
2603  1376            TAD (7601               /200 LOCATIONS
2604  3242            DCA TEMP2
2605  1375            TAD (OUTBUF             /STARTING LOCATION
2606  3243            DCA TEMP3
2607  1374            TAD (4200               /JMS INSTRUCTION
2610  3244            DCA TEMP4
2611  1244            TAD TEMP4               /STORE 128 JMS ,
2612  3643            DCA I TEMP3             /STARTING AT ADDRESS
2613  2244            ISZ TEMP4               /6000
2614  2243            ISZ TEMP3
2615  2242            ISZ TEMP2
2616  5211            JMP .-5
2617  1373            TAD (5600               /STORE JMP I RETUJM
2620  3643            DCA I TEMP3             /TO RETURN FROM JMS
2621  4775'           JMS OUTBUF              /EXECUTE 128 JMS
2622  1372    JMRETU, TAD (7603               /RETURN FROM EXECUTE
2623  3242            DCA TEMP2
2624  1371            TAD (OUTBUF+2
2625  3243            DCA TEMP3               /COMPARE ADDRESSES
2626  1243            TAD TEMP3               /FOR .+1
2627  7040            CMA
2630  1643            TAD I TEMP3
2631  7440            SZA
2632  7402            HLT                     /PROCESSOR BAD
2633  2243            ISZ TEMP3               /INC COMP AND FETCH
2634  2242            ISZ TEMP2               /DONE 128 YET
2635  5226            JMP JMRETU+4
2636  2241            ISZ TEMP1
2637  5203            JMP JMSTST+3
2640  5603            JMP I JMSTST

2641  0000    TEMP1,  0
2642  0000    TEMP2,  0
```

```
2643  0000    TEMP3,  0
2644  0000    TEMP4,  0
2645  0000    TEMP5,  0
2646  4263    PRAN1,  4263
2647  2634    PRAN2,  2634
2650  2622    RETUJM, JMRETU

                      /
```

```
2651  7402    WTRK,   XX
2652  6622            DFSC            /SKIP ON DONE FLAG
2653  7402            HLT             /PARITY ERROR GEN INTERRUPT
2654  3770'           DCA AC          /SAVE AC
2655  6611            DCEA            /TRACK ZERO
2656  7200            CLA
2657  3767'           DCA WC
2660  3766'           DCA IACW
2661  6605            DMAW
2662  6001            ION
2663  1770'           TAD AC          /RESTORE AC
2664  5651            JMP I WTRK
```

```
                    /WRITE ONE WORD AT DISK ADDRESS CONTAINED IN SR
                    /DO NOT WAIT FOR DONE FLAG

2665  7402    WONE,   XX
2666  3000            DCA 0000
2667  7240            CLA CMA
2670  3767'           DCA WC
2671  7240            CLA CMA
2672  3766'           DCA IACW
2673  1000            TAD 0000
2674  6605            DMAW            /START WRITE
2675  5665            JMP I WONE

                    /READ ONE WORD DO NOT WAIT FOR FLAG
2676  7402    RONE,   XX
2677  3000            DCA 0000
2700  7240            CLA CMA
2701  3767'           DCA WC
2702  7240            CLA CMA
2703  3766'           DCA IACW
2704  1000            TAD 0000
2705  6603            DMAR            /START READ
2706  5676            JMP I RONE

                    /SCOPE LOOP FOR ADDRESS TEST (WRITE)
                    /CONTENTS OF SWITCH REGISTER EQUAL DISK ADDRESS
2707  7604    SAWD,   LAS
2710  4265            JMS WONE
2711  6622            DFSC
2712  2765'           ISZ CTA
2713  5312            JMP .-1
2714  5307            JMP .-5

                    /SCOPE LOOP FOR ADDRESS TEST READ
2715  7604    SARD,   LAS
2716  4276            JMS RONE
2717  6622            DFSC
2720  2765'           ISZ CTA
2721  5320            JMP .-1
2722  5315            JMP .-5
```

```
                    /WRITE EACH TRACK WITH IT RACK ADDRESS
                    /READ EACH TRACK 5 TIMES BEFORE SEQUENCING TO NEXT
                    /
2723  0000          0                 /COUNTER
2724  7200    RDADJ, CLA
2725  3764'         DCA BT            /TRACK ADDRESS
2726  4763'         JMS TKCAL         /WRITE TRACKS
2727  1362          TAD (-5           /READ EACH TRACK 5 TIMES
2730  3323          DCA RDADJ-1
2731  1764'         TAD BT
2732  7010          RAR
2733  7630          SZL CLA           /ODD OR EVEN?
2734  5341          JMP .+5           /ODD
2735  1764'         TAD BT            /EVEN
2736  4761'         JMS RL5
2737  4760'         JMS RDLO
2740  5344          JMP .+4
2741  1764'         TAD BT
2742  4761'         JMS RL5
2743  4757'         JMS RDHI
2744  2323          ISZ RDADJ-1       /READ 5 TIMES
2745  5331          JMP RDADJ+5       /NO
2746  1356          TAD (-17          /YES
2747  1764'         TAD BT
2750  7650          SNA CLA           /ALL TRACKS
2751  5324          JMP RDADJ         /YES --- START OVER
2752  2764'         ISZ BT            /NO --- INCREMENT TRACK
2753  5327          JMP RDADJ+3
2756  7761
2757  4121
2760  4104
2761  4724
2762  7773
2763  3200
2764  6624
2765  6610
2766  7751
2767  7750
2770  6614
2771  7002
2772  7603
2773  5600
2774  4203
2775  7003
2776  7601
2777  7763
      3000    PAGE
```

```
3000  0000  CTIME, 0                    /COMPUTE CYCLE TIME
3001  6032        KCC
3002  6042        TCF
3003  7300        CLA CLL
3004  1377        TAD     (JMP I 2      /SET UP FOR INTERRUPT
3005  3001        DCA     1
3006  1376        TAD     (CTIMEA
3007  3002        DCA     2
3010  3345        DCA     CTIMEX
3011  3346        DCA     CTIMEY
3012  6046        TLS                   /SET TTY PRINTER FLAG
3013  6041        TSF
3014  5213        JMP     .-1
3015  6046        TLS                   /START TTY FOR 100 MS TIME DELAY
3016  6001        ION
3017  2345        ISZ     CTIMEX        /COUNT NO, OF CYCLES
3020  5217        JMP     .-1           /IN 100 MSECS
3021  2346        ISZ     CTIMEY
3022  5217        JMP     .-3
3023  7402        HLT                   /NO INTERRUPT FROM TTY
3024  6041  CTIMEA, TSF
3025  5336        JMP     CTIMEB        /WRONG INTERRUPT
3026  7200        CLA
3027  1375        TAD     (-3
3030  3350        DCA     CMPYR
3031  3351        DCA     X             /MPY CTIMEX TIMES 3
3032  7100        CLL
3033  1345        TAD     CTIMEX        /ADD LEAST SIG HALF
3034  7430        SZL                   /OVERFLOW?
3035  2351        ISZ     X             /YES, INCREMENT MOST SIG HALF
3036  2350        ISZ     CMPYR         /INCREMENT MULTIPLIER
3037  5232        JMP     .-5
3040  3352        DCA     X+1           /STORE LEAST SIG HALF
3041  1346        TAD     CTIMEY
3042  7041        CIA
3043  3350        DCA     CMPYR         /MULTIPLIER=-Y
3044  3353        DCA     Y
3045  3354        DCA     Y+1
3046  7300        CLA CLL               /MPY CTIMEY TIMES 12291
3047  1353        TAD     Y             /ADD MSH
3050  1374        TAD     (3
3051  3353        DCA     Y
3052  7300        CLA CLL
3053  1354        TAD     Y+1           /ADD LSH
3054  1374        TAD     (3
3055  3354        DCA     Y+1
3056  7430        SZL                   /OVERFLOW?
3057  2353        ISZ     Y             /YES, INCREMENT MSH
3060  2350        ISZ     CMPYR         /INCREMENT MULTIPLIER
3061  5246        JMP     .-13
3062  7200        CLA                   /(Y,12291)+(X,3)
3063  1351        TAD     X             /ANSWER IN Y AND Y+1
3064  1353        TAD     Y
3065  3353        DCA     Y
```

```
3066  7200          CLA
3067  7100          CLL
```

```
3070  1352            TAD     X+1
3071  1354            TAD     Y+1
3072  3354            DCA     Y+1
3073  7430            SZL                     /OVERFLOW?
3074  2353            ISZ     Y               /YES, INCREMENT MSH
3075  7200            CLA                     /1,10**7/Y=CYCLE TIME,100
3076  3347            DCA     CYCLE
3077  1353            TAD     Y               /Y=-Y
3100  7040            CMA
3101  3353            DCA     Y
3102  7300            CLA CLL
3103  1354            TAD     Y+1
3104  7041            CIA
3105  3354            DCA     Y+1
3106  7430            SZL
3107  2353            ISZ     Y
3110  7200            CLA
3111  1355            TAD     C4611           /MOST SIG HALF OF 10**7
3112  3351            DCA     X
3113  1356            TAD     C3200           /LEAST SIG HALF OF 10**7
3114  3352            DCA     X+1
3115  7300            CLA CLL
3116  1352            TAD     X+1             /X-Y LSH
3117  1354            TAD     Y+1
3120  3352            DCA     X+1
3121  1351            TAD     X               /X-Y MSH
3122  7430            SZL
3123  7001            IAC
3124  7100            CLL
3125  1353            TAD     Y
3126  3351            DCA     X
3127  7420            SNL
3130  5333            JMP     .+3
3131  2347            ISZ     CYCLE
3132  5315            JMP     .-15
3133  7200            CLA
3134  1347            TAD     CYCLE
3135  5600            JMP I   CTIME
3136  6032    CTIMEB, KCC                     /WRONG INTERRUPT
3137  1345            TAD     CTIMEX
3140  1373            TAD     (7
3141  3345            DCA     CTIMEX
3142  7430            SZL
3143  2346            ISZ     CTIMEY
3144  5400            JMP I   0
3145  0000    CTIMEX, 0
3146  0000    CTIMEY, 0
3147  0000    CYCLE,  0
3150  0000    CMPYR,  0
3151  0000    X,      0
3152  0000            0
3153  0000    Y,      0
3154  0000            0
3155  4611    C4611,  4611
```

```
          3156  3200    C3200,  3200
```

```
3173  0007
3174  0003
3175  7775
3176  3024
3177  5402
      3200    PAGE
              /TRACK WRITERS FOR DISC CALIBRATION
3200  7402    TKCAL,  XX
3201  6611            DCEA
3202  7200            CLA
3203  1377            TAD (0000
3204  4776'           JMS FILL
3205  0000            0000
3206  1377            TAD (0
3207  4775'           JMS WRTLO
3210  1374            TAD (1
3211  4776'           JMS FILL
3212  0001            1
3213  1377            TAD (0
3214  4773'           JMS WRTHI
3215  1372            TAD (2
3216  4776'           JMS FILL
3217  0002            2
3220  1371            TAD (100
3221  4775'           JMS WRTLO
3222  1370            TAD (3
3223  4776'           JMS FILL
3224  0003            3
3225  1371            TAD (100
3226  4773'           JMS WRTHI
3227  1367            TAD (4
3230  4776'           JMS FILL
3231  0004            4
3232  1366            TAD (200
3233  4775'           JMS WRTLO
3234  1365            TAD (5
3235  4776'           JMS FILL
3236  0005            5
3237  1366            TAD (200
3240  4773'           JMS WRTHI
3241  1364            TAD (6
3242  4776'           JMS FILL
3243  0006            6
3244  1363            TAD (300
3245  4775'           JMS WRTLO
3246  1362            TAD (7
3247  4776'           JMS FILL
3250  0007            7
3251  1363            TAD (300
3252  4773'           JMS WRTHI
3253  1361            TAD (10
3254  4776'           JMS FILL
3255  0010            10
3256  1360            TAD (400
```

```
3257  4775'          JMS WRTLO
```

```
3260  1357          TAD (11
3261  4776'         JMS FILL
3262  0011          11
3263  1360          TAD (400
3264  4773'         JMS WRTHI
3265  1356          TAD (12
3266  4776'         JMS FILL
3267  0012          12
3270  1355          TAD (500
3271  4775'         JMS WRTLO
3272  1354          TAD (13
3273  4776'         JMS FILL
3274  0013          13
3275  1355          TAD (500
3276  4773'         JMS WRTHI
3277  1353          TAD (14
3300  4776'         JMS FILL
3301  0014          14
3302  1352          TAD (600
3303  4775'         JMS WRTLO
3304  1351          TAD (15
3305  4776'         JMS FILL
3306  0015          15
3307  1352          TAD (600
3310  4773'         JMS WRTHI
3311  1350          TAD (16
3312  4776'         JMS FILL
3313  0016          16
3314  1347          TAD (700
3315  4775'         JMS WRTLO
3316  1346          TAD (17
3317  4776'         JMS FILL
3320  0017          17
3321  1347          TAD (700
3322  4773'         JMS WRTHI
3323  5600          JMP I TKCAL

                    PAUSE
```

```
3346  0017
3347  0700
3350  0016
3351  0015
3352  0600
3353  0014
3354  0013
3355  0500
3356  0012
3357  0011
3360  0400
3361  0010
3362  0007
3363  0300
3364  0006
3365  0005
3366  0200
3367  0004
3370  0003
3371  0100
3372  0002
3373  4067
3374  0001
3375  4053
3376  5033
3377  0000
      3400    PAGE
              /DATA TEST  =  TAPE 3
              /WRITE READ DISK COMPAR (OUT TO IN)
3400  7000    DWRCOI, NOP
3401  7200            CLA
3402  1377            TAD (0                  /TRACK 0
3403  4776'           JMS WRTLO
3404  1377            TAD (0
3405  4775'           JMS RDLO
3406  1377            TAD (0                  /TRACK 1
3407  4774'           JMS WRTHI
3410  1377            TAD (0
3411  4773'           JMS RDHI
3412  1372            TAD (100                /TRACK 2
3413  4776'           JMS WRTLO
3414  1372            TAD (100
3415  4775'           JMS RDLO
3416  1372            TAD (100                /TRACK 3
3417  4774'           JMS WRTHI
3420  1372            TAD (100
3421  4773'           JMS RDHI
3422  1371            TAD (200                /TRACK 4
3423  4776'           JMS WRTLO
3424  1371            TAD (200
3425  4775'           JMS RDLO
3426  1371            TAD (200                /TRACK 5
3    4774'           JMS WRTHI
3    1371            TAD (200
```

```
3431  4773'          JMS RDHI
3432  1370           TAD (300                /TRACK 6
3433  4776'          JMS WRTLO
3434  1370           TAD (300
3435  4775'          JMS RDLO
3436  1370           TAD (300                /TRACK 7
3437  4774'          JMS WRTHI
3440  1370           TAD (300
3441  4773'          JMS RDHI
3442  1367           TAD (400                /TRACK 8
3443  4776'          JMS WRTLO
3444  1367           TAD (400
3445  4775'          JMS RDLO
3446  1367           TAD (400                /TRACK 9
3447  4774'          JMS WRTHI
```

```
3450  1367          TAD (400
3451  4773'         JMS RDHI
3452  1366          TAD (500              /TRACK 10
3453  4776'         JMS WRTLO
3454  1366          TAD (500
3455  4775'         JMS RDLO
3456  1366          TAD (500              /TRACK 11
3457  4774'         JMS WRTHI
3460  1366          TAD (500
3461  4773'         JMS RDHI
3462  1365          TAD (600              /TRACK 12
3463  4776'         JMS WRTLO
3464  1365          TAD (600
3465  4775'         JMS RDLO
3466  1365          TAD (600              /TRACK 13
3467  4774'         JMS WRTHI
3470  1365          TAD (600
3471  4773'         JMS RDHI
3472  1364          TAD (700              /TRACK 14
3473  4776'         JMS WRTLO
3474  1364          TAD (700
3475  4775'         JMS RDLO
3476  1364          TAD (700              /TRACK 15
3477  4774'         JMS WRTHI
3500  1364          TAD (700
3501  4773'         JMS RDHI
3502  7000          NOP
3503  5600          JMP I DWRCOI
```

```
                        /DISK CHECK READ (OUT TO IN)
3504  7000      CKRDOI, NOP
3505  7200              CLA                       /TRACK 1ST
3506  4775'             JMS RDLO
3507  1377              TAD (0                    /TRACK 2ND
3510  4773'             JMS RDHI
3511  1372              TAD (100                  /TRACK 3RD
3512  4775'             JMS RDLO
3513  1372              TAD (100                  /TRACK 4TH
3514  4773'             JMS RDHI
3515  1371              TAD (200                  /TRACK 5TH
3516  4775'             JMS RDLO
3517  1371              TAD (200                  /TRACK 6TH
3520  4773'             JMS RDHI
3521  1370              TAD (300                  /TRACK 7TH
3522  4775'             JMS RDLO
3523  1370              TAD (300                  /TRACK 8TH
3524  4773'             JMS RDHI
3525  1367              TAD (400                  /TRACK 9TH
3526  4775'             JMS RDLO
3527  1367              TAD (400                  /TRACK 10TH
3530  4773'             JMS RDHI
3531  1366              TAD (500                  /TRACK 11TH
3532  4775'             JMS RDLO
3533  1366              TAD (500                  /TRACK 12TH
3534  4773'             JMS RDHI
3535  1365              TAD (600                  /TRACK 13TH
3536  4775'             JMS RDLO
3537  1365              TAD (600                  /TRACK 14TH
3540  4773'             JMS RDHI
3541  1364              TAD (700                  /TRACK 15TH
3542  4775'             JMS RDLO
3543  1364              TAD (700                  /TRACK 16TH
3544  4773'             JMS RDHI
3545  5704              JMP I CKRDOI              /EXIT
                        /EXECT WRITE READ DISK

3546  4200              JMS DWRCOI
3547  4304              JMS CKRDOI
3550  5346              JMP .-2
```

```
3564  0700
3565  0600
3566  0500
3567  0400
3570  0300
3571  0200
3572  0100
3573  4121
3574  4067
3575  4104
3576  4053
3577  0000
      3600     PAGE
               /WRITE ONE PAGE
               /JMS ... WITH DISK ADDRESS IN AC
3600  7000     WPAGE,  NOP
3601  3777'            DCA WADD                  /DISK ADDRESS
3602  1376             TAD (-200
3603  3775'            DCA WC                    /WORD COUNT
3604  1374             TAD (OUTBUF-1
3605  3773'            DCA IACW                  /INITIAL ADDRESS
3606  1777'            TAD WADD                  /DISK ADDRESS
3607  6605             DMAW                      /LOAD DISK - WRITE
3610  6621             DFSE                      /WAIT FOR FLAG
3611  4772'            JMS STATUS
3612  6622             DFSC
3613  5210             JMP .-3
3614  5600             JMP I WPAGE               /EXIT
               /
               /READ ONE PAGE
               /JMS ... WITH DISK ADDRESS IN AC

3615  7000     RPAGE,  NOP
3616  3771'            DCA RADD                  /DISK ADDRESS
3617  1376             TAD (-200
3620  3775'            DCA WC                    /WORD COUNT
3621  1370             TAD (INBUF-1
3622  3773'            DCA IACW                  /INITIAL ADDRESS
3623  1771'            TAD RADD                  /DISK ADDRESS
3624  6603             DMAR                      /LOAD DISK ... READ
3625  6621             DFSE                      /WAIT FOR FLAG
3626  4772'            JMS STATUS
3627  6622             DFSC
3630  5225             JMP .-3
3631  5615             JMP I RPAGE               /EXIT
```

```
                    /COMPARE OUTBUFFER WITH INBUFFER
3632  5232  COMPARE,        JMP .
3633  7200                  CLA
3634  1367                  TAD (-10
3635  3766'                 DCA ERCT                /ERROR COUNT
3636  1370                  TAD (INBUF-1            /INBUFFER - IAW
3637  3011                  DCA 11
3640  1374                  TAD (OUTBUF-1           /OUTBUFFER - IAW
3641  3012                  DCA 12
3642  1376                  TAD (-200
3643  3261                  DCA CTB                 /LOOP COUNTER
3644  7200  COMA,   CLA
3645  1411                  TAD I 11
3646  3765'                 DCA BD                  /DATA THAT WAS READ
3647  1412                  TAD I 12
3650  3764'                 DCA GD                  /DATA THAT WAS WRITTEN
3651  1764'                 TAD GD
3652  7041                  CIA
3653  1765'                 TAD BD
3654  7640                  SZA CLA
3655  4763'                 JMS ERRCOM              /ERROR
3656  2261                  ISZ CTB                 /DONE
3657  5244                  JMP COMA                /NO
3660  5632                  JMP I COMPAR            /YES EXIT
3661  0000  CTB,   0
```

```
                        /WRITE READ COMPARE
3662  7000    PWRC,     NOP
3663  7200              CLA
3664  1262              TAD     PWRC
3665  3762'             DCA     RDLO
3666  1361              TAD (3700
3667  4200              JMS WPAGE
3670  4760'             JMS FLUSH
3671  1361              TAD (3700
3672  4215              JMS RPAGE
3673  4232              JMS COMPARE
3674  5662              JMP I PWRC

                        /CHECK ZEROS

3675  7000    WRC00,    NOP
3676  7200              CLA
3677  1357              TAD (0000               /0000
3700  4756'             JMS FILL
3701  0000              0000
3702  4262              JMS PWRC
3703  5675              JMP I WRC00

                        /CHECK SEVENS
3704  7000              NOP
3705  7000    WRC77,    NOP
3706  7200              CLA                     /7777
3707  1355              TAD (7777               /7777
3710  4756'             JMS FILL
3711  7777              7777
3712  4262              JMS PWRC
3713  5705              JMP I WRC77

3755  7777
3756  5033
3757  0000
3760  5020
3761  3700
3762  4104
3763  6200
3764  6626
3765  6625
3766  6612
3767  7770
3770  7177
3771  6602
3772  6403
3773  7751
3774  6777
3775  7750
3776  7602
3777  6601
      4000    PAGE
```

```
                        /DO WRC OF DIFFERENT NUMBER - PAGE BASIC

4000  7000    WRCX,   NOP
4001  7200            CLA
4002  6615            DEAL
4003  7200            CLA
4004  1377            TAD (7777               /7777
4005  4776'           JMS FILL
4006  0000            0000            /0000
4007  4775'           JMS PWRC
4010  1374            TAD (7070               /7070
4011  4776'           JMS FILL
4012  7070            7070            /7070
4013  4775'           JMS PWRC
4014  1373            TAD (0707               /0707
4015  4776'           JMS FILL
4016  7070            7070            /7070
4017  4775'           JMS PWRC
4020  1372            TAD (5252               /5252
4021  4776'           JMS FILL
4022  2525            2525            /2525
4023  4775'           JMS PWRC
4024  1371            TAD (0123               /0123
4025  4776'           JMS FILL
4026  4567            4567            /4567
4027  4775'           JMS PWRC
4030  1370            TAD (0303               /0303
4031  4776'           JMS FILL
4032  0303            0303            /0303
4033  4775'           JMS PWRC
4034  1367            TAD (7474               /7474
4035  4776'           JMS FILL
4036  7474            7474            /7474
4037  4775'           JMS PWRC
4040  4766'           JMS RANFIL
4041  4775'           JMS PWRC
4042  1377            TAD (7777
4043  4776'           JMS FILL
4044  0001            0001
4045  4775'           JMS PWRC
4046  1365            TAD (3776
4047  4776'           JMS FILL
4050  4001            4001
4051  4775'           JMS PWRC
4052  5200            JMP WRCX
```

```
                    /ROUTINE TO WRITE EVEN TRACKS
                    /JMS WRTLO ,,, WITH TRACK ADDRESS IN AC

4053  5253    WRTLO,  JMP .
4054  0364            AND (3700
4055  3763'           DCA TKADD               /TRACK ADDRESS
4056  1763'           TAD TKADD
4057  6615            DEAL                    /LOAD TRACK ADDRESS
4060  7200            CLA
4061  4762'           JMS WPAGE               /WRITE A PAGE
4062  4761'           JMS WSYNC               /RETURN WITH MAC I N AC
4063  7500            SMA                     /SAME TRACK
4064  5261            JMP .-3                 /YES
4065  7200            CLA
4066  5653            JMP I WRTLO             /NO DONE EXIT

                    /ROUTINE TO WRITE ODD TRACKS
                    /JMS WRTLO ,,,, WITH TRACK ADDRESS IN AC
4067  5267    WRTHI,  JMP .
4070  0364            AND (3700
4071  3763'           DCA TKADD               /STORE TRACK ADDRESS
4072  1763'           TAD TKADD
4073  6615            DEAL                    /LOAD EXTENDED ADDRESS
4074  7200            CLA
4075  1360            TAD (4000               /2048 TO 4095
4076  4762'           JMS WPAGE               /WRITE A PAGE
4077  4761'           JMS WSYNC               /RETURN WITH MAC IN AC
4100  7510            SPA                     /SAME TRACK
4101  5276            JMP .-3                 /YES
4102  7200            CLA
4103  5667            JMP I WRTHI             /NO DONE EXIT
```

```
                    /ROUTINE TO READ EVEN TRACKS
                    /JMS RDLO ... WITH TRACK ADDRESS IN AC

4104  5304    RDLO,   JMP .
4105  0364            AND (3700
4106  3763'           DCA TKADD               /TRACK ADDRESS
4107  1763'           TAD TKADD
4110  6615            DEAL                    /LOAD TRACK ADDRESS
4111  7200            CLA
4112  4757'           JMS RPAGE               /READ A PAGE
4113  4756'           JMS COMPAR              /COMPARE
4114  4755'           JMS SYNC                /RETURN WITH MAC IN AC
4115  7500            SMA                     /SAME TRACK
4116  5312            JMP .+4                 /YES
4117  7200            CLA
4120  5704            JMP I RDLO              /NO DONE -  EXIT

                    /ROUTINE TO READ ODD TRACKS
                    /JMS RDHI ... WITH TRACK ADDRESS IN AC

4121  5321    RDHI,   JMP .
4122  0364            AND (3700
4123  3763'           DCA TKADD               /TRACK ADDRESS
4124  1763'           TAD TKADD               /LOAD TRACK ADDRESS
4125  6615            DEAL
4126  7200            CLA
4127  1360            TAD (4000
4130  4757'           JMS RPAGE               /READ A PAGE
4131  4756'           JMS COMPAR              /COMPARE
4132  4755'           JMS SYNC                /RETURN WITH MAC IN AC
4133  7510            SPA                     /SAME TRACK
4134  5330            JMP .-4                 /YES
4135  7200            CLA
4136  5721            JMP I RDHI              /NO - DONE - EXIT
```

```
4155  4472
4156  3632
4157  3615
4160  4003
4161  4503
4162  3600
4163  6604
4164  3700
4165  3776
4166  4627
4167  7474
4170  0303
4171  0123
4172  5252
4173  0707
4174  7070
4175  3662
4176  5033
4177  7777
      4200    PAGE
```

```
                    /QUICK TEST OF EACH TRACK

4200  0000          0                       /TRACK STORAGE
4201  0000          0                       /COUNTER
4202  4777'   MARGIN, JMS RANFIL            /RANDOM FILL
4203  1376          TAD (-7
4204  3201          DCA MARGIN-1            /COUNTER
4205  7200          CLA
4206  3200          DCA MARGIN-2            /TRACK
4207  1200          TAD MARGIN-2
4210  3200          DCA MARGIN-2
4211  1200          TAD MARGIN-2
4212  6615          DEAL
4213  4775'         JMS PWRC                /PAGE WRITE READ COMPARE
4214  7200          CLA
4215  1374          TAD (0100
4216  2201          ISZ MARGIN-1
4217  5207          JMP .-10
4220  7200          CLA
4221  5203          JMP MARGIN+1

                    /WRITE ONE PAGE TO BE USED WITH MARGIN TEST
                    /WRITE FROM INBUFFER AREA

4222  7402    WPAGEX, XX
4223  3773'         DCA WADD                /DISC ADDRESS
4224  1372          TAD (-200
4225  3771'         DCA WC                  /WORD COUNT
4226  1370          TAD (INBUF-1
4227  3767'         DCA IACW                /CURRENT ADDRESS
4230  1773'         TAD WADD
4231  6605          DMAW                    /WRITE
4232  6622          DFSC                    /SKIP ON DONE
4233  5232          JMP .-1
4234  5622          JMP I WPAGEX            /EXIT
```

```
4235  0000    SYNCT,  0
4236  7200            CLA
4237  3766'           DCA CTA
4240  1365            TAD (-6660
4241  3764'           DCA CTC
4242  1764'           TAD CTC
4243  3763'           DCA CTD
4244  6616            DEAC
4245  7000            NOP
4246  7500            SMA
4247  5253            JMP .+4
4250  2764'           ISZ CTC
4251  5244            JMP .-5
4252  5635            JMP I SYNCT
4253  6616            DEAC
4254  7000            NOP
4255  7510            SPA
4256  5266            JMP .+10
4257  2763'           ISZ CTD
4260  5253            JMP .-5
4261  5635            JMP I SYNCT
4262  6616            DEAC
4263  7000            NOP
4264  7500            SMA
4265  5635            JMP I SYNCT
4266  2766'           ISZ CTA
4267  5262            JMP .-5
4270  5635            JMP I SYNCT

4271  0000    CONV,   0
4272  7200            CLA
4273  1362            TAD (-6
4274  3763'           DCA CTD
4275  1761'           TAD CTB
4276  2763'           ISZ CTD
4277  5275            JMP .-2
4300  3761'           DCA CTB
4301  7330            CLA CLL CML RAR
4302  7002            7002
4303  7710            SPA CLA
4304  5760'           JMP     NOTBE
4305  1357            TAD (12
4306  7041            CIA
4307  3763'           DCA CTD
4310  1766'           TAD CTA
4311  2763'           ISZ CTD
4312  5310            JMP .-2
4313  3766'           DCA CTA
4314  7200    CONVB,  CLA
4315  1761'           TAD CTB
4316  4756'           JMS DEC
4317  6633            RCT
4320  7200            CLA
4321  1766'           TAD CTA
```

```
4322  4756'   NOSYNC, JMS DEC
4323  4343            SCT
4324  6046            TLS
4325  6041            TSF
4326  5325            JMP .-1
4327  4755'           JMS MESAGE
4330  4543            4543
4331  2220            2220
4332  1540            1540
4333  0000    RCT,    0
4334  0000            0
4335  4023            4023
4336  3116            3116
4337  0340            0340
4340  2411            2411
4341  1505            1505
4342  7540            7540
4343  7777    SCT,    7777
4344  7777            7777
4345  4015            4015
4346  1103            1103
4347  2217            2217
4350  4023            4023
4351  0503            0503
4352  2300            2300
4353  5671            JMP I CONV
```

```
4355  0200
4356  6634
4357  7012
4360  2464
4361  3661
4362  7772
4363  6611
4364  6603
4365  1120
4366  6610
4367  7751
4370  7177
4371  7750
4372  7600
4373  6601
4374  0100
4375  3662
4376  7771
4377  4627
      4400    PAGE
              /DISK WRITE CURRENT TEST
4400  7402    DKI,    XX
4401  7200            CLA
4402  1377            TAD (7777               /FILL WITH SEVENS
4403  4776'           JMS FILL
4404  7777            7777
4405  4775'           JMS WDISK               /MAKE SURE DISC IS SATURATED
4406  4775'           JMS WDISK
4407  4775'           JMS WDISK
4410  1374            TAD (3777               /WRITE COMPLIMENT
4411  4776'           JMS FILL
4412  3777            3777
4413  4775'           JMS WDISK
4414  4773'           JMS CKRDOI              /READ COMPARE
4415  4775'           JMS WDISK
4416  4775'           JMS WDISK               /WRITE NEW PATTERN
4417  1377            TAD (7777               /TO SATURATE DISK
4420  4776'           JMS FILL                /COMPLIMENTED DATA
4421  7777            7777
4422  4775'           JMS WDISK               /WRITE COMPLIMENT
4423  4773'           JMS CKRDOI              /READ COMPARE
4424  5600            JMP I DKI
```

```
                /ROUTINE TO TRANSFER DATA TO EXT MEMORY
                /S, R. BIT 9,10,11 . . . SELECT EXT BANK

4425  7402      XBANK,  HLT
4426  7604              LAS
4427  7004              RAL
4430  7006              RTL
4431  0372              AND (0070
4432  3771'             DCA BX                  /BANK "X"
4433  6615              DEAL
4434  4770'             JMS WRC77               /BANK 0 TO DISC
4435  7200              CLA
4436  1771'             TAD BX
4437  6615              DEAL
4440  7200              CLA
4441  1367              TAD (3700               /DISC TO X6200 TO X6400
4442  4766'             JMS RPAGE               /DISC TO BANK "X"
4443  7200              CLA
4444  6615              DEAL
4445  4765'             JMS WRC00               /CLEAN THE DISC FROM BANK 0
4446  7200              CLA
4447  1771'             TAD BX
4450  6615              DEAL
4451  7200              CLA
4452  1367              TAD (3700
4453  4764'             JMS WPAGEX              /BANK X TO DISC
4454  7200              CLA
4455  6615              DEAL
4456  7200              CLA
4457  1367              TAD (3700
4460  4766'             JMS RPAGE               /DISC TO BANK 0
4461  7240              CLA CMA
4462  4776'             JMS FILL
4463  7777              7777
4464  4763'             JMS COMPAR
4465  5226              JMP XBANK+1
```

```
                        /GROUP OF SUBROUTINES
                        /WAIT FOR FLAG
4466  5266      FLAG,   JMP .
4467  6622              DFSC                    /FLAG
4470  5267              JMP .-1                 /NO
4471  5666              JMP I FLAG              /YES EXIT

                        /WAIT FOR SYNC ... EXIT WITH DMAC IN AC

4472  5272      SYNC,   JMP .
4473  6616              DEAC                    /READ SYNC BIT 0
4474  7500              SMA                     /SYNC
4475  5273              JMP .-2                 /NO
4476  6626              DMAC                    /YES - READ MAC
4477  5672              JMP I SYNC              /EXIT

                        /EXIT WITH DMAC PLUS ONE IN AC
4500  5300      WSYNC,  JMP .
4501  4272              JMS SYNC
4502  1362              TAD (1)
4503  5700              JMP I WSYNC             /EXIT
```

```
                    /SUBROUTINE TO INCREMENT ON TRACK ERROR
                    /
4504  7402  TKTST, XX
4505  2761'       ISZ KA
4506  4272        JMS SYNC                /DMA IN AC
4507  0360        AND (3776
4510  7640        SZA CLA                 /NEW TRACK
4511  5704        JMP I TKTST             /NO
4512  1761'       TAD KA                  /ERROR PER TRACK
4513  0357        AND (7300
4514  7640        SZA CLA                 /LESS THAN 400
4515  4756'       JMS ERTK                /NO
4516  2755'       ISZ ERRTK               /YES --- TRACK BEING TESTED
4517  3761'       DCA KA                  /CLEAR FOR NEXT TRACK
4520  5704        JMP I TKTST

                    /INHIBIT PRINT OUT WHEN SW0 = 1
                    /
4521  7402  IPRINT, XX
4522  3754'       DCA AC
4523  7604        LAS                     /CHECK SWITCH
4524  7700        SMA CLA                 /SW0 = 1
4525  5333        JMP .+6                 /NO --- PRINTOUT
4526  1321        TAD IPRINT              /YES --- SET UP RETURN TO
4527  1353        TAD (-2                 /SKIP PRINT ROUTINE
4530  3321        DCA IPRINT
4531  1721        TAD I IPRINT
4532  3321        DCA IPRINT
4533  1754'       TAD AC
4534  5721        JMP I IPRINT
                    /
                    /WRITE MEMORY IN FIRST TWO TRACKS

4535  5335  WALL, JMP .
4536  6611        DCEA                    /TRACK ZERO
4537  3752'       DCA WC                  /4096 WORDS
4540  3751'       DCA IACW                /0000
4541  6605        DMAW                    /LOAD MAC, WRITE
4542  5735        JMP I WALL              /EXIT

4543  7402  EXSW, XX
4544  7604        LAS
4545  6615        DEAL
4546  7200        CLA
4547  5743        JMP I EXSW
```

```
4551  7751
4552  7750
4553  7776
4554  6614
4555  6606
4556  5632
4557  7300
4560  3776
4561  6600
4562  0001
4563  3632
4564  4222
4565  3675
4566  3615
4567  3700
4570  3705
4571  6613
4572  0070
4573  3504
4574  3777
4575  5100
4576  5033
4577  7777
      4600    PAGE
              /
              /ROUTINE TO CLEAR FLAG AND SETUP INTERRUPT
4600  7000    CLFLAG, NOP
4601  7200            CLA
4602  1377            TAD (JMP I 0000
4603  3001            DCA 0001
4604  6002            IOF
4605  6022            PCF
4606  6042            TCF
4607  6012            RRB
4610  6072            6072
4611  7000            NOP
4612  6032            KCC
4613  7000            NOP
4614  6104            6104
4615  6601            DCMA
4616  5600            JMP I CLFLAG

4617  5217    RANDOM, JMP .
4620  1776'           TAD NUM
4621  7104            RAL CLL
4622  7430            SZL
4623  1375            TAD (3
4624  3776'           DCA NUM
4625  1776'           TAD NUM
4626  5617            JMP I RANDOM

4627  7402    RANFIL, HLT
      7200            CLA
      1374            TAD (-200
```

```
4632  3773'          DCA CTA
4633  1372           TAD (OUTBUF-1
4634  3011           DCA 11
4635  7200           CLA
4636  4217           JMS RANDOM
4637  3411           DCA I 11
4640  2773'          ISZ CTA
4641  5235           JMP .-4
4642  4771'          JMS    FLUSH
4643  5627           JMP I RANFIL
```

```
                /ROUTINE TO WRITE A TRACK
                /1ST HALT LOAD DATA IN SR
                /WHILE RUNNING SR 8-11=TRACK
                /
4644  4255      	JMS FILLX               /WRITE A TRACK
4645  4266      	JMS WRTX
4646  5245      	JMP .-1
4647  4305      	JMS RDX         //      /READ A TRACK
4650  5247      	JMP .-1
4651  4255      	JMS FILLX               /WRITE/READ A TRACK
4652  4266      	JMS WRTX
4653  4305      	JMS RDX
4654  5252      	JMP .-2

4655  7402      FILLX,	XX                      /FILL OUT BUFFER
4656  7402      	HLT
4657  7604      	LAS
4660  3263      	DCA .+3
4661  1263      	TAD .+2
4662  4770'     	JMS FILL
4663  7402      	XX
4664  7402      	HLT                     /TO SET UP TK SELECTION
4665  5655      	JMP I FILLX

4666  7402      WRTX,	XX                      /WRITE SPECIFIED TRACK
4667  7604      	LAS
4670  3767'     	DCA TKADD
4671  1767'     	TAD TKADD
4672  7010      	RAR
4673  7630      	SZL CLA
4674  5301      	JMP .+5
4675  1767'     	TAD TKADD
4676  4324      	JMS RL5
4677  4766'     	JMS WRTLO
4700  5666      	JMP I WRTX
4701  1767'     	TAD TKADD
4702  4324      	JMS RL5
4703  4765'     	JMS WRTHI
4704  5666      	JMP I WRTX

4705  7402      RDX,	XX                      /READ SPECIFIED TRACK
4706  7604      	LAS
4707  3767'     	DCA TKADD
4710  1767'     	TAD TKADD
4711  7010      	RAR
4712  7630      	SZL CLA
4713  5320      	JMP .+5
4714  1767'     	TAD TKADD
4715  4324      	JMS RL5
4716  4764'     	JMS RDLO
4717  5705      	JMP I RDX
4720  1767'     	TAD TKADD
      4324      	JMS RL5
      4763'     	JMS RDHI
```

```
4723  5705            JMP I RDX

                      /ROTATE LEFT 5 AND CLEAR LINK
4724  7402  RL5,      XX
4725  7106            CLL RTL
4726  7006            RTL
4727  7004            RAL
4730  5724            JMP I RL5
```

```
4763  4121
4764  4104
4765  4067
4766  4053
4767  6604
4770  5033
4771  5020
4772  6777
4773  6610
4774  7600
4775  0003
4776  6607
4777  5400
      5000    PAGE
              /SUB ROUTINES
              /WRITE ONE WORD OF 7777 AT SPECIFIED ADDRESS
              /JMS WONEW7
              /AC=ADDRESS OF WHERE TO BE WRITTEN

5000  5200    WONEW7, JMP .
5001  3000            DCA 0000                /ST
5002  3777'           DCA CTC
5003  7240            CLA CMA
5004  3776'           DCA WC                  /ONE WORD
5005  7240            CLA CMA
5006  3775'           DCA IACW                /(IACW) = 0000 -1
5007  1000            TAD 0000
5010  6605            DMAW
5011  6622            DFSC                    /WAIT 36 MILL SEC
5012  7410            SKP
5013  5216            JMP .+3
5014  2777'           ISZ CTC
5015  5211            JMP .-4
5016  5600            JMP I WONEW7
5017  0000            0

              /CLEAR INBUF TO ALL ZEROS
5020  5223    FLUSH,  JMP .
5021  7200            CLA
5022  1374            TAD (-200
5023  3773'           DCA CTA
5024  1372            TAD (INBUF-1            /IACW OF INBUF
5025  3011            DCA 11
5026  7200            CLA
5027  3411            DCA I 11                /DEPOSIT ZERO
5030  2773'           ISZ CTA                 /DONE
5031  5226            JMP .-3                 /NO LOOP
5032  5620            JMP I FLUSH             /YES EXIT

              /FILL OUTBUFFER WITH DATA
              /JMS FILL FIRST WORD IN AC
              /XXXX = SECOND WORD

      5233    FILL,   JMP .
```

```
5034  3771'          DCA WORD1              /FIRST WORD
5035  1633           TAD I FILL
5036  3770'          DCA WORD2              /SECOND WORD
5037  2233           ISZ FILL
5040  1367           TAD (-100
5041  3773'          DCA CTA
5042  1366           TAD (OUTBUF-1          /IACW OF OUTBUFFER
5043  3011           DCA 11
5044  7200           CLA
5045  1771'          TAD WORD1              /DEPOSIT FIRST WORD
5046  3411           DCA I 11
5047  1770'          TAD WORD2              /DEPOSIT SECOND WORD
5050  3411           DCA I 11
5051  2773'          ISZ CTA                /DONE
5052  5244           JMP .-6                /NO ... LOOP
5053  4220           JMS FLUSH
5054  5633           JMP I FILL             /YES ... EXIT
```

```
                    /SCOPE LOOP SET UP
5055  7402    SCOPEA, XX
5056  4765'           JMS TRACE
5057  7604            LAS                     /LOAD ADDRESS SWITCH
5060  0364            AND (1000               /AND FOR SCOPE LOOP
5061  7640            SZA CLA                 /SCOPE LOOP
5062  5666            JMP I RETURN            /YES
5063  1255            TAD SCOPEA              /NO-SETUP REFERENCE
5064  3266            DCA RETURN
5065  5655            JMP I SCOPEA
                    /POINTER FOR SCOPE LOOP

5066  5163    RETURN, (BEGIN
5067  5666            JMP I ,-1

                    /ROUTINE TO RING BELL
5070  7402    BELL,   XX
5071  7200            CLA
5072  1362            TAD (207
5073  6046            TLS
5074  6041            TSF
5075  5274            JMP ,-1
5076  5670            JMP I BELL
5077  7000            NOP

                    /ROUTINE TO WRITE DISK (ANY NUMBER OF DISKS)
5100  7402    WDISK,  XX
5101  6611            DCEA                    /TRACK ZERO
5102  7200            CLA
5103  3761'           DCA GA                  /DISC ADDRESS ZERO
5104  3760'           DCA TKADD               /TRACK ZERO
5105  1357            TAD (-10
5106  3773'           DCA CTA                 /TRACK COUNTER
5107  1356            TAD (-40
5110  3355            DCA (XX                 /PAGE COUNTER
5111  4754'           JMS WPAGE               /WRITE
5112  1353            TAD (200                /INCREMENT BY
5113  1761'           TAD GA                  /PREVIOUS INITIAL ADDRESS
5114  3761'           DCA GA                  /STORE
5115  1761'           TAD GA                  /LOAD FOR WRITE
5116  2355            ISZ (XX                 /ALL PAGES
5117  5311            JMP ,-6                 /NO
5120  7200            CLA                     /YES
5121  1352            TAD (100                /INCREMENT TRACKS
5122  1760'           TAD TKADD
5123  6615            DEAL                    /LOAD TRACK
5124  3760'           DCA TKADD               /STORE TRACK
5125  2773'           ISZ CTA                 /ALL TRCKS
5126  5307            JMP WDISK+7             /NO
5127  6611            DCEA                    /YES
5130  5700            JMP I WDISK             /EXIT
```

```
                        /ROUTINE OF DISK CAN NUMBER OF DISK1
5131  7402      RDISK,  XX
5132  7200              CLA
5133  1351              TAD (-377               /NUMBER OF TRACKS
5134  3355              DCA (XX
5135  6615              DEAL
5136  7200              CLA
5137  4750'             JMS RPAGE               /READ
5140  4747'             JMS SYNC                /FIND NEXT ADDRESS
5141  2355              ISZ (XX
5142  5337              JMP .-3
5143  7200              CLA
5144  5731              JMP I RDISK
```

```
5147  4472
5150  3615
5151  7401
5152  7100
5153  6200
5154  3600
5155  7402
5156  7740
5157  7770
5160  6604
5161  6622
5162  5207
5163  0421
5164  1000
5165  5327
5166  6777
5167  7700
5170  6616
5171  6615
5172  7177
5173  6610
5174  7600
5175  7751
5176  7750
5177  6603
      5200    PAGE
              /READ RECOVERY TIME
              /WRITE 200 TO 377
              /READ 400 TO 577
              /TIME FROM WRITE TO READ 16.5 - 21 MICROSECONDS
5200  7402    RDREC,  XX
5201  7240            CLA CMA
5202  4777'           JMS FILL                /OUTPUT=7777
5203  7777            7777
5204  7200            CLA
5205  1376            TAD (RDREC
5206  3775'           DCA RDLO                /TAG FOR PRINTOUT
5207  4774'           JMS WDISK               /WRITE THE DISC
5210  6611            DCEA
5211  1373            TAD (200
5212  1372            TAD (-1
5213  3771'           DCA WADD
5214  1370            TAD (-200
5215  3767'           DCA WC
5216  1366            TAD (OUTBUF-1
5217  3765'           DCA IACW
5220  1771'           TAD WADD
5221  6605            DMAW                    /REWRITE 200 TO 377
5222  1364            TAD (401
5223  1372            TAD (-1
5224  3763'           DCA RADD
5225  1370            TAD (-200
      6622            DFSC                    /READ
      5226            JMP .-1                 /NO
```

```
5230  3767'          DCA WC
5231  1362           TAD (INBUF-1
5232  3765'          DCA IACW
5233  1763'          TAD RADD
5234  6603           DMAR                    /READ 401 TO 600
5235  4761'          JMS FLAG
5236  6621           DFSE
5237  4760'          JMS STATUS
5240  4757'          JMS COMPAR
5241  5600           JMP I RDREC
                PAUSE
```

```
                    /TAPE 4
                    /RANDOM WORD ADDRESS AND TRACK TEST
5242  7000    RANDSK, NOP
5243  7200            CLA
5244  6601            DCMA
5245  4756'           JMS RANDOM
5246  0355            AND (0700
5247  3323            DCA RANTK               /TRACK ADDRESS
5250  4756'           JMS RANDOM
5251  3324            DCA RANAD               /MEMORY ADDRESS COUNTER
5252  4756'           JMS RANDOM
5253  3325            DCA RANWD               /WORD
5254  7240            CLA CMA
5255  3767'           DCA WC                  /WORD CT=7777
5256  7200            CLA
5257  1354            TAD (RANWD-1
5260  3765'           DCA IACW
5261  1323            TAD RANTK
5262  6615            DEAL                    /LOAD TRACK ADDRESS
5263  7200            CLA
5264  1324            TAD RANAD
5265  6605            DMAW                    /LOAD MAC WRITE
5266  4761'           JMS FLAG
5267  7240            CLA CMA
5270  3767'           DCA WC                  /ONE WORD
5271  1353            TAD (RANWD              /ONE GREATER THAN READ
```

```
                    /
5272  3765'         DCA IACW
5273  1323          TAD RANTK
5274  6615          DEAL                    /LOAD TRACK
5275  7200          CLA
5276  1324          TAD RANAD
5277  6603          DMAR                    /LOAD MAC READ
5300  4761'         JMS FLAG
5301  6621          DFSE                    /PARITY ERROR
5302  4752'         JMS ERADD               /YES
5303  7200          CLA                     /NO
5304  1325          TAD RANWD               /WRITE
5305  7041          CIA
5306  1326          TAD RANWD+1             /READ FROM DISK
5307  7650          SNA CLA                 /READ FROM DISK
5310  5642          JMP I RANDSK
5311  6616          DEAC                    /READ STATUS
5312  7112          CLL RTR
5313  7630          SZL CLA                 /WRITE LOCK OR NO DISC
5314  5642          JMP I RANDSK
5315  1326          TAD RANWD+1
5316  3751'         DCA BD
5317  1325          TAD RANWD
5320  3750'         DCA GD
5321  4747'         JMS BADCOM              /GOOD DATA
5322  5642          JMP I RANDSK

5323  0000  RANTK, 0                       /RANDOM TRACK ADDRESS
5324  7402  RANAD, HLT                     /RANDOM DISK MEMORY ADDRESS COUNTER
5325  0000  RANWD, 0                       /RANDOM DATA WORD TO BE WRITTEN
5326  0000         0                       /RANDOM DATA WORD READ BACK
5327  0000  TRACE, 0
5330  7604          LAS
5331  7010          RAR
5332  7420          SNL
5333  5727          JMP I TRACE
5334  4746'         JMS SIXTY
5335  5055          SCOPEA
5336  5342          .+4
5337  5343          .+4
5340  4773'         JMS MESAGE
5341  4543          4543
5342  6060          6060
5343  6060          6060
5344  0000          0000
5345  5727          JMP I TRACE
```

```
5346  0260
5347  6040
5350  6626
5351  6625
5352  5600
5353  5325
5354  5324
5355  0700
5356  4617
5357  3632
5360  6400
5361  4466
5362  7177
5363  6602
5364  0401
5365  7751
5366  6777
5367  7750
5370  7600
5371  6601
5372  7777
5373  0200
5374  5100
5375  4104
5376  5200
5377  5033
      5400    PAGE
              /SCOPE LOOP FOR FAILING DATA LOCATION
              /THIS ROUTINE USES THE RESULTS OF ERRCOM
5400  1377            TAD (NOP                /HOUSEKEEPING
5401  7200    SCOPE,  CLA
5402  1776'           TAD ERRDSK
5403  7450            SNA                     /EQUAL TO ZERO
5404  5232            JMP SCOPE1              /YES
5405  0377            AND (7000               /NO
5406  7450            SNA                     /EQUAL TO 0XXX
5407  5217            JMP SCOPE2              /YES
5410  0375            AND (4000               /NO
5411  7640            SZA CLA                 /EQUAL TO (1XX) (XXX) (XXX) (XXX)
5412  5224            JMP SCOPE3              /YES
5413  1776'           TAD ERRDSK              /NO
5414  1377            TAD (7000               /SUBTRACT 1000 FROM DISK ADDRESS
5415  3776'           DCA ERRDSK
5416  5236            JMP SCOPE4
5417  7200    SCOPE2, CLA                     /CORRECT LOW TRACK
5420  1776'           TAD ERRDSK
5421  1374            TAD (2777
5422  3776'           DCA ERRDSK
5423  5236            JMP SCOPE4
5424  7200    SCOPE3, CLA                     /CORRECT HIGH TRACK
5425  1776'           TAD ERRDSK
      1373            TAD (3777
      1375            TAD (4000
```

```
5430  3776'          DCA ERRDSK
5431  5236           JMP SCOPE4
5432  7200  SCOPE1, CLA                    /CORRECT ZERO CASE
5433  1373           TAD (3777
5434  1776'          TAD ERRDSK
5435  3776'          DCA ERRDSK
5436  7000  SCOPE4, OPR

                     /WRITE 1 WORD AT LOCATION BEFORE FAILING LOCATION.
5437  7240           CLA CMA
5440  3772'          DCA WC                 /ONE WORD
5441  1371           TAD (GD-1
5442  3770'          DCA IACW               /GOOD DATA - WRITE
5443  1767'          TAD ERRTK              /TRACK ADDRESS
5444  6615           DEAL                   /LOAD TRACK
5445  1776'          TAD ERRDSK             /LOAD DISK ADDRESS START WRITE
5446  6605           DMAW
5447  6622           DFSC                   /DONE?
5450  5247           JMP .-1                /NO
5451  7000           OPR
```

```
                    /READ ONE WORD
5452  7240          CLA CMA
5453  3772'         DCA WC                  /ONE WORD
5454  1366          TAD (BD-1               /BAD DATA-READ
5455  3770'         DCA IACW
5456  1767'         TAD ERRTK               /TRACK ADDRESS
5457  6615          DEAL                    /LOAD TRACK
5460  1776'         TAD ERRDSK              /DISK ADDRESS
5461  6603          DMAR                    /START READ
5462  6622          DFSC                    /DONE
5463  5262          JMP .-1                 /NO
5464  7000          OPR
5465  5236          JMP SCOPE4              /JUMP TO WRITE

                    /DATA TONE LOOP WITH BELL ON ERROR
5466  7402    DBELL, HLT
5467  7604          LAS
5470  0365          AND     (76
5471  4764'         JMS RL5
5472  6615          DEAL                    /LOAD TRACK AND DISC
5473  7402          HLT
5474  7604          LAS                     /LOAD ADDRESS
5475  3763'         DCA GA
5476  7402          HLT
5477  7604          LAS                     /LOAD DATA
5500  3762'         DCA GD
5501  7240          CLA CMA
5502  3772'         DCA WC                  /ONE WORD
5503  1371          TAD (GD-1
5504  3770'         DCA IACW
5505  1763'         TAD GA
5506  6605          DMAW                    /WRITE
5507  4761'         JMS FLAG
5510  7240          CLA CMA
5511  3772'         DCA WC                  /ONE WORD
5512  1366          TAD (BD-1
5513  3770'         DCA IACW
5514  1763'         TAD GA
5515  6603          DMAR                    /READ
5516  4761'         JMS FLAG
5517  7200          CLA
5520  1762'         TAD GD
5521  7041          CIA
5522  1771'         TAD BD
5523  7440          SZA                     /COMPARE
5524  4763'         JMS BELL                /ERROR
5525  5276          JMP DBELL+10
```

```
                    /ADDRESS SCOPE LOOP WITH BELL ON ERROR
                            HALT
5526  4757'     JMS ERADD
5527  7604                  LAS
5530  3763'                 DCA GA
5531  1763'                 TAD GA
5532  4756'                 JMS WONEW7              /AC=ADDRESS
5533  4755'                 JMS SYNC                /ADDRESS+1 IN AC
5534  7041                  CIA
5535  1763'                 TAD GA
5536  7440                  SZA                   /TEST GOOD
5537  4760'                 JMS BELL                /NO
5540  5327                  JMP .-11                /YES
```

```
                    /PDP 8 DISC
5555  4472
5556  5000
5557  5600
5560  5070
5561  4466
5562  6626
5563  6622
5564  4724
5565  0076
5566  6624
5567  6606
5570  7751
5571  6625
5572  7750
5573  3777
5574  2777
5575  4000
5576  6605
5577  7000
      5600    PAGE
              /PRINT OUT ROUTINES
              /ROUTINE TO PRINT OUT FAILING TEST ADDRESS
5600  7402    ERADD,  XX
5601  4777'           JMS IPRINT
5602  6002            IOF
5603  4776'           JMS SIXTY
5604  5600            ERADD

5605  5611            .+4
5606  5612            .+4
5607  4775'           JMS MESAGE
5610  4543            4543
5611  6060            6060
5612  6060            6060
5613  4000            4000
5614  4776'           JMS SIXTY
5615  6614            AC
5616  5622            .+4
5617  5623            .+4
5620  4775'           JMS MESAGE
5621  4040            4040
5622  6060            6060
5623  6060            6060
5624  0000            0000
5625  7604            LAS                     /TEST FOR HALT
5626  0374            AND (2000
5627  7640            SZA CLA
5630  7402            HLT                     /HALT IF SW1 = ONE
5631  5600            JMP I ERADD
```

```
                    /TRACK ERROR RATIO PRINT OUT
                    /TKXX BAD XXXX ----- LESS THAN 200 NOT PRINTED
                    /
5632  7402          ERTK,   XX
5633  4777'                 JMS IPRINT
5634  4776'                 JMS SIXTY
5635  6606                  ERRTK                   /TRACK NUMBER
5636  5647                  .+11
5637  5647                  .+10
5640  4776'                 JMS SIXTY
5641  6600                  KA                      /NUMBER OF ERRORS
5642  5653                  .+11
5643  5654                  .+11
5644  4775'                 JMS MESAGE
5645  4543                  4543
5646  2413                  2413
5647  6060                  6060
5650  4040                  4040
5651  0201                  0201
5652  0440                  0440
5653  6060                  6060
5654  6060                  6060
5655  0000                  0
5656  5632                  JMP I ERTK
```

```
                    /
                    /PRINT OUT NUMBER OF PASSES
                    /
5657  7402    ENDCT,  XX
5660  4776'           JMS SIXTY
5661  6617            END                     /NUMBER OF PASS COMPLETED
5662  5667            .+5
5663  5667            .+4
5664  4775'           JMS MESAGE
5665  4543            4543
5666  2003            2003
5667  6060            6060
5670  0000            0
5671  5657            JMP I ENDCT
```

```
5672  7402    STOP,   XX
5673  7604            LAS
5674  0374            AND (2000
5675  7650            SNA CLA
5676  7410            SKP
5677  7402            HLT
5700  5672            JMP I STOP
5701  0000    SPEED,  0
5702  6032            KCC
5703  6042            TCF
5704  1373            TAD (-143
5705  3772'           DCA CTA
5706  3771'           DCA CTB
5707  7200            CLA
5710  1370            TAD (RINT
5711  3002            DCA 2
5712  1367            TAD (JMP I 2
5713  3001            DCA 1
5714  7200            CLA
5715  6046            TLS
5716  6001            ION
5717  6616            DEAC
5720  7000            NOP
5721  7700            SMA CLA
5722  5317            JMP .-3
5723  6616            DEAC
5724  7000            NOP
5725  7710            SPA CLA
5726  5323            JMP .-3
5727  2771'           ISZ CTB
5730  7000            NOP
5731  5317            JMP .-12
5732  6041    RINT,   TSF
5733  5355            JMP ADDR+1
5734  6042            TCF
5735  3357            DCA ACSAV
5736  1754            TAD I ADDR
5737  6046            TLS
5740  6001            ION
5741  7200            CLA
5742  2766'           ISZ CTC
5743  5346            JMP .+3
5744  1365            TAD (NOP
5745  3346            DCA .+1
5746  2354    ADDINC, ISZ ADDR
5747  1357            TAD ACSAV
5750  2772'           ISZ CTA
5751  5400            JMP I 0
5752  6002            IOF
5753  5701            JMP I SPEED
5754  0000    ADDR,   0
5755  6001            ION
5756  5400            JMP I 0
5757  0000    ACSAV,  0
```

```
5765  7000
5766  6603
5767  5402
5770  5732
5771  3661
5772  6610
5773  7635
5774  2000
5775  0200
5776  0260
5777  4521
      6000    PAGE
              /PRINT OUT ROUTINE FOR BAD TRACK
6000  7402    ETRACK, XX
6001  4777'           JMS IPRINT
6002  4776'           JMS SIXTY
6003  6000            .-3
6004  6010            .*4
6005  6011            .*4
6006  4775'           JMS MESAGE
6007  4543            4543
6010  6060            6060
6011  6060            6060
6012  0000            0000
6013  4776'           JMS SIXTY
6014  6623            GT                      /GOOD TRACK
6015  6027            .*12
6016  6030            .*12
6017  4776'           JMS SIXTY
6020  6624            BT                      /BAD TRACK
6021  6033            .*12
6022  6034            .*12
6023  4775'           JMS MESAGE
6024  4040            4040
6025  0724            0724
6026  4040            4040
6027  6060            6060
6030  6060            6060
6031  4002            4002
6032  2440            2440
6033  6060            6060
6034  6060            6060
6035  0000            0000
6036  4774'           JMS STOP
6037  5600            JMP I ETRACK
```

```
                    /COMPARISON ERROR PRINT OUT
                    /GDXXXX  BDXXXX
6040  7402    BADCOM, XX
6041  4777'           JMS IPRINT
6042  4776'           JMS SIXTY
6043  6040            .-3
6044  6050            .+4
6045  6051            .+4
6046  4775'           JMS MESAGE
6047  4543            4543
6050  6060            6060
6051  6060            6060
6052  0000            0000
6053  4776'           JMS SIXTY
6054  6626            GD                      /GOOD
6055  6067            .+12
6056  6070            .+12
6057  4776'           JMS SIXTY
6060  6625            BD                      /BAD
6061  6073            .+12
6062  6074            .+12
6063  4775'           JMS MESAGE
6064  4040            4040                    /CR LF
6065  0704            0704                    /GOOD DATA
6066  4040            4040
6067  6060            6060
6070  6060            6060
6071  4002            4002
6072  0440            0440                    /BAD DATA
6073  6060            6060
6074  6060            6060
6075  0000            0000
6076  4774'           JMS STOP
6077  5640            JMP I BADCOM            /EXIT

                    /SYNC ADDRESS TEST PRINT OUT GAXXXX  SYNCXXXX
6100  7402    ERSYNC, XX
6101  4777'           JMS IPRINT
6102  4776'           JMS SIXTY
6103  6621            BA                      /MAC
6104  6123            SYNC1+11                /BAD ADDRESS
6105  6124            SYNC1+12
6106  4776'           JMS SIXTY
6107  6622            GA
6110  6116            SYNC1+4                 /GOOD ADDRESS
6111  6117            SYNC1+5
6112  4775'   SYNC1,  JMS MESAGE
6113  4543            4543                    /CR LF
6114  0701            0701                    /GA
6115  4040            4040
6116  6060            6060                    /GOOD ADDRESS
6117  6060            6060
6120  4023            4023                    /SYNC
```

```
6121  3116          3116
6122  0340          0340
6123  6060          6060                /BAD ADDRESS
6124  6060          6060
6125  0000          0000
6126  4774'         JMS STOP
6127  5700          JMP I ERSYNC
```

```
                    /FALSE COMPARE AT ADDRESS XXXX
                    /FALCOM XXXX
6130  7402          TEXTE,  XX
6131  4777'                 JMS IPRINT
6132  4776'                 JMS SIXTY
6133  6622                  GA                        /FROM
6134  6144                  .*10                      /TO
6135  6145                  .*10                      /TO
6136  4775'                 JMS MESAGE
6137  4543                  4543                      /FALCOM XXXX
6140  0601                  0601
6141  1403                  1403
6142  1715                  1715
6143  4040                  4040
6144  6060                  6060
6145  6060                  6060
6146  0000                  0000
6147  4774'                 JMS STOP
6150  5730                  JMP I TEXTE

6174  5672
6175  0200
6176  0260
6177  4521
      6200    PAGE
```

```
                    /COMPARISON ERROR PRINTOUT
6200  7402          ERRCOM, XX
6201  4777'               JMS IPRINT
6202  2776'               ISZ ERCT                /ERROR COUNT
6203  7410                SKP
6204  5775'               JMP CTB-1
6205  7300                CLA CLL
6206  1774'               TAD CTB                 /COMPARE LOOP COUNTER
6207  0373                AND (0177               /EXTRACT HOW FAR
6210  1772'               TAD RADD                /ADD TO INITIAL DISK ADDRESS
6211  1371                TAD (1                  /CORRECT
6212  3770'               DCA ERRDSK              /ERROR DISK ADDRESS
6213  4767'               JMS SYNC
6214  6616                DEAC                    /READ TRACK COUNTER
6215  0366                AND (0700               /EXTRACT TRACK
6216  3765'               DCA ERRTK               /ERROR TRACK ADDRESS
6217  7100                CLL
6220  1770'               TAD ERRDSK
6221  7004                RAL
6222  3770'               DCA ERRDSK
6223  7004                RAL
6224  3764'               DCA LINKA
6225  1765'               TAD ERRTK
6226  7012                RTR
6227  7012                RTR
6230  7012                RTR
6231  3765'               DCA ERRTK
6232  1764'               TAD LINKA
6233  7010                RAR
6234  1765'               TAD ERRTK
6235  7004                RAL
6236  3765'               DCA ERRTK
6237  1770'               TAD ERRDSK
6240  7010                RAR
6241  3770'               DCA ERRDSK
6242  4763'               JMS SIXTY
6243  4104                RDLO
6244  6250                .+4
6245  6251                .+4
6246  4762'               JMS MESAGE
6247  4543                4543
6250  6060                6060
6251  6060                6060
6252  4000                4000
6253  4763'               JMS SIXTY
6254  6606                ERRTK                   /ERROR TRACK
6255  6276                .+21
6256  6276                .+20
6257  4763'               JMS SIXTY
6260  6605                ERRDSK                  /DISK ADDRESS
6261  6301                .+20
6262  6302                .+20
      4763'               JMS SIXTY
      6626                GO                      /GOOD
```

```
6265  6305          ,+20
6266  6306          ,+20
6267  4763'         JMS SIXTY
6270  6625          BD                      /BAD DATA
6271  6311          ,+20
6272  6312          ,+20
6273  4762'         JMS MESAGE
6274  4024          4024                    /DSK ADDRESS
6275  1340          1340
6276  6060          6060
6277  4004          4004
6300  0140          0140
6301  6060          6060                    /GOOD DATA
6302  6060          6060
6303  4007          4007
6304  0440          0440
6305  6060          6060
6306  6060          6060                    /BAD DATA
6307  4002          4002
6310  0440          0440
6311  6060          6060
6312  6060          6060
6313  0000          0000
6314  4761'         JMS STOP
6315  5600          JMP I ERRCOM
```

```
6316  7402    BADADD, XX
6317  4777'           JMS IPRINT              /INHIBIT PRINTOUT
6320  4763'           JMS SIXTY
6321  6316            .-3
6322  6326            .+4
6323  6327            .+4
6324  4762'           JMS MESAGE
6325  4543            4543
6326  6060            6060
6327  6060            6060
6330  0000            0000
6331  4763'           JMS SIXTY
6332  6622            GA
6333  6345            .+12
6334  6346            .+12
6335  4763'           JMS SIXTY
6336  6621            BA
6337  6351            .+12
6340  6352            .+12
6341  4762'           JMS MESAGE
6342  4040            4040
6343  0701            0701
6344  4040            4040
6345  6060            6060
6346  6060            6060
6347  4002            4002
6350  0140            0140
6351  6060            6060
6352  6060            6060
6353  0000            0000
6354  4761'           JMS STOP
6355  5716            JMP I BADADD

6361  5672
6362  0200
6363  0260
6364  6632
6365  6606
6366  0700
6367  4472
6370  6605
6371  0001
6372  6602
6373  0177
6374  3661
6375  3660
6376  6612
6377  4521
      6400    PAGE
```

```
6400  0000    STATUS, 0
6401  4777'           JMS IPRINT
6402  6616            DEAC
6403  3776'           DCA SR
6404  4775'           JMS MESAGE
6405  4543            4543
6406  2324            2324                    /ST
6407  0124            0124                    /AT
6410  4005            4005                    /E
6411  2222            2222                    /RR
6412  4040            4040
6413  0000            0000
6414  7200            CLA
6415  1200            TAD STATUS
6416  7041            CIA
6417  1374            TAD (WPAGE*12
6420  7440            SZA
6421  5227            JMP .+6
6422  4775'           JMS MESAGE
6423  2722            2722                    /WR
6424  1124            1124                    /IT
6425  0500            0500                    /E
6426  5233            JMP .+5
6427  4775'           JMS MESAGE
6430  2205            2205                    /RE
6431  0104            0104                    /AD
6432  0000            0000
6433  1773'           TAD TKADD
6434  0372            AND (0700
6435  7012            RTR
6436  7012            RTR
6437  7012            RTR
6440  3771'           DCA ERRTK
6441  1770'           TAD RADD
6442  7100            CLL
6443  7004            RAL
6444  3767'           DCA ERRDSK
6445  1771'           TAD ERRTK
6446  7004            RAL
6447  3771'           DCA ERRTK
6450  1767'           TAD ERRDSK
6451  7010            RAR
6452  3767'           DCA ERRDSK
6453  4766'           JMS SIXTY
6454  6606            ERRTK
6455  6471            .+14
6456  6471            .+13
6457  4766'           JMS SIXTY
```

```
6460  6605          ERRDSK
6461  6474          .+13
6462  6475          .+13
6463  4775'         JMS MESAGE
6464  4040          4040
6465  2301          2301                    /SA
6466  7540          7540                    /=
6467  4024          4024                    /T
6470  1340          1340                    /K
6471  6060          6060
6472  4004          4004                    /D
6473  0140          0140                    /A
6474  6060          6060
6475  6060          6060
6476  0000          0000
6477  7200          CLA
6500  1776'         TAD SR
6501  4341          JMS STAT
6502  3306          DCA .+4
6503  4775'         JMS MESAGE
6504  4543          4543
6505  2005          2005                    /PE
6506  6060          6060
6507  0000          0000
6510  7200          CLA
6511  1765'         TAD STATSV
6512  4341          JMS STAT
6513  3323          DCA .+10
6514  4775'         JMS MESAGE
6515  4040          4040
6516  1605          1605                    /NE
6517  0440          0440                    /D
6520  1722          1722                    /OR
6521  4027          4027                    /W
6522  1417          1417                    /LO
```

```
6523  6060            6060
6524  0000            0000
6525  7200            CLA
6526  1765'           TAD STATSV
6527  4341            JMS STAT
6530  3335            DCA .+5
6531  4775'           JMS MESAGE
6532  4040            4040
6533  0422            0422                    /DR
6534  1440            1440                    /L
6535  6060            6060
6536  4300            4300
6537  4764'           JMS STOP
6540  5600            JMP I STATUS
6541  0000    STAT,   0
6542  7100            CLL
6543  7010            RAR
6544  3765'           DCA STATSV
6545  7430            SZL
6546  5351            JMP .+3
6547  1353            TAD STAT0
6550  5741            JMP I STAT
6551  1354            TAD STAT1
6552  5741            JMP I STAT
6553  7560    STAT0,  7560
6554  7561    STAT1,  7561
6564  5672
6565  6633
6566  0260
6567  6605
6570  6602
6571  6606
6572  0700
6573  6604
6574  3612
6575  0200
6576  6620
6577  4521
      6600    PAGE
```

```
                    /CONSTANTS
          6611      DCEA=6611                   /CL EXT ADDRESS REGISTER
          6601      DCMA=6601                   /CLEAR MAR, PE, DONE
          6612      DSAC=6612                   /CLEAR AC SKIP ON ADC
          6603      DMAR=6603                   /LOAD AND START READ
          6605      DMAW=6605                   /LOAD AND START WRITE
          6615      DEAL=6615                   /LOAD EXTENDED ADDRESS
          6616      DEAC=6616                   /READ EXTENDED ADDRESS
          6621      DFSE=6621                   /SKIP ON NO ERROR
          6622      DFSC=6622                   /SKIP ON FLAG
          6626      DMAC=6626                   /READ DISK ADDRESS
          7402      XX=7402                     /
          7750      WC=7750
          7751      IACW=7751
          7751      CACW=IACW
6600      0000      KA,     0
6601      3000      WADD,   0                   /IACW-1 FOR WRITE
6602      0000      RADD,   0                   /IACW-1 FOR READ
6603      0000      CTC,    0
6604      0000      TKADD,  0
6605      0000      ERRDSK, 0                   /DISK ERROR ADDRESS
6606      0000      ERRTK,  0
6607      0001      NUM,    1
6610      0000      CTA,    0
6611      0000      CTD,    0
6612      0000      ERCT,   0                   /ERROR COUNT FOR COMPARES
6613      0000      BX,     0                   /STORE EXT. MEMORY BANK
6614      0000      AC,     0                   /SAVE AC
6615      0000      WORD1,  0
6616      0000      WORD2,  0
6617      0000      END,    0                   /NUMBER OF PASS COMPLETED
6620      0000      SR,     0                   /STATUS REGISTER
6621      0000      BA,     0                   /BAD ADDRESS
6622      0000      GA,     0                   /GOOD ADDRESS
6623      0000      GT,     0                   /GOOD TRACK
6624      0000      BT,     0                   /BAD TRACK
6625      0000      BD,     0                   /BAD DATA
6626      0000      GD,     0                   /GOOD DATA
6627      0000      CTADC,  0
6630      0000              0
6631      0000              0
6632      0000      LINKA,  0
6633      0000      STATSV, 0

6634      0000      DEC,    0
6635      3326              DCA DECA
6636      3327              DCA THOU
6637      3330              DCA HUND
6640      3331              DCA TENS
6641      3332              DCA UNIT
6642      1326              TAD DECA
6643      7450              SNA
66        7002              JMP PACK
```

```
6645  7100          CLL
6646  1377          TAD (-1750
6647  7420          SNL
6650  5253          JMP .+3
6651  2327          ISZ THOU
6652  5245          JMP .-5
6653  1376          TAD (1750
6654  7450          SNA
6655  5302          JMP PACK
6656  1375          TAD (-144
6657  7510          SPA
6660  5263          JMP .+3
6661  2330          ISZ HUND
6662  5256          JMP .-4
6663  1374          TAD (144
6664  7450          SNA
6665  5302          JMP PACK
6666  1373          TAD (-12
6667  7510          SPA
6670  5273          JMP .+3
6671  2331          ISZ TENS
6672  5266          JMP .-4
6673  1372          TAD (12
6674  7450          SNA
6675  5302          JMP PACK
6676  1371          TAD (-1
6677  2332          ISZ UNIT
6700  7440          SZA
6701  5276          JMP .-3
6702  7200    PACK, CLA
6703  1634          TAD I DEC
6704  3326          DCA DECA
6705  2234          ISZ DEC
6706  1327          TAD THOU
6707  7106          RTL CLL
6710  7006          RTL
6711  7006          RTL
6712  1330          TAD HUND
6713  1370          TAD (6060
6714  3726          DCA I DECA
6715  2326          ISZ DECA
6716  1331          TAD TENS
6717  7106          RTL CLL
6720  7006          RTL
6721  7006          RTL
6722  1332          TAD UNIT
```

```
6723  1370          TAD (6060
6724  3726          DCA I DECA
6725  5634          JMP I DEC
6726  0000  DECA,   0
6727  0000  THOU,   0
6730  0000  HUND,   0
6731  0000  TENS,   0
6732  0000  UNIT,   0

6733  0215  TABL,   215
6734  0212          212
6735  0304          304
6736  0311          311
6737  0323          323
6740  0313          313
6741  0240          240
6742  0304          304
6743  0301          301
6744  0324          324
6745  0301          301
6746  0240          240
6747  0324          324
6750  0305          305
6751  0323          323
6752  0324          324
6753  0215          215
6754  0212          212
6755  0252          252
6770  6060
6771  7777
6772  0012
6773  7766
6774  0144
6775  7634
6776  1750
6777  6030
      7000    PAGE
7000  0000  OUTBUF, 0
      7200    PAGE
7200  0000  INBUF,  0
```

```
          7600    *7600
7600      1205            TAD 7605
7601      3350            DCA 7750
7602      1206            TAD 7606
7603      3351            DCA 7751
7604      5377            JMP 7777
7605      1355            1355
7606      5743            5743
                  $
0140      2651
0141      6200
0142      6400
0143      6600
0144      1111
0145      1077
0146      4425
0147      4202
0150      4000
0151      2724
0152      4651
0153      4647
0154      4644
0155      5466
0156      5527
0157      2715
0160      2707
0161      5401
0162      2045
0163      2177
0164      2000
0165      1431
0166      1120
0167      4322
0170      7410
0171      2212
0172      7240
0173      5040
0174      5242
0175      4400
0176      4400
0177      5200
```

```
0000  00000000  00000000  11111111  11111111  11111111  11111111  11111111  11100001
0100  11111111  11111111  11111000  00000000  11111111  11111111  11111111  11111111

0200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
0300  11111111  11111111  11111111  11111111  11111000  00000000  00000000  00011111

0400  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
0500  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111

0600  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111110
0700  00000000  00000000  00000000  00000000  00000000  00000000  00000000  01111111

1000  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
1100  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111

1200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
1300  11111111  11111111  10000000  00000000  00000000  00000000  00111111  11111111

1400  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
1500  11111111  11111111  11111111  10000000  00000000  00000000  11111111  11111111

1600  11111111  11111111  11111111  11111111  11111111  11111111  11100000  00000000
1700  00000000  00000000  00000000  00000000  00000000  00000000  00000111  11111111

2000  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
2100  11111111  11111111  11111111  11111111  00111111  11111111  11111111  11111111

2200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  00000000
2300  00000000  00000000  00000000  00000000  00000000  00000000  11111111  11111111

2400  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
2500  11111111  11111111  11111111  10000000  00000000  00000000  00111111  11111111

2600  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
2700  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111

3300  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
3100  11111111  11111111  11111111  11111111  11111111  11111111  00000000  00011111

3200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
3300  11111111  11111111  11111000  00000000  11111111  11111111  11111111  11111111

3400  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
3500  11111111  11111111  11111111  11111111  11111111  11111111  00011111  11111111

3600  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
3700  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
```

```
4000  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
4100  11111111  11111111  11111111  11111110  00000000  00000111  11111111  11111111

4200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
4300  11111111  11111111  11111111  11111111  11111111  11110111  11111111  11111111

4400  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
4500  11111111  11111111  11111111  11111111  11111111  01111111  11111111  11111111

4600  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
4700  11111111  11111111  11111111  10000000  00000000  00000000  00011111  11111111


5000  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
5100  11111111  11111111  11111111  11111111  11111001  11111111  11111111  11111111

5200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
5300  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111

5400  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
5500  11111111  11111111  11111111  11111111  10000000  00000111  11111111  11111111

5600  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
5700  11111111  11111111  11111111  11111111  11111111  11111111  00000111  11111111


6000  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
6100  11111111  11111111  11111111  11111111  11111111  10000000  00000000  00001111

6200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
6300  11111111  11111111  11111111  11111111  11111111  11111100  01111111  11111111

6400  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
6500  11111111  11111111  11111111  11111111  11111111  11111000  00001111  11111111

6600  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
6700  11111111  11111111  11111111  11111111  11111111  11111100  00000000  11111111


7000  10000000  00000000  00000000  00000000  00000000  00000000  00000000  00000000
7100  00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000000

7200  10000000  00000000  00000000  00000000  00000000  00000000  00000000  00000000
7300  00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000000

7400
7500

7600  11111110  00000000  00000000  00000000  00000000  00000000  00000000  00000000
7700  00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000000
```

AC	0014	DISPAY	0620	[illegible]	[illegible]	TADYST	[illegible]
ACSAV	5757	DK1	4400	[illegible]	[illegible]	TEMP1	[illegible]
ADDING	5743	DMAC	6526	[illegible]	[illegible]	TEMP2	[illegible]
ADDR	5754	DMAS	6623	[illegible]	[illegible]	TEMP3	[illegible]
ATEST	1120	DMAX	6620	[illegible]	[illegible]	TEMP4	[illegible]
BA	6621	DSAV	6613	[illegible]	[illegible]	TEMP5	[illegible]
BADADD	6316	DWRGD1	3400	[illegible]	[illegible]	TEMP6	[illegible]
BADCOM	6040	END	6617	RANCSH	2242	TEXTE	[illegible]
BD	6625	ENDO7	5657	RANFIL	2627	TKDC	[illegible]
BEGIN	0421	ERADD	5600	RANTK	1323	TKADD	[illegible]
BELL	5070	EROT	6612	RANWD	1325	TKDAL	[illegible]
BT	6624	ERRCOM	6200	RATIO	[illegible]	TKDEC	[illegible]
BX	6613	ERRDSK	6605	RD	[illegible]	TKERR	[illegible]
C212	0254	ERRTK	6606	[illegible]	[illegible]	TKINC	[illegible]
C215	0256	ERSYNC	6100	[illegible]	[illegible]	TKRD	[illegible]
C245	0257	ERTK	5632	[illegible]	[illegible]	TKTST	[illegible]
C3200	3156	ETRACK	6000	[illegible]	[illegible]	TKWT	[illegible]
C340	0252	EXSW	4543	[illegible]	[illegible]	TRACE	5327
C4611	3155	FALCOM	1632	[illegible]	[illegible]	TYPECH	[illegible]
CACW	7751	FCOM	1601	RETURN	2650	UNIT	[illegible]
CKRDOI	3504	FILL	5033	RETURN	[illegible]	WADD	[illegible]
CLFLAG	4600	FILLX	4655	[illegible]	[illegible]	WALL	[illegible]
CMPYR	3150	FLAG	4466	RLB	6724	WC	7750
COMA	3644	FLUSH	5020	RLA	3056	WDISK	5100
COMPAR	3632	GA	6622	RSAC	2676	WONE	2005
CONV	4271	GD	6626	ROTIT3	2400	WONEW7	5000
CONVB	4314	GT	6623	ROT273	2416	WORD1	6615
CTA	6610	HUND	6730	RPAGE	3615	WORD2	6616
CTADC	6627	IACW	7751	RPM	0400	WPAGE	3600
CTB	3661	INBUF	7200	SARD	2715	WPAGEX	4222
CTC	6603	IPRINT	4521	SAWD	2707	WRC00	3675
CTD	6611	ISZTST	2245	SCOPE	5401	WRC77	3725
CTIME	3000	JMRETU	2622	SCOPE1	5432	WRCX	4000
CTIMEA	3024	JMSTST	2600	SCOPE2	5417	WRTHI	4047
CTIMEB	3136	KA	6602	SCOPE3	5424	WRTLO	4053
CTIMEX	3145	LINKA	6634	SCOPE4	5436	WRTX	4656
CTIMEY	3146	M2	0255	SCOPE5	5055	WSYNC	4500
CYCLE	3147	M3	0253	SCT	4343	WTRK	2651
DBELL	5466	M40	0251	SIXTY	0260	X	3157
DBTST	2205	MARGIN	4207	SLOW8	0263	XBANK	[illegible]
DCEA	6611	MASK	0252	SPEED	6701	XX	[illegible]
DCMA	6601	MASK	0340	SR	0020	[illegible]	[illegible]
DEAC	6616	MASK	0341	START	0341		
DEAL	6615	MASK	0342	START	0353		
DEC	6534	MASK	2541	[illegible]	[illegible]		
DECA	6726	MESAGE	2201	[illegible]	[illegible]		
DFSC	6622	MORDR	0211	[illegible]	[illegible]		
DFSD	[illegible]	MTR	0213	[illegible]	5602		
DISK	[illegible]	NORMAC	4520	[illegible]	[illegible]		
DISKP	[illegible]	NOTRT	2400	[illegible]	[illegible]		
[illegible]	[illegible]	NUM	6607	[illegible]	[illegible]		
[illegible]	[illegible]	OUTPUT	7600	[illegible]	[illegible]		

```
DISK DATA TEST          DIAG 5CE.
*************************************************************************************
RPM 1488 SYNC TIME= 0201 MICRO SECS
0424        ELAPSED TIME IN
0430        MINUTES FROM
0435          START
0441
0446
0455
0465
0473
0515                          TYPEOUTS 0424 THRU 2121
0526                            ONLY OCCUR IF PROGRAM TRACE
0531                           IS REQUESTED BY SETTING
0601                             SW 11.
0612
0624
0634
0642
0655
0664
1001
1021
1040
1051
1064
1100
1112
1122  — APPROX 1 MINUTE TO HERE
1201     2 MINS
1255     3 "
1320 ┐
1401 │
1431 ├ 6 "
1601 ┘
2001     11 "
2034     12 "
2046     12.5 "
2053     13
2060     14
2065     14.5
2072     15
2077     16
2104     16.5
2111     17.5
2116 ┐
2121 ┘ 18
PC00  ——  END OF PASS Ø    36 MINUTES.
0424
0430
0435
0441
0446
0455
0465
0473
0515
0526
0531
0601
0612
0624
0634
0642
0655
0664
1001
1021
1
```