IDENTIFICATION

PRODUCT NAME: ADBE,AMBE A-D CONVERTER AND MULTIPLEXER DIAGNOSTIC

PRODUCT CODE: MAINDEC-BE-D6BB-D-(D)

DATE CREATED: JULY 14, 1971

MAINTAINER: DIAGNOSTIC GROUP

AUTHOR: MATT TAFFEL

READ THIS DOCUMENT PRIOR TO RUNNING PROGRAM!

1. ABSTRACT

This program performs basic tests on the Input/Output control logic and multiplexer. The analog tests are designed to provide a means of calibrating the converter and checking conversion parameters.

2. REQUIREMENTS

2.1 Equipment

PDP-8/E with 4K core, ASR33 teletype, AD8E A-D Converter, (AM8E Multiplexer optional), Adjustable High Quality Voltage Source (0.01% or better, Z out <1.0ohm).

NOTE: To run MONOTINICITY TEST, a wave form generator, sine or ramp, must be used.

2.2 Storage

Maindec resides in locations 0000-4177.

2.3 Preliminary Programs

All basic CPU and teletype Maindecs must have been run successfully.

NOTE: If external enable utilizing the DK8-E REAL TIME CLOCK is to be run, the Maindec for the DK8-E must be successfully run first. In addition, VC8-E Control Tests must be run prior to special LAB-E SYSTEM CHECK routine.

3. LOADING PROCEDURE

The binary loader is used to load the program.

4. USAGE PROCEDURE

SEE SPECIFICATIONS FOR MAXIMUM VOLTAGE INPUTS!!

INSURE THAT TELETYPE IS ON-LINE.

A. CONTROL SWITCHES

SW0 = Suppress error messages and "END LOGIC TEST" message
SW1 = Halt on error with PC displayed in AC.
SW2 = Scope loop override to exit from loop on error and permit continuance of test. Also halts with converted word in AC for EXTERNAL ENABLE when there is no error.
SW3 = Enables halt during calibration routine. Converted word is displayed in AC.
SW4 = Must be set to run EXTERNAL ENABLE test.
SW5 = Allows operator to explicity select any one of the logic routines.

B. Normal start for control logic tests.

1. LOAD 200.

2. Press CLEAR then CONTINUE. HALT will occur.

3. Select options from switches 0,1,2,5.

4. If SW5 is present (1), select test from SW6-11.

5. Press CONTINUE.

NOTE: With SW5 down and SW2 up, any error will be reported once, then program will continue to next test.

C. IOT Scope Loop

1. LOAD 201.

2. Place low order six bits of IOT 65xx in SW6-11.

3. Press CLEAR, then CONTINUE.

NOTE: IOT may be reselected while running.

D', Display Converted Value in AC'.

1', Apply voltage to A-D converter input or preamplifiers'.

2', LOAD 202,

3', If a HALT after conversion is desired, select SW3'.

4', Select MPX channel from SW8-11'.

5', Press CLEAR, then CONTINUE'.

6', When SW3 halt select is engaged, operator may change channels, if desired, then press CONTINUE to loop. SW3 may be deselected at this time'.

E', External Enable with Real Time Clock

1', Apply voltage to A-D Converter input or preamplifiers, if desired'.

2', LOAD 203,

3', Set SW4',

4', Select switches 0 or 2 as desired',

5', Select channel with SW 8-11',

6', Press CLEAR, then CONTINUE',

NOTE: Channel may be changed while running test'.

F', Monotinicity Test

NOTE: Ramp Speed of function generator must be slower than slow rate of converter. See ENGINEERING SPECIFICATIONS'.

1', LOAD 204

2', Select SW0 if desired'.

3', Press CLEAR, then CONTINUE',

4', Program will halt',

5', Select Stall time between tests iterations by setting SW0-11'. The larger the number in the switch register, the greater the stall time.

6', Press CONTINUE.

7', If error occurs, program will halt with word "N" in AC. Pressing CONTINUE will display "N+1" word in AC. Pressing CONTINUE again will restart test.

G', Resolution Accuracy Test

1', Apply a known voltage to A-D converter input.

2', LOAD 205.

3', Select SWS 0,1 if desired.

4', Select channel with SW8-11.

5', Press CLEAR, then CONTINUE.

6', If error occurs, program will typeout non-comparing words on TTY then continue with test.

7', If no error occurs, TTY bell will ring once then, program will recycle.

H', Successive Reads Test

1', Apply any voltage to A-D converter inputs or preamplifier.

2', LOAD 206.

3', Select SW0 if desired.

4', Select channel from SW8-11.

5', Press CLEAR, then CONTINUE.

6', If error occurs, program will halt with first read in AC. Press CONTINUE to get second read into AC.

7', To restart, press continue.

8', If no error occurs, TTY bell will ring once, then program will recycle.

J', Multiplexer noise test

1', LOAD 207.

2', Select channel in SW8-11 and apply voltage to that channel.

3', Select SW0 if desired',

4', Press CLEAR, then CONTINUE',

5', If error occurs, message will be typed on TTY, then routine will recycle,

K', LAB8-E SYSTEM TEST

1', LOAD 205

2', Press CLEAR, then CONTINUE',

3', Program will HALT',

4', Load CLOCK FREQUENCY into SW3-5,

5', Press CONTINUE, then follow TTY instructions,

6', Press CONTINUE',

5', PROGRAM DESCRIPTION

5',1 Control Logic Tests

TST0 - Checks that A-D DONE and TIMING ERROR flags are cleared by Initialize',

TST1 - Checks that A-D DONE flag can be set then cleared',

TST2 - Checks that TIMING ERROR flag can be set then cleared',

TST3 - Tests for unexpected interrupt request,

TST4 - Tests to see if ADRB jam transfers to AC',

TST5 - Tests to see if ADRS jam transfers to AC,

TST6 - Tests to see if enable register can be loaded and read back',

TST7 - Tests to see if A-D DONE will generate interrupt',

TST10- Tests to see if TIMING ERROR will generate interrupt',

TST11= Tests that MPX Register can be loaded and read back,

TST12= Tests that all channels can be loaded into MPX register and read back,

TST13= Tests auto-increment mode of MPX register,

TST14= Tests to see if conversion can be made in specified time,

5,2 Miscellaneous Tests

A, IOT Scope Loop Test = enables IOT to be repeated for troubleshooting,

B, External Enable Test = utilizes DK8/E Real Time Clock to start conversion, NOTE: This test can be used only if DK8/E is present in system,

C, Display Converted Value in AC = used to calibrate converter, (See setup procedure of AD8E)>,

D, LAB8-E SYSTEM CHECKS = assures reliability of system as homogeneous unit,

5,3 Analog Tests

A, Successive Reads Tests = checks for noise in A-D buffer logic,

B, Monotinicity Test = checks that all specified values can be converted,

C, Resolution Accuracy Test = samples a known voltage 64 times and checks that resolution is within specification,

D, Multiplexer Noise Test = checks for noise in MPX, ENABLE, and STATUS REGISTER,

6, ERROR REPORTS

6,1 Logic Errors

Message will be typed out once per error on teletypewriter stating test number and nature of failure.

6.2 Other Errors

Message will be typed out on teletypewriter stating nature of failure.

```
                /MAINDEC-8E-D6BB-L-(D)  A TO D CONVERTER AND MULTIPLEXER DIAGNOSTIC
                /AD8EA,AM8EA,AM8EB
                /COPYRIGHT 1971, DIGITAL EQUIPMENT CORPORATION, MAYNARD, MASS. 01754
                /AUTHOR: MATT TAFFEL
                /DATE: 14 JUL 71

                /IOT DEFINITIONS
4520    ADCL=   JMS I   XADCL           /CLEAR ALL
4521    ADLM=   JMS I   XADLM           /LOAD MPX REG FROM AC8-11, CLA
4522    ADST=   JMS I   XADST           /CLEAR FLAGS, START CONVERSION
4523    ADRB=   JMS I   XADRB           /CLEAR DONE, READ A-D BUFFER INTO AC,
4524    ADSK=   JMS I   XADSK           /SKIP ON A-D DONE, DO NOT CLEAR FLAG,
4525    ADSE=   JMS I   XADSE           /SKIP ON TMG ERROR, DO NOT CLEAR FLAG,
4526    ADLE=   JMS I   XADLE           /LOAD ENAB REG FROM AC 2-5, CLA,
4527    ADRS=   JMS I   XADRS           /READ STATUS, ENAB,  MPX REG INTO AC,
4530    CLOE=   JMS I   XCLOE           /AC TO CLOCK ENABLE
4531    CLSK=   JMS I   XCLSK           /SKIP ON CLOCK OVERFLOW
4532    CLZE=   JMS I   XCLZE           /ONES IN AC CLEAR CLOCK ENABLE REGISTER
4533    CLSA=   JMS I   XCLSA           /CLOCK STATUS TO AC, AC ONES CLEAR CLOCK STATUS REGISTER
4534    CLED=   JMS I   XCLED           /CLOCK ENABLE TO AC
4535    CLAB=   JMS I   XCLAB           /AC ONES TO CLOCK BUFFER
4536    DISD=   JMS I   XDISD           /SKIP ON DISPLAY DONE
4537    DILX=   JMS I   XDILX           /LOAD X
4540    DILY=   JMS I   XDILY           /LOAD Y
4541    DIXY=   JMS I   XDIXY           /INTENSIFY
4542    DILE=   JMS I   XDILE           /LOAD DISPLAY ENABLE FROM AC

6007    CAF=    6007
7002    BSW=    7002

                /MPX, ENABLE, STATUS REGISTER

                / 0  AD DONE
                / 1  TIMING ERROR
                / 2  ENABLE INTERRUPT ON AD DONE
                / 3  ENABLE INTERRUPT ON TIMING ERROR
                / 4  ENABLE EXTERNAL AD START
                / 5  AUTO-INCREMENT MODE
                / 6,7  NOT USED
                / 8-11  MPX CHANNEL 0-17 OCTAL


                /STARTING ADDRESS       TEST
                /
                /200                    NORMAL START FOR CONTROL LOGIC TESTS
                /201                    IOT SCOPE LOOP
                /202                    DISPLAY CONVERTED VALUE IN AC
                /203                    EXTERNAL ENABLE TEST
                /204                    MONOTINICITY TEST
                /205                    RESOLUTION ACCURACY TEST
                /206                    SUCCESSIVE READS TEST
                /207                    MULTIPLEXER NOISE TEST
                /210                    SYSTEM CHECK FOR LAB8-E
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                0000    *0
0000  0000              0
0001  5402              JMP I   .+1
0002  0000              0
0003  5404              JMP I   .+1
0004  0000              0
0005  0000              0


                0017    *17
0017  0145    MSGPNT,   ERMSG

                0020    *20
0020  4000    SW0,      4000            /SWITCH REG 0 INHIBIT TYPEOUT
0021  2000    SW1,      2000            /             1 HALT ON ERROR
0022  1000    SW2,      1000            /             2 SCOPE LOOP OVERRIDE
0023  0400    SW3,      0400            /             3 CALIBRATION TEST HALT
0024  0200    SW4,      0200            /             4 EXTERNAL ENABLE
0025  0100    SW5,      0100            /             5 SELECT TEST
0026  0000    TEMP0,    0               /STORAGE BUFFER 0
0027  0000    TEMPA,    0               /STORAGE BUFFER A
0030  0000    TEMPB,    0               /               B
0031  0000    TEMPC,    0               /               C
0032  0000    CNTR1,    0               /MONOTONICITY COUNTER
0033  0000    TALLY,    0
0034  1226    ERR,      ERTYP           /ERROR REPORT ROUTINE
0035  1000    XCONVT,   CONVT           /DISPLAY CONVERTED VALUE
0036  1400    XINSTR,   INSTR           /IOT SCOPE LOOP
0037  2000    XMONCT,   MONOT           /MONOTONICITY TEST
0040  0207    K207,     207             /BELL CODE
0041  0212    K212,     212             /LINE FEED
0042  0215    K215,     215             /CARRIAGE RETURN
0043  6500    K6500,    6500
0044  7777    M1,       7777
0045  7776    M2,       7776
0046  7774    M4,       7774
0047  1000    K1000,    1000
0050  0077    K77,      0077
0051  1200    XMOVE,    MOVE
0052  1024    EXTBL,    EXTL
0053  2267    XSTOR,    STORAG-1
0054  2400    XCOMPR,   COMPAR
0055  2200    XRESOL,   RESOL
0056  2051    XNOISE,   NOISE
0057  2103    XGLIT,    GLITCH
0060  2622    XSYST,    SYST
0061  7777    ERSWIT,   7777
0062  0000    CHAN,     0
0063  1600    TAL,      XTAL
0064  1647    SELECT,   XSELEC
0065  1552    SETUP,    XSETUP
                0077    *77
0077  0000    CHNL,     0
0100  0001              1
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```
0101  0002            2
0102  0003            3
0103  0004            4
0104  0005            5
0105  0006            6
0106  0007            7
0107  0010            10
0110  0011            11
0111  0012            12
0112  0013            13
0113  0014            14
0114  0015            15
0115  0016            16
0116  0017            17
0117  0000            0


      0120    *120

              /IOT LINKS

0120  1410    XADCL,  XXADCL
0121  1414    XADLM,  XXADLM
0122  1420    XADST,  XXADST
0123  1424    XADRB,  XXADRB
0124  1430    XADSK,  XXADSK
0125  1436    XADSE,  XXADSE
0126  1444    XADLE,  XXADLE
0127  1450    XADRS,  XXADRS
0130  1454    XCLOE,  XXCLOE
0131  1460    XCLSK,  XXCLSK
0132  1466    XCLZE,  XXCLZE
0133  1472    XCLSA,  XXCLSA
0134  1476    XCLED,  XXCLED
0135  1502    XCLAB,  XXCLAB
0136  1506    XDISD,  XXDISD
0137  1514    XDILX,  XXDILX
0140  1520    XDILY,  XXDILY
0141  1524    XDIXY,  XXDIXY
0142  1530    XDILE,  XXDILE

      0145    *145

              /ERROR MESSAGE LINKS

0145  3200    ERMSG,  EMSG0
0146  3244            EMSG1
0147  3322            EMSG2
0150  3344            EMSG3
0151  3372            EMSG4
0152  3422            EMSG5
0153  3452            EMSG6
0154  3503            EMSG7
0155  3540            EMSG10
0156  3601            EMSG11
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0157  3637          EMSG12
0160  3677          EMSG13
0161  3744          EMSG14
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                0200    *200
0200    5211            JMP     START           /NORMAL START
0201    5436            JMP I   XINSTR          /IOT SCOPE LOOP OPTION
0202    5435            JMP I   XCONVT          /DISPLAY CONVERTED VALUE OPTION
0203    5452            JMP I   EXTBL           /EXTERNAL ENABLE TEST
0204    5437            JMP I   XMONOT          /MONOTINICITY TEST
0205    5455            JMP I   XRESOL          /RESOLUTION ACCURACY TEST
0206    5456            JMP I   XNOISE          /SUCCESSIVE READS TEST
0207    5457            JMP I   XGLIT           /MPX NOISE TEST
0210    5460            JMP I   XSYST           /LAB8-E SYSTEM CHECK
0211    7402    START,  HLT
0212    7604            LAS
0213    0025            AND     SW5             /SELECT SPECIFIC TEST?
0214    7440            SZA                     /SKIP IF NO
0215    4464            JMS I   SELECT          /YES

                /HOUSEKEEPING
0216    7300    INITL,  CLA CLL
0217    4777'           JMS     MESAGE
0220    4161            XLABEL
0221    1376            TAD     (144
0222    3017            DCA     MSGPNT          /INITIALIZE ERROR POINTER
0223    4465            JMS I   SETUP
0224    6007    TST0,   CAF
0225    4524            ADSK                    /CHECK FOR DONE FLAG - SHOULD BE CLEARED BY INIT
0226    5231            JMP     .+3
0227    4434            JMS I   ERR             /DONE FLAG NOT CLEARED
0230    0224            TST0
0231    4525            ADSE                    /CHECK FOR TIMING ERROR FLAG - SHOULD BE CLEARED BY INIT
0232    5237            JMP     .+5
0233    4434            JMS I   ERR             /TIMING ERROR FLAG NOT CLEARED
0234    0224            TST0
0235    5240            JMP     TST1-1
0236    5224            JMP     TST0
0237    4463            JMS I   TAL

                /CHECK TO SET DONE FLAG AND CLEAR DONE FLAG
0240    4465            JMS I   SETUP
0241    7200    TST1,   CLA
0242    4522            ADST                    /CONVERT, RESULTS NOT NEEDED
0243    1177            TAD     C-100
0244    3026            DCA     TEMP0
0245    2026            ISZ     TEMP0
0246    5245            JMP     .-1
0247    4524            ADSK
0250    7410            SKP
0251    5255            JMP     .+4
0252    4434            JMS I   ERR             /FLAG NOT SET
0253    0241            TST1
0254    5265            JMP     TST2-1
0255    4520            ADCL                    /CLEAR FLAG
0256    4524            ADSK                    /CHECK FOR FLAG
0257    5264            JMP     .+5             /FLAG CLEARED
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0260  4434            JMS I   ERR             /FLAG NOT CLEARED
0261  0241            TST1
0262  5265            JMP     TST2-1
0263  5241            JMP     TST1
0264  4463            JMS I   TAL

                  /CHECK TO SET TIMING ERROR FLAG AND CLEAR TIMING ERROR FLAG
0265  4465            JMS I   SETUP
0266  7200  TST2,     CLA
0267  4522            ADST                    /TWO A-D STARTS TO PRODUCE TIMING ERROR
0270  4522            ADST
0271  4525            ADSE                    /CHECK FOR TIMING ERROR FLAG
0272  7410            SKP
0273  5276            JMP     .+3
0274  4434            JMS I   ERR             /FLAG NOT SET
0275  0266            TST2
0276  4520            ADCL                    /CLEAR FLAG
0277  4525            ADSE                    /CHECK FLAG
0300  5305            JMP     .+5
0301  4434            JMS I   ERR             /FLAG NOT CLEARED
0302  0266            TST2
0303  5306            JMP     TST3-1
0304  5266            JMP     TST2
0305  4463            JMS I   TAL

                  /TEST FOR UNEXPECTED INTERRUPT REQUEST
0306  4465            JMS I   SETUP
0307  7200  TST3,     CLA
0310  1176            TAD     [TST3S
0311  3004            DCA     4
0312  1317            TAD     .+5             /ERROR TRAP
0313  3001            DCA     1
0314  6001            ION                     /TURN INT ON
0315  7000            NOP
0316  5322            JMP     .+4
0317  4434            JMS I   ERR             /UNEXPECTED INTERRUPT OCCURRED
0320  0307            TST3
0321  5326            JMP     TST4-1
0322  6002  TST3S,    IOF                     /TURN INT OFF
0323  7410            SKP
0324  5307            JMP     TST3
0325  4463            JMS I   TAL

                  /TEST THAT ADRB JAM TRANSFERS TO AC

0326  4465            JMS I   SETUP
0327  7240  TST4,     CLA CMA                 /AC=7777
0330  4523            ADRB                    /SHOULD CLEAR AC
0331  3027            DCA     TEMPA           /SAVE AC
0332  7040            CMA
0333  4523            ADRB                    /READ WITH AC=0
0334  7041            CIA
0335  1027            TAD     TEMPA
0336  7440            SZA                     /EQUAL?
0337  7410            SKP
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0340  5345            JMP     .+5
0341  4434            JMS I   ERR             /NO-ERROR
0342  0327            TST4
0343  5346            JMP     TST5-1
0344  5327            JMP     TST4
0345  4463            JMS I   TAL

                  /TEST THAT ADRS JAM TRANSFERS TO AC

0346  4465            JMS I   SETUP
0347  4520    TST5,   ADCL
0350  4521            ADLM
0351  4522            ADST
0352  4524            ADSK
0353  5352            JMP     .-1
0354  7340            CLA CMA CLL             /AC=7777
0355  4527            ADRS
0356  3027            DCA     TEMPA           /SAVE AC, SHOULD BE 4000
0357  1027            TAD     TEMPA
0360  7004            RAL
0361  7440            SZA                     /DID ADRS CLEAR AC?
0362  7410            SKP
0363  5370            JMP     .+5
0364  4434            JMS I   ERR             /NO
0365  0347            TST5
0366  5775'           JMP     TST6-1
0367  5347            JMP     TST5
0370  4463            JMS I   TAL
0371  5775'           JMP     TST6-1

0375  0400
0376  0144
0377  1274
      0400    PAGE

                  /CHECKS THAT ENABLE REGISTER CAN BE LOADED AND READ BACK

0400  4465            JMS I   SETUP
0401  7300    TST6,   CLA CLL
0402  1175            TAD     C17             /GET BITS AND
0403  7002            BSW                     /PLACE IN AC 2-5
0404  4526            ADLE                    /LOAD
0405  7440            SZA
0406  7410            SKP
0407  5212            JMP     .+3
0410  4434            JMS I   ERR             /AC NOT CLEARED BY ADLE
0411  0401            TST6
0412  7040            CMA
0413  4527            ADRS                    /READ BACK
0414  7002            BSW
0415  1174            TAD     C7761           /CHECK FOR ONLY AC 2-5 SET
0416  7440            SZA
0417  7410            SKP
0420  5225            JMP     .+5
0421  4434            JMS I   ERR             /WRONG BITS
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0422  0401            TST6
0423  5226            JMP     TST7-1
0424  5201            JMP     TST6
0425  4463            JMS I   TAL             /DONE?

                  /GENERATE INTERRUPT WITH A-D DONE FLAG
0426  4465            JMS I   SETUP
0427  7200  TST7,     CLA
0430  4522            ADST                    /CONVERT
0431  4524            ADSK                    /DONE?
0432  5231            JMP     .-1             /WAIT
0433  1173            TAD     [DON1
0434  3002            DCA     2               /RETURN POINTER
0435  1047            TAD     K1000
0436  4526            ADLE                    /LOAD INTERRUPT ENABLE
0437  6001            ION
0440  7000            NOP
0441  6002            IOF
0442  4434            JMS I   ERR             /DID NOT INTERRUPT
0443  0427            TST7
0444  5251            JMP     TST10-1
0445  4520  DON1,     ADCL                    /CLEAR WORLD
0446  7410            SKP
0447  5227            JMP     TST7
0450  4463            JMS I   TAL

                  /GENERATE INTERRUPT WITH TIMING ERROR FLAG
0451  4465            JMS I   SETUP
0452  7200  TST10,    CLA
0453  1172            TAD     [TMG1
0454  3002            DCA     2
0455  4522            ADST                    /CAUSE ERROR HERE
0456  4522            ADST
0457  4524            ADSK                    /DONE?
0460  5257            JMP     .-1
0461  4525            ADSE                    /TIMING ERROR?
0462  5261            JMP     .-1
0463  7300            CLA CLL
0464  1047            TAD     K1000
0465  7010            RAR
0466  4526            ADLE                    /LOAD INTERRUPT ENABLE
0467  6001            ION                     /INT ON
0470  7000            NOP
0471  6002            IOF                     /INT OFF
0472  4434            JMS I   ERR             /DID NOT INTERRUPT
0473  0452            TST10
0474  5301            JMP     TST11-1
0475  4520  TMG1,     ADCL                    /CLEAR WORLD
0476  7410            SKP
0477  5252            JMP     TST10
0500  4463            JMS I   TAL


                  /LOAD AND READ MPX REG
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```
0501  4465            JMS I   SETUP
0502  7240  TST11,     CLA CMA
0503  4521            ADLM
0504  7450            SNA                     /CHECK IF AC CLEARED
0505  5311            JMP     .+4
0506  4434            JMS I   ERR             /AC WAS NOT CLEARED BY ADLM
0507  0502            TST11
0510  7200            CLA
0511  4521            ADLM                    /LOAD MPX REG WITH 00
0512  4527            ADRS                    /READ MPX REG
0513  0175            AND     C17             /MASK FOR MPX REG
0514  7440            SZA
0515  7410            SKP
0516  5321            JMP     .+3
0517  4434            JMS I   ERR             /MPX REG NOT 0
0520  0502            TST11
0521  7040            CMA
0522  0175            AND     C17
0523  4521            ADLM                    /MPX REG SET TO 17
0524  4527            ADRS                    /READ MPX REG
0525  0175            AND     C17
0526  1171            TAD     C7760           /MASK
0527  7040            CMA
0530  7440            SZA
0531  7410            SKP
0532  5337            JMP     .+5
0533  4434            JMS I   ERR             /MPX REG NOT 17
0534  0502            TST11
0535  5777'           JMP     TST12-1
0536  5302            JMP     TST11
0537  4463            JMS I   TAL
0540  5777'           JMP     TST12-1

0577  0600
      0600      PAGE

                /LOAD MPX REG WITH EACH CHANNEL
0600  4465            JMS I   SETUP
0601  7300  TST12,     CLA CLL
0602  3026            DCA     TEMP0
0603  1026            TAD     TEMP0           /CHANNEL INTO AC
0604  7040            CMA
0605  3027            DCA     TEMPA           /COMPLEMENTED CHANNEL
0606  1026            TAD     TEMP0
0607  4521            ADLM                    /LOAD IT
0610  4527            ADRS                    /READ MPX REG
0611  0175            AND     C17             /MASK 8-11
0612  3030            DCA     TEMPB           /STORE IT
0613  1027            TAD     TEMPA           /CHECK IT
0614  1030            TAD     TEMPB
0615  7001            IAC
0616  7440            SZA
0617  7410            SKP
0620  5224            JMP     .+4
0621  4434            JMS I   ERR             /WRONG CHANNEL
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0622  0601            TST12
0623  5236            JMP     TST13-1
0624  1171            TAD     C7760
0625  1026            TAD     TEMP0
0626  7001            IAC
0627  7440            SZA                     /DONE WITH ALL CHANNELS?
0630  7410            SKP                     /NO
0631  5235            JMP     .+4             /YES
0632  7300            CLA CLL
0633  2026            ISZ     TEMP0           /SET NEXT CHANNEL
0634  5203            JMP     TST12+2
0635  4463            JMS I   TAL             /DONE WITH TEST?


                /AUTO-INCREMENT MODE TEST
0636  4465            JMS I   SETUP
0637  7300    TST13,  CLA CLL
0640  1170            TAD     C76
0641  3010            DCA     10
0642  4520            ADCL
0643  7200    AUTO1,  CLA
0644  1410            TAD I   10              /CHANNEL N
0645  3027            DCA     TEMPA
0646  1027            TAD     TEMPA
0647  7040            CMA
0650  3030            DCA     TEMPB
0651  1025            TAD     SW5             /AUTO-INCREMENT BIT
0652  4526            ADLE                    /LOAD ENABLE REG
0653  1027            TAD     TEMPA           /CHANNEL N
0654  4521            ADLM                    /LOAD MPX REG
0655  4522            ADST                    /START CONVERSION
0656  4524            ADSK                    /WAIT FOR
0657  5256            JMP     .-1             /DONE FLAG
0660  4527            ADRS                    /READ STATUS
0661  0175            AND     C17             /MASK OUT ALL BUT MPX REG
0662  3031            DCA     TEMPC
0663  1027            TAD     TEMPA           /CHECK IF CHANNEL 17 INCREMENTED TO 0
0664  1174            TAD     C7761
0665  7640            SZA CLA                 /IF CHANNEL 17 SKIP
0666  5272            JMP     .+4
0667  1410            TAD I   10
0670  1031            TAD     TEMPC
0671  5274            JMP     AUTO2           /AC SHOULD = 0
0672  1031            TAD     TEMPC
0673  1030            TAD     TEMPB           /CHECK FOR CHANNEL N+1
0674  7440    AUTO2,  SZA
0675  7410            SKP
0676  5302            JMP     .+4
0677  4434            JMS I   ERR             /WRONG CHANNEL
0700  0637            TST13
0701  5310            JMP     TST14-1
0702  1031            TAD     TEMPC
0703  7440            SZA                     /LAST CHANNEL?
0704  5243            JMP     AUTO1           /NO
0705  7410            SKP
```

```
0706  5237            JMP     TST13
0707  4463            JMS I   TAL

                /ROUTINE TO CHECK THAT CONVERSION CAN BE MADE IN 20 MICROSECS
0710  4465            JMS I   SETUP
0711  7300    TST14,  CLA CLL
0712  1377            TAD     (-6
0713  3026            DCA     TEMP0
0714  4520            ADCL
0715  4522            ADST
0716  2026            ISZ     TEMP0
0717  5316            JMP     .-1
0720  4524            ADSK
0721  7410            SKP
0722  5327            JMP     .+5
0723  4434            JMS I   ERR             /TIME OUT ERROR
0724  0711            TST14
0725  5330            JMP     FINIS
0726  5311            JMP     TST14
0727  4463            JMS I   TAL
0730  7604    FINIS,  LAS
0731  0020            AND     SW0             /SWITCH SET TO DELETE
0732  7640            SZA CLA                 /TYPEOUT OF END LOGIC TEST
0733  5337            JMP     .+4
0734  4776'           JMS     MESAGE
0735  4146            XEND
0736  7200            CLA
0737  1040            TAD     K207
0740  4775'           JMS     PRLP
0741  5774'           JMP     TST0-3          /RETURN TO BEGINNING OF LOGIC TESTS,


0774  0221
0775  1534
0776  1274
0777  7772
      1000    PAGE

                /ROUTINE TO DISPLAY CONVERTED VALUE IN AC,
1000  4520    CONVT,  ADCL                    /CLEAR WORLD
1001  3026            DCA     TEMP3
1002  7604            LAS                     /LOAD CHANNEL
1003  4521            ADLM                    /LOAD MPX REG
1004  4522            ADST                    /CONVERT
1005  4524            ADSK                    /DONE?
1006  5205            JMP     .-1             /WAIT
1007  4523            ADRB                    /READ A-D BUFFER
1010  2026            ISZ     TEMP3           /STALL TO DISPLAY
1011  5210            JMP     .-1             /CONVERTED VALUE
1012  2026            ISZ     TEMP3           /IN AC FOR
1013  5212            JMP     .-1             /33 MILLISECONDS
1014  3031            DCA     TEMP3
1015  7624            LAS                     /CHECK IF HALT DESIRED
1016  0023            AND     SW3
```

```
1017  7650          SNA CLA
1020  5223          JMP     .+3
1021  1031          TAD     TEMPC
1022  7402          HLT                     /PRESS CONTINUE IF NOT DONE ADJUSTING
1023  5200          JMP     CONVT           /LOOP


                    /ROUTINE TO CHECK FOR EXTERNAL ENABLE FROM REAL TIME CLOCK

1024  4465  EXTL,   JMS I   SETUP
1025  4520          ADCL                    /CLEAR ALL
1026  7604          LAS
1027  0024          AND     SW4             /CHECK FOR EXT'L ENABLE SWITCH
1030  7450          SNA
1031  7402          HLT                     /SWITCH NOT SET, STOP!
1032  7604  EXT1,   LAS
1033  0024          AND     SW4
1034  4526          ADLE
1035  7604          LAS
1036  0175          AND     C17
1037  4521          ADLM                    /LOAD CHANNEL FROM SW8-11
1040  1377          TAD     (4340           /LOAD CLOCK ENABLE REG
1041  4530          CLOE                    /TRIGGER FROM RTC
1042  7040          CMA
1043  4532          CLZE
1044  4531          CLSK                    /OCCURS ON OVERFLOW
1045  5244          JMP     .-1
1046  4533          CLSA                    /STOP CLOCK
1047  7240          CLA CMA
1050  4532          CLZE
1051  7200          CLA
1052  2026          ISZ     TEMP0           /TIME OUT
1053  5252          JMP     .-1
1054  4524          ADSK
1055  4776'         JMS     ERPT3           /CONVERSION NOT MADE
1056  4523          ADRB
1057  3027          DCA     TEMPA           /STORE CONVERSION
1060  7604          LAS
1061  0022          AND     SW2             /LOOP?
1062  7650          SNA CLA
1063  5266          JMP     EXTTE           /YES
1064  1027          TAD     TEMPA           /HALT WITH CONVERTED
1065  7402          HLT                     /VALUE IN AC.
1066  4465  EXTTE,  JMS I   SETUP
1067  4520          ADCL
1070  7604          LAS
1071  0024          AND     SW4
1072  4526          ADLE
1073  7240          CLA CMA
1074  4535          CLAR                    /CLOCK BUFFER = 7777
1075  7200          CLA
1076  1375          TAD     (164'           /TO GIVE TIMING ERROR ON NEXT CLOCK
1077  4530          CLOE
1100  7000          NOP
```

```
1101  4525            ADSE                    /TIMING ERROR SEEN HERE
1102  4776'           JMS     ERPT3           /DID NOT RAISE FLAG
1103  7240            CLA CMA
1104  4532            CLSE
1105  7200            CLA
1106  4520            ADCL
1107  1024            TAD     SW4
1110  4526            ADLE
1111  7240            CLA CMA
1112  4535            CLAB
1113  7200            CLA
1114  4535            CLAB
1115  1374            TAD     (-6
1116  3031            DCA     TEMPC
1117  2031            ISZ     TEMPC
1120  5317            JMP     .-1
1121  4524            ADSK
1122  5325            JMP     .+3
1123  4776'           JMS     ERPT3
1124  4520            ADCL
1125  7200            CLA
1126  1040            TAD     K207
1127  4773'           JMS     PRLP
1130  5232            JMP     EXT1



1173  1534
1174  7772
1175  1640
1176  1732
1177  4340
      1200    PAGE

              /SUBROUTINE TO MOVE VARIABLE LENGTH DATA FIELDS

1200  0000    MOVE,   0
1201  7300            CLA CLL
1202  1600            TAD I   MOVE            /GET "FROM ADDR" AND
1203  3223            DCA     FADDR           /STORE
1204  2200            ISZ     MOVE
1205  1600            TAD I   MOVE            /GET "TO ADDR" AND
1206  3224            DCA     TADDR           /STORE
1207  2200            ISZ     MOVE
1210  1600            TAD I   MOVE            /GET "MOVE COUNT" AND
1211  3225            DCA     MCTR            /STORE
1212  2200            ISZ     MOVE            /SETUP FOR EXIT
1213  7200    MOVEA,  CLA
1214  1623            TAD I   FADDR           /GET "FROM" WORD
1215  3624            DCA I   TADDR           /STORE AT "TO" LOCATION
1216  2223            ISZ     FADDR           /+1 TO "FROM" ADDR
1217  2224            ISZ     TADDR           /+1 TO "TO" ADDR
1220  2225            ISZ     MCTR            /ALL WORDS MOVED?
1221  5213            JMP     MOVEA           /NO, RETURN
1222  5600            JMP I   MOVE            /YES, EXIT
```

```
1223  0000    FADDR,  0
1224  0000    TADDR,  0
1225  0000    MCTR,   0


                /ERROR TYPEOUT ROUTINE

1226  0000    ERTYP,  0
1227  7200            CLA
1230  1346            TAD     IND
1231  7640            SZA CLA
1232  5243            JMP     EOUT+1          /TYPE ERROR MESSAGE ONE TIME ONLY
1233  7604            LAS
1234  0020            AND     SW0             /SUPPRESS TYPEOUT?
1235  7710            SPA CLA
1236  5247            JMP     EOUT+5          /YES
1237  1417            TAD I   MSGPNT          /GET POINTER FOR ERROR MESSAGE
1240  3242            DCA     EOUT
1241  4274            JMS     MESAGE
1242  7402    EOUT,   HLT
1243  7200            CLA
1244  1346            TAD     IND
1245  7640            SZA CLA
1246  5250            JMP     .+2
1247  2346            ISZ     IND
1250  7604            LAS
1251  0021            AND     SW1             /HALT ON ERROR SWITCH ON?
1252  7650            SNA CLA                 /SKIP IF ON
1253  5257            JMP     SCOPE
1254  1226            TAD     ERTYP
1255  1044            TAD     M1
1256  7402            HLT                     /HALT WITH ERROR P.C. IN AC.
1257  7604    SCOPE,  LAS
1260  0022            AND     SW2             /OVERRIDE LOOP?
1261  7640            SZA CLA
1262  5272            JMP     .+10
1263  1626            TAD I   ERTYP           /NO
1264  3271            DCA     EXIT
1265  1017            TAD     MSGPNT
1266  1044            TAD     M1
1267  3017            DCA     MSGPNT
1270  5671            JMP I   EXIT
1271  7422    EXIT,   HLT
1272  2226            ISZ     ERTYP           /YES
1273  5626            JMP I   ERTYP

                /MESSAGE ROUTINE FOR LOGIC ERRORS

1274  0000    MESAGE, 0
1275  7240            CLA CMA
1276  1674            TAD I   MESAGE
1277  3012            DCA     12
1300  2274            ISZ     MESAGE
```

```
1301  1410            TAD I   10
1302  3313            DCA     MSRGHT
1303  1313            TAD     MSRGHT
1304  7212            RTR
1305  7012            RTR
1306  7012            RTR
1307  4614            JMS     TYPECH
1310  1313            TAD     MSRGHT
1311  4614            JMS     TYPECH
1312  5601            JMP     MESAGE+5
1313  0000    MSRGHT, 0
1314  0000    TYPECH, 0
1315  0050            AND     K77
1316  7450            SNA
1317  5674            JMP I   MESAGE
1320  1377            TAD     (-40
1321  7510            SPA
1322  5325            JMP     .+3
1323  1376            TAD     (240
1324  5340            JMP     MTP
1325  7001            IAC
1326  7440            SZA
1327  5332            JMP     .+3
1330  1042            TAD     K215
1331  5340            JMP     MTP
1332  7001            IAC
1333  7440            SZA
1334  5337            JMP     .+3
1335  1041            TAD     K212
1336  5340            JMP     MTP
1337  1375            TAD     (336
1340  6046    MTP,    TLS
1341  6041            TSF
1342  5341            JMP     .-1
1343  6042            TCF
1344  7200            CLA
1345  5714            JMP I   TYPECH
1346  0000    IND,    0


1375  0336
1376  0240
1377  7740
      1400    PAGE
              /SCOPE LOOP FOR IOTS 65XX.
1400  7000    INSTR,  NOP
1401  7604            LAS                     /SELECT IOT FROM SR 6-11
1402  0050            AND     K77             /MASK OUT AC 0-5
1403  1043            TAD     K6500           /CREATE IOT
1404  3405            DCA     .+1
1405  7402            HLT                     /LOCATION OF IOT
1406  7000            NOP                     /POSSIBLE SKIP
1407  5201            JMP     INSTR+1         /LOOP
```

```
                    /IOT SUBROUTINES

1410  0000  XXADCL, 0
1411  6530         6530                    /CLEAR ALL
1412  5610         JMP I   XXADCL
1413  7402         HLT

1414  0000  XXADLM, 0
1415  6531         6531                    /LOAD MPX REG
1416  5614         JMP I   XXADLM
1417  7402         HLT

1420  0000  XXADST, 0
1421  6532         6532                    /START CONVERSION
1422  5620         JMP I   XXADST
1423  7402         HLT

1424  0000  XXADRB, 0
1425  6533         6533                    /READ A-D BUFFER
1426  5624         JMP I   XXADRB
1427  7402         HLT

1430  0000  XXADSK, 0
1431  6534         6534                    /SKIP ON A-D DONE
1432  7410         SKP
1433  2230         ISZ     XXADSK
1434  5630         JMP I   XXADSK
1435  7402         HLT

1436  0000  XXADSE, 0
1437  6535         6535                    /SKIP ON TIMING ERROR
1440  7410         SKP
1441  2236         ISZ     XXADSE
1442  5636         JMP I   XXADSE
1443  7402         HLT

1444  0000  XXADLE, 0
1445  6536         6536                    /LOAD ENABLE REGISTER
1446  5644         JMP I   XXADLE
1447  7402         HLT

1450  0000  XXADRS, 0
1451  6537         6537                    /READ STATUS REGISTER
1452  5650         JMP I   XXADRS
1453  7402         HLT

1454  0000  XXCLOE, 0
1455  6132         6132                    /LOAD CLOCK ENABLE
1456  5654         JMP I   XXCLOE
1457  7402         HLT

1460  0000  XXCLSK, 0
1461  6131         6131                    /SKIP ON CLOCK OVERFL
1462  7410         SKP
1463  2260         ISZ     XXCLSK
```

```
1464  5660          JMP I   XXCLSK
1465  7402          HLT

1466  0000  XXCLZE, 0
1467  6130          6130                    /ONES IN AC CLEAR CLOCK ENABLE REG
1470  5666          JMP I   XXCLZE
1471  7402          HLT

1472  0000  XXCLSA, 0
1473  6135          6135                    /CLOCK STATUS TO AC, AC ONES CLR CLK STATUS REG
1474  5672          JMP I   XXCLSA
1475  7402          HLT

1476  0000  XXCLED, 0
1477  6134          6134                    /CLOCK ENABLE TO AC
1500  5676          JMP I   XXCLED
1501  7402          HLT

1502  0000  XXCLAB, 0
1503  6133          6133                    /AC ONES TO CLOCK BUFFER
1504  5702          JMP I   XXCLAB
1505  7402          HLT


1506  0000  XXDISD, 0
1507  6052          6052                    /SKIP ON DISPLAY DONE
1510  7410          SKP
1511  2306          ISZ     XXDISD
1512  5706          JMP I   XXDISD
1513  7402          HLT

1514  0000  XXDILX, 0
1515  6053          6053                    /LOAD X
1516  5714          JMP I   XXDILX
1517  7402          HLT

1520  0000  XXDILY, 0
1521  6054          6054                    /LOAD Y
1522  5720          JMP I   XXDILY
1523  7402          HLT

1524  0000  XXDIXY, 0
1525  6055          6055                    /INTENSIFY
1526  5724          JMP I   XXDIXY
1527  7402          HLT

1530  0000  XXDILE, 0
1531  6056          6056                    /LOAD ENABLE FROM AC, CLEAR AC
1532  5732          JMP I   XXDILE
1533  7402          HLT



                /PRINT ROUTINE
1534  0000  PRLP,   0
```

```
1535  6046          TLS                     /XMIT CHARACTER
1536  6041          TSF                     /WAIT FOR FLAG
1537  5336          JMP     .-1
1540  7200          CLA
1541  5734          JMP I   PRLP            /RETURN

                    /CARRIAGE RETURN LINE FEED ROUTINE
1542  0000  CRLF,   0
1543  7240          CLA CMA
1544  0042          AND     K215            /CARRIAGE RETURN CODE
1545  4334          JMS     PRLP            /PRINT ROUTINE
1546  7240          CLA CMA
1547  0041          AND     K212            /LINE FEED CODE
1550  4334          JMS     PRLP            /PRINT ROUTINE
1551  5742          JMP I   CRLF            /RETURN


                    /ROUTINE TO CLEAR WORKING BUFFERS PRIOR TO TEST

1552  0000  XSETUP, 0
1553  4451          JMS I   XMOVE           /CLEAR WORK AREA
1554  0026          TEMP0
1555  0027          TEMPA
1556  7773          -5
1557  6002          IOF
1560  6007          CAF
1561  1167          TAD     [5402
1562  3001          DCA     1
1563  7040          CMA
1564  3061          DCA     ERSWIT
1565  3767          DCA I   XIND
1566  5752          JMP I   XSETUP
1567  1346  XIND,   IND

      1600  PAGE

                    /ROUTINE TO CHECK IF TEST COMPLETED ITERATION


1600  0000  XTAL,   0
1601  7604          LAS
1602  0022          AND     SW2             /LOOP OVERRIDE?
1603  7640          SZA CLA
1604  5230          JMP     XTAL1           /YES
1605  7604          LAS
1606  0025          AND     SW5             /TEST SELECTED?
1607  7640          SZA CLA
1610  5214          JMP     .+4
1611  2033          ISZ     TALLY           /DONE WITH TEST?
1612  7410          SKP                     /NO
1613  5230          JMP     XTAL1           /YES
1614  1061          TAD     ERSWIT          /CHECK FOR ERROR
1615  7640          SZA CLA                 /ERROR THIS PASS?
1616  5224          JMP     .+6             /NO
1617  1017          TAD     MSGPNT          /GET MESSAGE POINTER
```

```
1620  1044          TAD     M1              /DECREMENT POINTER
1621  3017          DCA     MSGPNT          /RESTORE POI"ER
1622  1044          TAD     M1
1623  3061          DCA     ERSWIT          /RESTORE ERROR INDICATOR
1624  1200          TAD     XTAL            /SET RETURN ADDRESS
1625  1045          TAD     M2
1626  3200          DCA     XTAL            /STORE RETURN ADDRESS
1627  5600          JMP I   XTAL
1630  2017  XTAL1,  ISZ     MSGPNT
1631  5620          JMP I   XTAL
                    /POINTER FOR SELECTED TEST OPTION

1632  0223  XTEST,  TST0-1
1633  0240          TST1-1
1634  0265          TST2-1
1635  0306          TST3-1
1636  0326          TST4-1
1637  0346          TST5-1
1640  0400          TST6-1
1641  0426          TST7-1
1642  0451          TST10-1
1643  0501          TST11-1
1644  0600          TST12-1
1645  0636          TST13-1
1646  0710          TST14-1

                    /ROUTINE TO SELECT SPECIFIC LOGIC TEST SUBROUTINE

1647  0000  XSELEC, 0
1650  7604          LAS                     /GET TEST
1651  0175          AND     C17
1652  3026          DCA     TEMP0           /STORE TEST
1653  1026          TAD     TEMP0
1654  1044          TAD     M1
1655  1166          TAD     C140
1656  3017          DCA     17              /MESSAGE POINTER SET NOW
1657  1026          TAD     TEMP0           /GET TEST
1660  1266          TAD     JMPLOC          /DEVELOP POINTER
1661  0050          AND     K77
1662  1267          TAD     JMPINS          /DEVELOP INSTRUCTION
1663  3264          DCA     JMPPTR
1664  7402  JMPPTR, HLT                     /DO IT!
1665  7402          HLT                     /TRAP
1666  1632  JMPLOC, XTEST
1667  5600  JMPINS, 5600


                    /ERROR HANDLERS FOR OPEN LOOP TESTS

1670  0000  ERPT1,  0
1671  7604          LAS
1672  0020          AND     SW0
1673  7710          SPA CLA
1674  5320          JMP     .+4
```

```
1675  4777'          JMS     MESAGE
1676  4003           EMSG20
1677  4776'          JMS     CRLF
1700  4775'          JMS     MESS
1701  4776'          JMS     CRLF
1702  7604           LAS
1703  0021           AND     SW1             /HALT ON ERROR?
1704  7650           SNA CLA                 /SKIP IF YES
1705  5670           JMP I   ERPT1
1706  7402           HLT
1707  5774'          JMP     RESOL           /RETURN TO ROUTINE

1710  0000    ERPT2, 0
1711  7604           LAS
1712  0020           AND     SW0
1713  7710           SPA CLA
1714  5320           JMP     .+4
1715  4777'          JMS     MESAGE
1716  4034           EMSG21
1717  4776'          JMS     CRLF
1720  7604           LAS
1721  0021           AND     SW1             /HALT ON ERROR?
1722  7650           SNA CLA                 /SKIP IF YES
1723  5710           JMP I   ERPT2
1724  1027           TAD     TEMPA
1725  7402           HLT
1726  7200           CLA
1727  1030           TAD     TEMPB
1730  7402           HLT
1731  5773'          JMP     NOISE           /RETURN TO ROUTINE

1732  0000    ERPT3, 0
1733  7604           LAS
1734  0020           AND     SW0
1735  7710           SPA CLA
1736  5342           JMP     .+4
1737  4777'          JMS     MESAGE
1740  4056           EMSG22
1741  4776'          JMS     CRLF
1742  7604           LAS
1743  0021           AND     SW1
1744  7650           SNA CLA
1745  5732           JMP I   ERPT3
1746  1332           TAD     ERPT3
1747  1044           TAD     M1
1750  7402           HLT

1751  0000    ERPT4, 0
1752  4777'          JMS     MESAGE
1753  4105           EMSG23
1754  4776'          JMS     CRLF
1755  5751           JMP I   ERPT4

1756  0000    ERPT5, 0
1757  7604           LAS
```

```
1760  0020            AND     SW0
1761  7710            SPA CLA
1762  5366            JMP     .+4
1763  4777'           JMS     MESAGE
1764  4122            EMSG24
1765  4776'           JMS     CRLF
1766  5756            JMP I   ERPT5



1773  2051
1774  2200
1775  3000
1776  1542
1777  1274
      2000    PAGE
              /MONOTONICITY TEST
2000  7300    MONOT,  CLA CLL
2001  3027            DCA     TEMPA           /CLEAR N AND
2002  3030            DCA     TEMPB           /N+1 CONVERSION STORAGE
2003  4520            ADCL                    /CLEAR CONVERTER
2004  4522            ADST                    /START CONVERSION
2005  4524            ADSK                    /WAIT FOR DONE
2006  5205            JMP     .-1
2007  4523            ADRB                    /READ A-D BUFFER
2010  3027            DCA     TEMPA           /STORE NTH CONVERSION
2011  7604    CONT,   LAS                     /GET SWITCHES
2012  7040            CMA                     /COMPLEMENT FOR DOWN COUNT
2013  3032            DCA     CNTR1
2014  4522            ADST                    /DO N+1ST CONVERSION
2015  4524            ADSK
2016  5215            JMP     .-1
2017  4523            ADRB
2020  3030            DCA     TEMPB           /SAVE
2021  1027            TAD     TEMPA           /SUBTRACT
2022  7041            CIA
2023  1030            TAD     TEMPB
2024  7510            SPA                     />0?

2025  7041            CIA                     /NO, TAKE ABSOLUTE VALUE
2026  7450            SNA                     /DIFFERENCE 0?
2027  5243            JMP     OK              /YES, OK.
2030  1044            TAD     M1
2031  7650            SNA CLA                 /DIFFERENCE = 1?
2032  5243            JMP     OK              /YES, OK.
2033  4777'           JMS     ERPT4
2034  7200            CLA
2035  1027            TAD     TEMPA   /DIFFERENCE > 1, DISPLAY NTH CONVERSION
2036  7402            HLT
2037  7300            CLA CLL
2040  1030            TAD     TEMPB   /DISPLAY N+1 CONVERSION
2041  7402            HLT
2042  5200            JMP     MONOT           /RESTART TO RESYNC
2043  2032    OK,     ISZ     CNTR1   /STALL
```

```
2044  5243          JMP     .-1
2045  7300          CLA CLL
2046  1030          TAD     TEMPB   /N+1 CONVERSION BECOMES
2047  3027          DCA     TEMPA   /N
2050  5211          JMP     CONT    /GET N+1 CONVERSION
```

```
                    /ROUTINE TO TEST FOR EQUALITY OF TWO SUCCESSIVE ADRB'S.

2051  7300    NOISE,  CLA CLL
2052  1177            TAD     C-100           /SET TALLY FOR 64 TIMES
2053  3026            DCA     TEMP0
2054  1022            TAD     SW2             /ENABLE DONE BIT
2055  4521            ADLM                    /LOAD MPX REG
2056  4522            ADST                    /CONVERT
2057  4524            ADSK                    /DONE FLAG?
2060  5257            JMP     .-1             /NO
2061  4523            ADRB                    /YES, READ AD BUFFER
2062  3027            DCA     TEMPA           /STORE
2063  4523            ADRB                    /RE-READ
2064  3030            DCA     TEMPB           /STORE
2065  1027            TAD     TEMPA           /COMPARE FOR EQUALITY
2066  7041            CIA
2067  1030            TAD     TEMPB
2070  7420            SNL                     /LINK SHOULD BE SET
2071  4776'           JMS     ERPT2           /NOT EQUAL
2072  7440            SZA
2073  4776'           JMS     ERPT2           /NOT EQUAL
2074  7300            CLA CLL
2075  2026            ISZ     TEMP0           /CONTINUE
2076  5256            JMP     NOISE+5         /YES
2077  7200            CLA
2100  1040            TAD     K207
2101  4775'           JMS     PRLP            /RING BELL
2102  5251            JMP     NOISE           /DO TEST AGAIN
                    /ROUTINE TO CHECK FOR NOISE IN MULTIPLEXER

2103  7300    GLITCH, CLA CLL
2104  1177            TAD     C-100
2105  3026            DCA     TEMP0
2106  7604            LAS                     /OPERATOR TO SELECT CHANNEL
2107  0175            AND     C17
2110  3031            DCA     TEMPC
2111  1031            TAD     TEMPC
2112  4521            ADLM
2113  4522            ADST
2114  4524            ADSK
2115  5314            JMP     .-1
2116  4523            ADRB
2117  3027            DCA     TEMPA
2120  4344    CHNL1,  JMS     RANCHN          /GET RANDOM CHANNEL
2121  1077            TAD     CHNL
2122  4521            ADLM
2123  4527            ADRS
2124  2026            ISZ     TEMP0
2125  5320            JMP     CHNL1
2126  7300            CLA CLL
2127  4523            ADRB
2130  3030            DCA     TEMPB
2131  1027            TAD     TEMPA
```

```
2132  7041            CIA
2133  1030            TAD     TEMPB
2134  7420            SNL
2135  4774'           JMS     ERPT5
2136  7440            SZA
2137  4774'           JMS     ERPT5
2140  7300            CLA CLL
2141  1040            TAD     K207
2142  4775'           JMS     PRLP
2143  5303            JMP     GLITCH

2144  1357    RANCHN, TAD     FSTNO
2145  7006            RTL
2146  3357            DCA     FSTNO
2147  1357            TAD     FSTNO
2150  1360            TAD     SECNO
2151  7006            RTL
2152  1360            TAD     SECNO
2153  7012            RTR
2154  0175            AND     D17
2155  3077            DCA     CHNL
2156  5744            JMP I   RANCHN

2157  0437    FSTNO,  0437
2160  2525    SECNO,  2525
```

```
2174  1756
2175  1534
2176  1710
2177  1751
      2200    PAGE
              /ROUTINE TO PERFORM 64 CONVERSIONS OF ANY GIVEN VOLTAGE ON SELECTED CHANNEL

2200  0065    RESOL,  SETUP
2201  1053            TAD     XSTOR
2202  3010            DCA     10
2203  3270            DCA     STORAG
2204  4451            JMS I   XMOVE           /CLEAR WORK AREA
2205  2270            STORAG
2206  2271            STORAG+1
2207  7700            -100
2210  1177            TAD     [-100
2211  3026            DCA     TEMP0
2212  4520            ADCL
2213  7604            LAS                     /GET CHANNEL
2214  0175            AND     [17
2215  3062            DCA     CHAN            /STORE CHANNEL
2216  1062            TAD     CHAN
2217  4521            ADLM                    /LOAD CHANNEL
2220  4522            ADST
2221  4524            ADSK
2222  5221            JMP     .-1
2223  4523            ADRB
2224  3410            DCA I   10              /PLACE IN TABLE
2225  2026            ISZ     TEMP0           /DONE?
2226  5220            JMP     .-6             /NO
2227  5454            JMP I   XCOMPR          /YES, NOW CHECK

              /STORAGE TABLE FOR VOLTAGE COMPARISONS
      2270    *.50

2270  0000    STORAG, 0                       /100(8) LOCATIONS
      2400    PAGE

              /ROUTINE TO COMPARE FOR GREATER THAN + OR - 1 LSB DIFFERENCE IN 64 CONVERSIONS

2400  7300    COMPAR, CLA CLL
2401  1165            TAD     [-77
2402  3026            DCA     TEMP0
2403  1053            TAD     XSTOR           /POINTER FOR FIRST WORD
2404  3010            DCA     10
2405  1410            TAD I   10
2406  3027            DCA     TEMPA
2407  7200    COMPR1, CLA
2410  1410            TAD I   10
2411  3030            DCA     TEMPB
2412  1027            TAD     TEMPA
2413  7041            CIA
2414  1030            TAD     TEMPB
2415  7440            SZA                     /SKIP HERE
```

```
2416  5222            JMP     .+4             /AND
2417  7420            SNL                     /HERE IF =
2420  5222            JMP     .+2
2421  5257            JMP     AOK
2422  7430            SZL
2423  5230            JMP     .+5
2424  7040            CMA
2425  7440            SZA                     /SKIP HERE IF DIFFERENCE +1 LSB
2426  7410            SKP
2427  5257            JMP     AOK
2430  7100            CLL
2431  7010            RAR
2432  7440            SZA                     /SKIP HERE
2433  5237            JMP     .+4             /AND
2434  7420            SNL                     /HERE IF DIFFERENCE -1 LSB
2435  7410            SKP
2436  5257            JMP     AOK
2437  7300            CLA CLL                 /CHECK FOR SPECIAL CASE OF 7777 AND 0
2440  1027            TAD     TEMPA
2441  7440            SZA                     /A=0?
2442  7410            SKP                     /NO
2443  5247            JMP     .+4             /YES
2444  7040            CMA                     /A=7777?
2445  7440            SZA                     /SKIP IF YES
2446  4777'           JMS     ERPT1
2447  1030            TAD     TEMPB           /A =7777 OR 0
2450  7440            SZA                     /B=0?
2451  5253            JMP     .+2             /NO
2452  5257            JMP     AOK
2453  7040            CMA                     /B=7777?
2454  7440            SZA                     /SKIP IF YES
2455  4777'           JMS     ERPT1
2456  5257            JMP     AOK
2457  7300    AOK,    CLA CLL
2460  1030            TAD     TEMPB
2461  3027            DCA     TEMPA
2462  2026            ISZ     TEMP0           /DONE?
2463  5207            JMP     COMPR1          /NO
2464  5776'           JMP     RESOL           /YES, REPEAT TEST

2576  2200
2577  1670
      2600    PAGE

              /LAB8-E SYSTEM CHECK

2600  0000    SYST,   0
2601  4465            JMS I   SETUP
2602  4520            ADCL
2603  7402            HLT
2604  7604            LAS
2605  0377            AND     (700
2606  1376            TAD     (4040           /RATE AND ENABLE EXT'L
2607  3031            DCA     TEMPC           /SAVE
2610  1031            TAD     TEMPC
```

```
2611  4530            CLOE
2612  7040            CMA
2613  4532            CLZE
2614  7200            CLA
2615  1024            TAD     SW4             /EXT START FOR A-D
2616  3026            DCA     TEMP2
2617  4775'           JMS     MESAGE
2620  4215            AUTMSG
2621  7402            HLT
2622  7604            LAS
2623  0025            AND     SW5
2624  7440            SZA                     /SKIP IF NOT AUTO-INCREMENT
2625  4321            JMS     LSTCHN          /CHECK FOR LAST CHANNEL
2626  7604            LAS
2627  0175            AND     C17
2630  4521            ADLM                    /LOAD CHANNEL
2631  1026            TAD     TEMP0
2632  4526            ADLE                    /LOAD EXT ENABLE BIT IF PRESENT
2633  1026            TAD     TEMP0
2634  7650            SNA CLA                 /SKIP FOR EXTL ENABLE
2635  5245            JMP     .+10
2636  1374    CLKST,  TAD     (7001           /-X(MAX)
2637  3027            DCA     TEMPA
2640  4533            CLSA
2641  4531            CLSK
2642  5241            JMP     .-1
2643  7240            CLA CMA
2644  4532            CLZE                    /STOP CLOCK
2645  7200            CLA
2646  7410            SKP
2647  4522            ADST
2650  4524            ADSK
2651  5250            JMP     .-1
2652  4527            ADRS
2653  0175            AND     C17
2654  1030            TAD     TEMPB
2655  7001            IAC
2656  7440            SZA
2657  5261            JMP     .+2
2660  4521            ADLM
2661  4523            ADRB
2662  4540            DILY
2663  7200            CLA
2664  1027            TAD     TEMPA
2665  4537            DILX
2666  7001            IAC
2667  3027            DCA     TEMPA
2670  1027            TAD     TEMPA
2671  1374            TAD     (7001
2672  7640            SZA CLA                 /SKIP IF +X(MAX)

2673  7410            SKP
2674  5325            JMP     RESTR
2675  4536            DISD
2676  5275            JMP     .-1
```

```
2677  4541            DIXY
2700  1046            TAD     M4
2701  3340            DCA     TEMPX
2702  2340            ISZ     TEMPX
2703  5302            JMP     .-1
2704  5245            JMP     CLKST+7
2705  1031  RESTR,    TAD     TEMPC           /TO RESTART CLOCK
2706  4530            CLOE
2707  7040            CMA
2710  4532            CLZE
2711  7604            LAS
2712  0025            AND     SW5             /A-I MODE
2713  7640            SZA CLA                 /SKIP IF NO
2714  5236            JMP     CLKST
2715  7604            LAS
2716  0175            AND     C17             /TO CHANGE CHANNEL
2717  4521            ADLM
2720  5236            JMP     CLKST           /GO
2721  0000  LSTCHN,   0
2722  7604            LAS
2723  0175            AND     C17
2724  7040            CMA
2725  3030            DCA     TEMPB
2726  2321            ISZ     LSTCHN
2727  2321            ISZ     LSTCHN
2730  7604            LAS
2731  0025            AND     SW5
2732  7650            SNA CLA
2733  5337            JMP     .+4
2734  1024            TAD     SW4
2735  1025            TAD     SW5
2736  3026            DCA     TEMP0
2737  5721            JMP I   LSTCHN
2740  0000  TEMPX,    0


2774  7001
2775  1274
2776  4040
2777  0700
      3000      PAGE
3000  0000  MESS,    0
3001  4777'           JMS     CRLF
3002  7300            CLA CLL
3003  1027            TAD     TEMPA
3004  2376            AND     (7000
3005  7002            BSW
3006  7012            RTR
3007  7010            RAR
3010  1375            TAD     (260
3011  4774'           JMS     PRLP
3012  7300            CLA CLL
3013  1027            TAD     TEMPA
3014  7006            RTL
3015  7004            RAL
```

```
3016  0376          AND     (7000
3017  7002          BSW
3020  7012          RTR
3021  7010          RAR
3022  1375          TAD     (260
3023  4774'         JMS     PRLP
3024  7300          CLA CLL
3025  1027          TAD     TEMPA
3026  7012          RTR
3027  7010          RAR
3030  0373          AND     (7
3031  1375          TAD     (260
3032  4774'         JMS     PRLP
3033  7300          CLA CLL
3034  1027          TAD     TEMPA
3035  0373          AND     (7
3036  1375          TAD     (260
3037  4774'         JMS     PRLP
3040  7300          CLA CLL
3041  4777'         JMS     CRLF
3042  7300          CLA CLL
3043  1030          TAD     TEMPB
3044  0376          AND     (7000
3045  7002          BSW
3046  7010          RAR
3047  7012          RTR
3050  1375          TAD     (260
3051  4774'         JMS     PRLP
3052  7300          CLA CLL
3053  1030          TAD     TEMPB
3054  7006          RTL
3055  7004          RAL
3056  0376          AND     (7000
3057  7002          BSW
3060  7010          RAR
3061  7012          RTR
3062  1375          TAD     (260
3063  4774'         JMS     PRLP
3064  7300          CLA CLL
3065  1030          TAD     TEMPB
3066  7010          RAR
3067  7012          RTR
3070  0373          AND     (7
3071  1375          TAD     (260
3072  4774'         JMS     PRLP
3073  7300          CLA CLL
3074  1030          TAD     TEMPB
3075  0373          AND     (7
3076  1375          TAD     (260
3077  4774'         JMS     PRLP
3100  7300          CLA CLL
3101  4777'         JMS     CRLF
3102  4777'         JMS     CRLF
3103  7300          CLA CLL
3104  5600          JMP I   MESS
```

```
3173  0007
3174  1534
3175  0260
3176  7000
3177  1542
      3200    PAGE

              /CONTROL LOGIC ERROR MESSAGES

3200  3736    EMSG0,  TEXT    "**TEST 0 - DONE FLAG OR TIMING ERROR FLAG NOT CLEARED OR SKIP FAILURE**"
3201  2405
3202  2524
3203  4060
3204  4055
3205  4004
3206  1716
3207  0540
3210  0614
3211  0107
3212  4017
3213  2240
3214  2411
3215  1511
3216  1607
3217  4005
3220  2222
3221  1722
3222  4006
3223  1401
3224  0740
3225  1617
3226  2440
3227  0314
3230  0501
3231  2205
3232  0440
3233  1722
3234  4023
3235  1311
3236  2040
3237  0601
3240  1114
3241  2522
3242  0537
3243  3600
3244  3736    EMSG1,  TEXT    "**TEST 1 - DONE FLAG NOT SET THEN CLEARED OR SKIP FAILURE**"
3245  2405
3246  2524
3247  4061
3250  4055
3251  4004
3252  1716
3253  0540
```

```
3254  0614
3255  0107
3256  4016
3257  1724
3260  4023
3261  0524
3262  4024
3263  1005
3264  1640
3265  0314
3266  0501
3267  2205
3270  0440
3271  1722
3272  4023
3273  1311
3274  2040
3275  0601
3276  1114
3277  2522
3300  0537
3301  3600
3302  3736    EMSG2,  TEXT    "**TEST 2 - TIMING ERROR FLAG NOT SET THEN CLEARED OR SKIP FAILURE**"
3303  2405
3304  2324
3305  4062
3306  4055
3307  4024
3310  1115
3311  1116
3312  0740
3313  0522
3314  2217
3315  2240
3316  0614
3317  0107
3320  4016
3321  1724
3322  4023
3323  0524
3324  4024
3325  1005
3326  1640
3327  0314
3330  0501
3331  2205
3332  0440
3333  1722
3334  4023
3335  1311
3336  2040
3337  0601
3340  1114
3341  2522
3342  0537
```

```
3343  3600
3344  3736    EMSG3,  TEXT    "←↑TEST 3 - UNEXPECTED INTERRUPT OCCURRED←↑"
3345  2405
3346  2324
3347  4063
3350  4055
3351  4025
3352  1605
3353  3020
3354  0503
3355  2405
3356  0440
3357  1116
3360  2405
3361  2222
3362  2520
3363  2440
3364  1703
3365  0525
3366  2222
3367  0504
3370  3736
3371  0000
3372  3736    EMSG4,  TEXT    "←↑TEST 4 - ADRB FAILED TO JAM TRANSFER TO AC←↑"
3373  2405
3374  2324
3375  4064
3376  4055
3377  4001
3400  0422
3401  0240
3402  0601
3403  1114
3404  0504
3405  4024
3406  1740
3407  1201
3410  1540
3411  2422
3412  0116
3413  2306
3414  0522
3415  4024
3416  1740
3417  0103
3420  3736
3421  0000
3422  3736    EMSG5,  TEXT    "←↑TEST 5 - ADRS FAILED TO JAM TRANSFER TO AC←↑"
3423  2405
3424  2324
3425  4065
3426  4055
3427  4001
3430  0422
3431  2340
```

```
3432  0601
3433  1114
3434  0524
3435  4024
3436  1740
3437  1201
3440  1540
3441  2422
3442  0116
3443  2326
3444  0522
3445  4024
3446  1740
3447  0103
3450  3736
3451  0000
3452  3736    EMSG6,  TEXT    "**TEST 6 - ENABLE REGISTER NOT PROPERLY LOADED**"
3453  2405
3454  2324
3455  4066
3456  4055
3457  4005
3460  1601
3461  0214
3462  0540
3463  2205
3464  0711
3465  2324
3466  0522
3467  4016
3470  1724
3471  4020
3472  2217
3473  2005
3474  2214
3475  3140
3476  1417
3477  0104
3500  0504
3501  3736
3502  0000
3503  3736    EMSG7,  TEXT    "**TEST 7 - FAILED TO GENERATE INTERRUPT WITH DONE FLAG**"
3504  2405
3505  2324
3506  4067
3507  4055
3510  4006
3511  0111
3512  1405
3513  0440
3514  2417
3515  4007
3516  0516
3517  0522
3520  0124
```

```
3521  0540
3522  1116
3523  2405
3524  2222
3525  2520
3526  2440
3527  2711
3530  2410
3531  4004
3532  1716
3533  0540
3534  0614
3535  0107
3536  3736
3537  0000
3540  3736    EMSG10, TEXT    "**TEST 10 - FAILED TO GENERATE INTERRUPT WITH TIMING ERROR FLAG**"
3541  2405
3542  2324
3543  4061
3544  6040
3545  5540
3546  0601
3547  1114
3550  0504
3551  4024
3552  1740
3553  0705
3554  1605
3555  2201
3556  2405
3557  4011
3560  1624
3561  0522
3562  2225
3563  2024
3564  4027
3565  1124
3566  1040
3567  2411
3570  1511
3571  1607
3572  4005
3573  2222
3574  1722
3575  4006
3576  1401
3577  0737
3600  3600
3601  3736    EMSG11, TEXT    "**TEST 11 - FAILED TO LOAD AND READ MPX REG AND CLEAR AC**"
3602  2405
3603  2324
3604  4061
3605  6140
3606  5540
3607  0601
```

```
3610  1114
3611  0504
3612  4024
3613  1740
3614  1417
3615  0104
3616  4001
3617  1604
3620  4022
3621  0501
3622  0440
3623  1520
3624  3040
3625  2205
3626  0740
3627  0116
3630  0440
3631  0314
3632  0501
3633  2240
3634  0103
3635  3736
3636  0000
3637  3736    EMSG12, TEXT    "**TEST 12 - FAILED TO LOAD AND READ ALL CHANNELS INTO MPX REG**"
3640  2405
3641  2324
3642  4061
3643  6240
3644  5540
3645  0601
3646  1114
3647  0504
3650  4024
3651  1740
3652  1417
3653  0104
3654  4001
3655  1604
3656  4022
3657  0501
3660  0440
3661  0114
3662  1440
3663  0310
3664  0116
3665  1605
3666  1423
3667  4011
3670  1624
3671  1740
3672  1520
3673  3040
3674  2205
3675  0737
3676  3600
```

```
3677  3736    EMSG13, TEXT    "←↑TEST 13 - FAILED TO LOAD AND READ ALL CHANNELS IN AUTO-INCREMENT MODE←↑"
3700  2405
3701  2324
3702  4061
3703  6340
3704  5540
3705  0601
3706  1114
3707  0504
3710  4024
3711  1740
3712  1417
3713  0104
3714  4001
3715  1604
3716  4022
3717  0501
3720  0440
3721  0114
3722  1440
3723  0310
3724  0116
3725  1605
3726  1423
3727  4011
3730  1640
3731  0125
3732  2417
3733  5511
3734  1603
3735  2205
3736  1505
3737  1624
3740  4015
3741  1704
3742  0537
3743  3600
3744  3736    EMSG14, TEXT    "←↑TEST 14 - FAILED TO COMPLETE CONVERSION IN SPECIFIED TIME←↑"
3745  2405
3746  2324
3747  4061
3750  6440
3751  5540
3752  0601
3753  1114
3754  0504
3755  4024
3756  1740
3757  0317
3760  1520
3761  1405
3762  2405
3763  4003
3764  1716
3765  2605
```

```
3766  2223
3767  1117
3770  1640
3771  1116
3772  4023
3773  2005
3774  0311
3775  0611
3776  0504
3777  4024
4000  1115
4001  0537
4002  3600
4003  3736    EMSG20, TEXT    "←↑FAILED TO RESOLVE CONVERSIONS TO + OR - 1 LSB←↑"
4004  0601
4005  1114
4006  0504
4007  4024
4010  1740
4011  2205
4012  2317
4013  1426
4014  0540
4015  0317
4016  1626
4017  0522
4020  2311
4021  1716
4022  2340
4023  2417
4024  4053
4025  4017
4026  2240
4027  5540
4030  6140
4031  1423
4032  0237
4033  3600
4034  3736    EMSG21, TEXT    "←↑TWO SUCCESSIVE READS NOT EQUAL←↑"
4035  2427
4036  1740
4037  2525
4040  0303
4041  0523
4042  2311
4043  2605
4044  4022
4045  0501
4046  3423
4047  4016
4050  1724
4051  4025
4052  2165
4053  0114
4054  3736
```

```
4055  0000
4056  3736    EMSG22, TEXT    "<<^ERRONEOUS EXTERNAL ENABLE OR TIMING ERROR<<^"
4057  0522
4060  2217
4061  1605
4062  1725
4063  2340
4064  0530
4065  2405
4066  2216
4067  0114
4070  4005
4071  1601
4072  0214
4073  0540
4074  1722
4075  4024
4076  1115
4077  1116
4100  0740
4101  0522
4102  2217
4103  2237
4104  3600
4105  3736    EMSG23, TEXT    "<<^MONOTINICITY FAILURE<<^"
4106  1517
4107  1617
4110  2411
4111  1611
4112  0311
4113  2431
4114  4006
4115  0111
4116  1425
4117  2205
4120  3736
4121  0000
4122  3736    EMSG24, TEXT    "<<^NOISE IN MULTIPLEXER AND A-D BUFFER<<^"
4123  1617
4124  1123
4125  0540
4126  1116
4127  4015
4130  2514
4131  2411
4132  2014
4133  0530
4134  0522
4135  4001
4136  1604
4137  4001
4140  5504
4141  4002
4142  2506
4143  0605
```

```
4144  2237
4145  3600
                  /END OF LOGIC TEST TYPESTRING
4146  3736    XEND,   TEXT    "←↑END OF LOGIC TEST←↑"
4147  0516
4150  0440
4151  1706
4152  4014
4153  1707
4154  1103
4155  4024
4156  0523
4157  2437
4160  3600
                  /HEADER MESSAGE
4161  3736    XLABEL, TEXT    "←↑AD8E A TO D CONVERTER, AM8E MULTIPLEXER DIAGNOSTIC←↑"
4162  0104
4163  7005
4164  4001
4165  4024
4166  1740
4167  0440
4170  0317
4171  1626
4172  0522
4173  2405
4174  2254
4175  4001
4176  1570
4177  0540
4200  1525
4201  1424
4202  1120
4203  1405
4204  3005
4205  2240
4206  0411
4207  0107
4210  1617
4211  2324
4212  1103
4213  3736
4214  0000
4215  3736    AUTMSG, TEXT    "←↑SET SW5 (AUTO-INC), # OF CHANS IN SW8-11, OR SET SW8-11 (SINGLE CHAN)←↑"
4216  2305
4217  2440
4220  2327
4221  6540
4222  5001
4223  2524
4224  1755
4225  1116
4226  0351
4227  5440
4230  4340
```

```
4231  1706
4232  4003
4233  1001
4234  1623
4235  4011
4236  1640
4237  2327
4240  7055
4241  6161
4242  5440
4243  1722
4244  4023
4245  0524
4246  4023
4247  2770
4250  5561
4251  6140
4252  5023
4253  1116
4254  0714
4255  0540
4256  0310
4257  0116
4260  5137
4261  3600
```

$

```
0165  7701
0166  0140
0167  5402
0170  0076
0171  7760
0172  0475
0173  0445
0174  7761
0175  0017
0176  0322
0177  7700
```

```
2000  11111100  00000001  11111111  11111111  11111111  11111111  11111100  00000001
2100  11111111  11111111  11111111  11111111  11100111  11111111  11000111  11111111

3200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
0300  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11000111

0400  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
0500  11111111  11111111  11111111  11111111  10000000  00000000  00000000  00000001

0600  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
0700  11111111  11111111  11111111  11111111  11000000  00000000  00000000  00001111


1000  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
1100  11111111  11111111  11111111  10000000  00000000  00000000  00000000  00011111

1200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
1300  11111111  11111111  11111111  11111111  11111110  00000000  00000000  00000111

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

1600  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
1700  11111111  11111111  11111111  11111111  11111111  11111111  11111110  00011111


2000  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
2100  11111111  11111111  11111111  11111111  11111111  11111111  10000000  00001111

2200  11111111  11111111  11111111  00000000  00000000  00000000  00000000  10000000
2300  00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000000

2400  11111111  11111111  11111111  11111111  11111111  11111111  11111000  00000000
2500  00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000011

2600  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
2700  11111111  11111111  11111111  11111111  10000000  00000000  00000000  00001111


3000  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
3100  11111000  00000000  00000000  00000000  00000000  00000000  00000000  00011111

3200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
3300  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111

3400  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
3500  11111111  11111111  11111111  11111111  11111111  11111111  11111111  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  11111111  11111111  11111111  11111111  11111111

4200  11111111  11111111  11111111  11111111  11111111  11111111  11000000  00000000
4300  00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000000

4400
4500

4600
4700


5000
5100

5200
5300

5400
5500

5600
5700


6000
6100

6200
6300

6400
6500

6600
6700


7000
7100

7200
7300

7400
7500

7600
7700
```

ERRORS DETECTED: 0

LINKS GENERATED: 49

RUN-TIME: 14 SECONDS

3K CORE USED