IDENTIFICATION

Product Code:	MAINDEC-8I-D6AB-D
Product Name:	AX08 Diagnostic
Date Created:	October 8, 1968
Maintainer:	Diagnostic Group
Author(s):	J. Kelly J. Hittell

1. ABSTRACT

This unit is tested in three sections: (a) an instruction test of the logic; (b) a display test for the scope; (c) a calibration section for the A/D Converter.

2. REQUIREMENTS

2.1 Equipment

PDP-8, 8L or 8I Standard Computer

AX08 option

Adjustable Voltage Source (0.01% or better, Z out < 1.0 ohm)

2.2 Storage

2.2.1 Program Storage - The routine uses memory from address 0 to 4500.

3. LOADING PROCEDURE

3.1 Methods

Procedure for normal binary tape is followed.

4. STARTING PROCEDURE

For normal starting operation all switches should be down. Starting address is 200.

4.1 Program and/or Operator Action

Connect non-zero voltage source to input connector for channel zero.

Set "Timing Control" minimum (C.C.W.)

Load the program into memory.

Set switch register to starting address - SA = 0200

Load Address.

Press Start.

4.1.1 The program will loop in the first section of the test, and the display, if on, will read

"DIAGNOSTIC RUNNING"
"SAME VALUE IN XX ICMX"

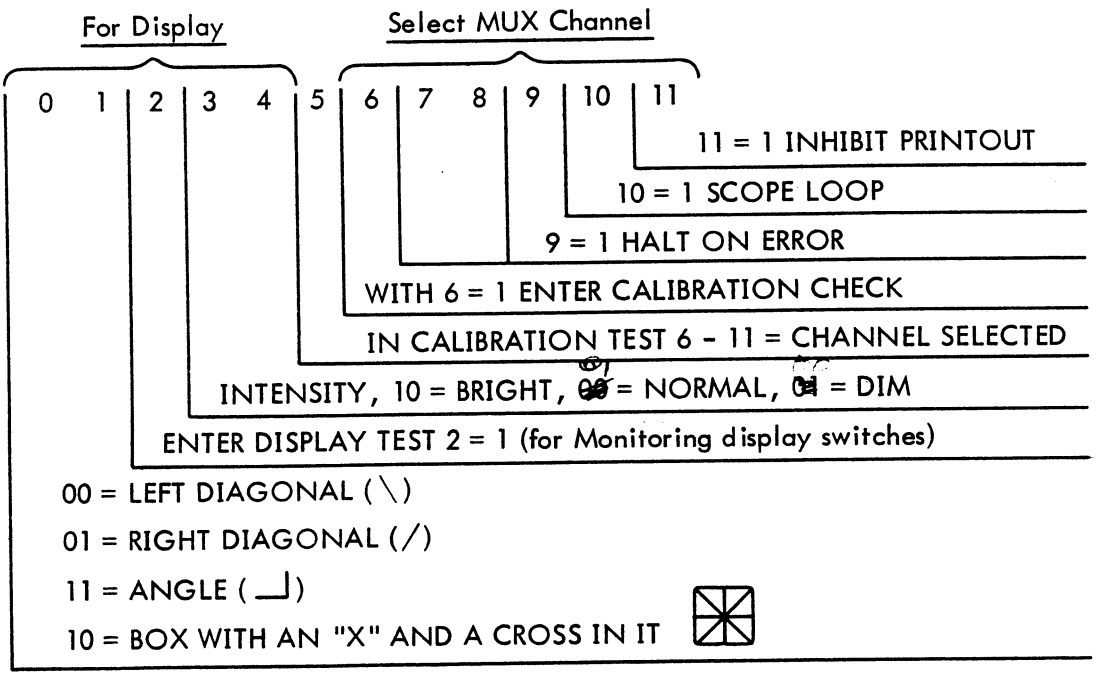
If there is an error, the teleprinter will print out the error and continue on in section test. (XX = the multiplexer channel + 1 where overflow occurs)

5. OPERATING PROCEDURE

5.1 Operational Switch Settings

With all switches down (Logical zero), the test will stay in the instruction section. With switch 2 up the test will enter the display section, from the instruction section. With switch 6 up the test will enter the A/D calibration section, from the display section.

5.1.1 Switches -



5.2 Subroutine Abstract

5.2.1 BEGIN - This is AX08 instruction test of the logic which tests that all registers and flip-flops initiated by start key are in the correct state. Also tested is the ability to set and clear the (Y) register, the skip on flag and interrupt logic for--the A/D timing, the RC clock and the crystal clock. Other logic functions of the display and the A/D converter are also tested.

5.2.2 CHTST - This is an increment test of multiplexer and assumes that (1) the display is operating; (2) the A/D is calibrated; (3) the channel zero of the multiplexer has a non-zero voltage applied to it,

and that all other channels have no voltage applied to them. This routine records the voltage it sees on channel zero, counts increments of the multiplexer until the same voltage (+/-1/2 LSB) is found again. Then uses the display for the message "SAME VALUE IN XX ICMX" (ICMX is the increment instruction).

5.2.3 Display - There are four basic patterns which can be displayed: (1) a right diagonal from the lower left corner to the upper right; (2) a left diagnoal from the upper left corner to the lower right corner; (3) an angle from the middle to the left edge of the screen to the center then to the top; (4) a box with an "X" and a cross in it. These tests are designed to show inverted bit transfers from accumulator to the deflection registers, malfunctions in the deflection logic and deflection amplifier faults.

5.2.4 INIT3 - This routine is the A/D Converter calibration check. Bits 6-11 of the switch register selects the multiplexer channel, then 1000 octal conversions are made on this channel and stored in a buffer. The first word of the buffer, which is the binary value of the analog voltage is displayed in the upper left of the scope. A horizontal line is now drawn on the scope. A deviation in the amplitude of the horizontal sweep from its point of origin represents a change in the A/D Converter output for a fixed voltage in. A voltage at the converter switching point will give two levels in the horizontal sweep. A noisy converter, or voltage source may give a staircase pattern which indicates excessive noise in the system. The refresh rate of the sweep is controlled by the RC (timing control) clock adjustment on the front panel.

5.2.5 SCOPE - This subroutine call, is placed between each subtest in the instruction section and records the starting address of each subtest as it is being entered. If a scope loop is requested, it will jump to the start of the subtest that the scope loop is requested for.

5.2.6 HALT - This routine printouts an address that tags the failing subtest and the contents of the AC at the time of the failure.

5.3 Program and/or Operator Action

Loading and starting at 200 with all switches down is the start of the IOT instruction test. If an error is detected here, there will be a printout in this section. When an error is detected, and it is necessary to scope on it, place SW9 UP to halt on error, then SW10 UP to loop on it, then SW11 to DELETE printouts.

When errors in the instruction section have been corrected SW2 UP will advance the program to the display test.

SR 0 and 1 select which of the four figures are to be displayed. SR 3 and 4 control the display intensity. SR2 UP allows the program to monitor SW 0, 1, 3 and 4.

When the display is operating correctly SW6 UP will advance the program to the A/D calibration section.

Bits 6 - 11 of the switch register select the multiplexer channel which has a maximum of 27 plus 34, 35, 36 and 37 octal channels.

6. ERRORS

6.1 Error Halt and Description

Halt (PC)	FUNCTION TESTED
0205	DOES START KEY CLEAR SYNC PULSE CHANNEL?
0211	DOES START KEY CLEAR ERROR FLAG?
0221	DOES START KEY CLEAR ALL INTERRUPT ENABLES?
0231	DOES START KEY CLEAR THE RC CLOCK FLAG?
0241	NO RC CLOCK INTERRUPT UP?
0253	(Y) REGISTER EQUAL ZERO (0000)?
0264	(Y) REGISTER EQUAL SEVENS (7777)?
0275	(RADC) INSTRUCTION CLEARS (Y) REGISTER?
0304	CONTINGENCY AND PULSE CHANNEL EQUAL ZERO (0000)?
0313	WILL (ADCV) CONVERT INSTRUCTION SET A/D DONE FLAG?
0324	WILL (RADC) READ BUFFER INSTRUCTION CLEAR A/D DONE FLAG?
0334	WILL (CLER) INSTRUCTION CLEAR A/D DONE FLAG?
0341	DOES (OTEN) INSTRUCTION CLEAR THE AC?
0354	THAT (ICMX) INC MUX DOES NOT SET A/D DONE
0361	THAT (ICMX) DOES NOT CHANGE THE AC
0365	THAT (ICMX) DOES NOT CHANGE THE AC
0375	(Y) REGISTER EQUAL ZERO (0000)
0410	(Y) REGISTER EQUAL SEVENS (7777)

6.1.1 Module Callout For The AX08 - Program cannot be loaded due to bits in AC,

a. if bits 0 to 5 B07, B05

b. if bits 6 to 11 B08, B06

Address	Good (AC)	Bad (AC)	Corrective Action
0205	0000	XX00	A13, A15
↓	0000	Bit 0	C08
	0000	Bit 1, 2	C07
	0000	Bit 3	C06
0211	0000	NA	D19, C13, A13, A15

Address	Good (AC)	Bad (AC)	Corrective Action
0221	0000	NA	C13, B14, C03, B13
0231	0000	NA	C12, C13
0241	0000	NA	C13
0253	0000	XXXX	D17, D15, A11, A10, A9, D19
↓	0000	7400	C20, B7
	0000	0200	C20, B7
	0000	0100	C19, B7
	0000	0040	C19, B8
	0000	Bit 7 or 8	C18, B8
	0000	Bit 9 or 10	C17, B8
	0000	0001	C16, B8
0264	0000	7777	A17, B14, A10, A8
0275	7777	0000	A17, A13, A12, A16, B16
↓	7777	0377	C20, C14, B02, B07
	7777	7577	C20, B07, C14, B02
	7777	7677	C19, B07, C14, B03
	7777	7737	C19, B08, C14, B03
(0275)	7777	7757	C18, B08, C15, B03
↓	7777	7767	C18, B08, C15, B04, B03
	7777	7773	C17, B08, C15, B04
	7777	7775	C17, B08, C15, B04
	7777	7776	C16, B08, C15, B04
0304	0000	0XXX	B12
↓	0000	Bit 10, 11	B11
	0000	Bit 7, 8, 9	B10
	0000	Bit 4, 5, 6	B9
0313	0000	NA	B14, B17, A08, D23, D22, D15, D21, B21, B18, B19, B20, A11, A12, A13, D13
↓			
0324	NA	NA	B17, D18
0334	NA	NA	A11, A14, D18
0341	0000	7777	A14, A11
0354	NA	NA	A7
0361	0000	XXXX	B14, A10
0365	7777	XXXX	B14, A10

Address	Good (AC)	Bad (AC)	Corrective Action
0375	0000	7777	A08, A07
0410	0000	7777	A08, A07
0421	7777	0000	A08, A07
0430	0000	0000	A08
0440	NA	NA	A08, A10
0445	NA	NA	C13, C19, A18, D15, B13, A12
0463	0000	0000	D19, D18
0470	0000	0000	D19, D18
0475	0000	0000	D13, D15, D18
0504	0000	0000	D18, A14, A11
0520	0000	0000	D18, D19
0533	0000	0000	B14, C03
0550	0000	0000	C13, C03
0570	0000	0000	B14, C03, A15
0612	0000	0000	C13, C03
0625	NA	NA	A08
0635	NA	NA	A07
0637	NA	NA	A07
0646	NA	NA	A07
0656	NA	NA	A07
0660	NA	NA	A07
0670	0000	0000	C4, F28, C10, A16, C12, C13, B16
0702	0000	0000	B16, D17
0712	0000	0000	C12, A14
0725	0000	0000	C02, C13
0743	0000	0000	B16, D17
0754	0000	0000	A15, C01
0764	0000	0000	A16
0770	0000	0000	A16, C9, C8
1014	0000	0000	C13
1025	0000	0000	C11, C12, C13, B13
1040	0000	0000	B12, C12
1053	0000	0000	C11

Address	Good (AC)	Bad (AC)	Corrective Action
0066	0000	0000	C11
1102	0000	0000	C13, C02
1112	4000	0000	C08, A13, A12, B01, B05
1122	0000	0000	C13
1137	NA	NA	D17, D15/CH 34 SHOULD HAVE NON-ZERO VOLTAGE APPLIED
1151	XXXX	7777	A16, B16/CH 34 SHOULD HAVE NON-ZERO VOLTAGE
1160	7777	NA	A16, B16
1167	0000	0000	D17, D15
1241	0000		F28
1303	0000		F28
1324			C8, C9, C10
1461	0000	0000	C14, B13, A24/EXTERNAL INTERRUPT
1503	0000	X000	E27, E28, C07/EXTERNAL STIMULUS
	0000	0X00	E26, 06/EXTERNAL STIMULUS
1524	NA	NA	D17

6.1.2 Display section of list

a. if no Intensity, A21, A18, A16, A24

b. cannot vary Intensity, A19, A20, B16, A24

c. if Alphanumeric is displayed as a series of dots, Intensity duration is too long or not applied to scope.

0421	(RADC + 10) INSTRUCTION CLEARS THE (Y) REGISTER
0430	WILL (ADCV + 10) CONVERT INSTRUCTION SET A/D DONE FLAG?
0440	WILL (RADC + 10) READ BUFFER INSTRUCTION CLEAR A/D DONE FLAG?
0445	WILL TWO (ADCV) RAISE ERROR CONDITION?
0463	DOES (CLER), CLEAR THE ADCIP "FF"?
0470	TEST FOR NO ADC TIMING ERROR
0475	SET ERROR CONDITION
0504	DOES (CLER) CLEAR ERROR FLAG?
0520	DOES (CLER) CLEAR THE (ADCIF) "FF"?
0533	TEST A/D DONE INTERRUPT ENABLE
0550	TEST ERROR INTERRUPT ENABLE
0570	TEST A/D DONE INTERRUPT ENABLE
0612	TEST ERROR INTERRUPT ENABLE
0625	TEST A/D DONE WITH MICRO PROGRAMMED IOT'S

0635	WILL (ICMX AND ADCV) SET A/D DONE?
0637	WILL MICRO PROGRAMMED IOT RAISE ERROR FLAG"
0646	SET A/D DONE WITH (ACMX, RADC, AND ADCV)
0656	SET A/D DONE WITH MICRO PROGRAMMED IOT'S
0660	RAISE ERROR CONDITION WITH MICRO PROGRAMMED IOT'S
0670	SET RC CLOCK FLAG
0702	RAISE ERROR WITH RC CLOCK
0712	CLEAR RC CLOCK FLAG
0725	RAISE INTERRUPT WITH RC CLOCK
0743	SET A/D DONE FLAG WITH RC CLOCK
0754	CLEAR RC CLOCK AND TEST FOR NO SKIP
0764	RC CLOCK (SLOW) SET TOO SOON
0770	RC CLOCK (SLOW) NOT SET
1014	RAISE AN INTERRUPT WITH RC CLOCK
1025	RAISE CRYSTAL CLOCK FLAG
1040	CLEAR CRYSTAL CLOCK FLAG
1053	TEST CRYSTAL CLOCK DOES NOT SET FLAG TOO SOON
1066	TEST CRYSTAL CLOCK DOES NOT SET FLAG TOO SLOW
1102	INTERRUPT ON CRYSTAL CLOCK
1112	SET CHANNEL FLAG
1122	TEST CRYSTAL INTERRUPT ENABLE
1137	(DYC) INHIBITED BY CONVERT COMMAND
1151	(DYL) INHIBITED BY CONVERT COMMAND
1160	(DXL) INHIBITED BY CONVERT COMMAND
1167	(DXC) INHIBITED BY CONVERT COMMAND
1241	TEST RC CLOCK STABILITY AT ONE EIGHTH SPEED
1303	TEST RC CLOCK STABILITY NORMAL SPEED
1324	TEST RC CLOCK FAST/SLOW RATIO
1461	TEST FOR ABSENCE OF EXTERNAL INTERRUPT
1503	TEST FOR ABSENCE OF EXTERNAL STIMULUS
1524	TEST THAT RC CLOCK DOES NOT INHIBIT ADCV

6.2 Error Recovery

Depress Continue or Restart at 200

7. RESTRICTIONS

Starting restrictions always starts at 200. There are no operation restrictions.

8. MISCELLANEOUS

Execution time for section 1 is about .1 sec.

9. PROGRAM DESCRIPTION

The three sections of this program are designed to be an increment test of the system. The first section which is a test of hardware's logic, checks that start key initiated the system correctly.

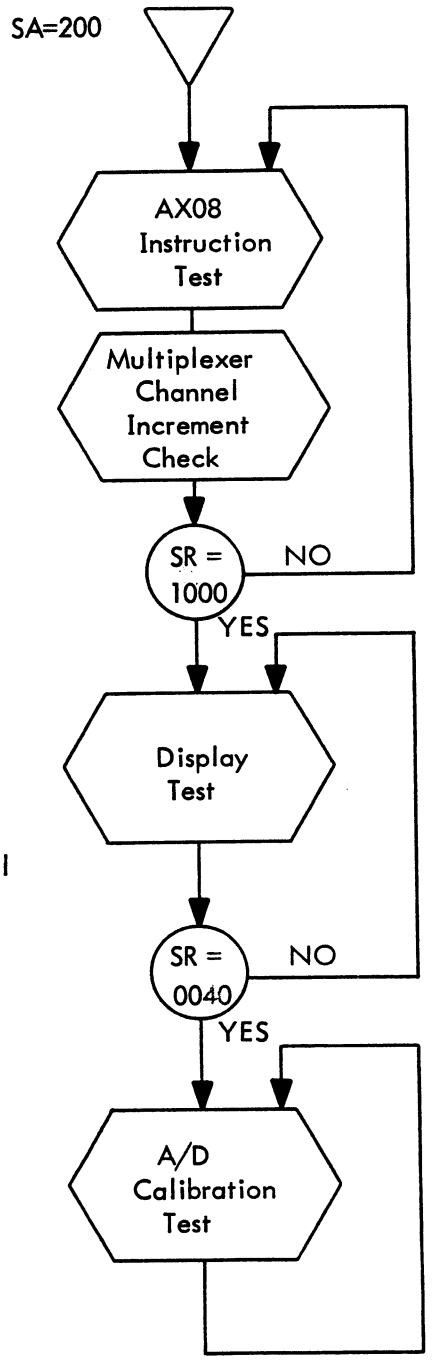
The following are tested automatically by the computer: flags, interrupts, crystal and RC clocks, Y register, timing error conditions, external registers, and other integrated logic functions that are associated with the display and analog digital converter.

The second section uses the display logic and the scope to validate the display. The switch register is used in the test to control the generation of intensity and pattern selection. At this stage of the test, the operator must determine if the display responds correctly in relation to the switch register.

The third section of the test is a check on the calibration and repetition of the A/D Converter and its respective multiplexer channel. The switch register selects the multiplexer channels; conversions on that channel are made and stored into a buffer. The buffer is then displayed on the scope. The first buffer voltage is displayed as an octal value; a deviation in horizontal sweep indicates noise in the system, measuring monotonicity, repeatability and drift. Using this routine is a subjective check on the A/D portions and the environment in which the system is installed; the quality of analog input must be considered in evaluating this display.

11. FLOW CHART

Flow of AX08 Diagnostic



With all switches down test will stay in this section

11=1 Inhibit printout

10=1 Scope Loop

9=1 Halt on Error

Switch Register Control Sweep and Intensity

Patterns		Intensity	
0	1	3	4
0	0 =	1	0 = Bright
0	1 =	0	0 = Normal
1	1 =	0	1 = Dim
1	0 =		

Test indicates Binary value of Analog Converted Voltage.
Amplitude changes in sweep indicate multi-state condition.
Switch register 6 to 11 select multiplexer channel.

```
                        /INSTRUCTIONS FOR THE AX08
                        /
                        /COPYRIGHT 1968, DIGITAL EQUIPMENT CORP., MAYNARD, MASS.
                        /
  6301                  DXC=6301                  /CLEAR X REGISTER
  6302                  DXL=6302                  /LOAD X REGISTER (1) SIDE
  6304                  DIS=6304                  /DISPLAY
  6311                  DYC=6311                  /CLEAR Y REGISTER
  6312                  DYL=6312                  /LOAD Y REGISTER (1) SIDE
  6321                  SXXK=6321                 /SKIP ON CRYSTAL CLOCK
  6322                  SXER=6322                 /SKIP ON ADC TIMING ERROR
  6324                  DS=-=6324                 /SET BRIGHTNESS
  6331                  XRIN=6331                 /OR EXTERNAL SENSE REGISTER INTO AC
  6332                  SXAD=6332                 /SKIP ON A/D DONE
  6334                  XRCL=6334                 /CLEAR SENSE BIT WITH ONE IN AC
  6341                  SXRK=6341                 /SKIP ON RC TIMING CLOCK
  6342                  ZIPN=6342                 /ZERO IN AC INHIBIT INTERRUPT REGISTER
  6344                  OIEN=6344                 /ONES IN AC ENABLE INTERRUPT
  6351                  CLER=6351                 /CLEAR ADC TIMING ERROR CONDITION
  6352                  CLXK=6352                 /CLEAR CRYSTAL CLOCK FLAG
  6354                  CLRK=6354                 /CLEAR RC CLOCK AND FLAG
  6361                  INCX=6361                 /INCREMENT MULTIPLEXER
  6362                  RADC=6362                 /CLEAR AC, READ A/D BUFFER
  6364                  ADCV=6364                 /START CONVERSION
  6371                  ADMX=6371                 /JAM SET MULTIPLEXER
  7344                  MIP=CLA CLL CMA RAL
  0020                  *20
0020  0400              M1400,  -1400
0021  1400              K1400,  1400
0022  7733              KM0043, -0043
0023  0400              K0400,  0400
0024  7001              KM0777, -0777
0025  0000              SL1,    0
0026  0000              FI1,    0
0027  7401              M0377,  -0377
0030  0030              K0034,  0034
0031  0100              K0100,  0100
0032  1000              K1000,  1000
0033  0002              K0002,  0002
0034  2002              K2002,  2002
0035  3002              K3002,  3002
0036  0004              K0004,  0004
0037  0010              C0010,  0010
0040  0200              K0200,  0200
0041  1004              K1004,  1004
0042  0340              K0340,  0340
0043  4002              K4002,  4002
0044  0015              K0015,  0015
0045  7700              K7700,  7700
0046  0017              K0017,  0017
0047  7000              KM1000, -1000
0050  7760              KM0020, -20
0051  1002              K1002,  1002
0052  7776              K7776,  7776
```

```
0033  7777          K7777,  7777
0034  4263          MSSG,   MESG
0035  5000          CHUSC1, CHUSC
0036  5755          AUSTBL, USCTBL
0037  0000          MUXNUM, 0
0040  0003          K2+03,  0003
```

```
0001  7772        KM0006, -6
0002  0000        CTEMA,  0
0003  0000        CTEMB,  0
0004  0000        CTEMC,  0
0005  0000        CCONTA, 0
0006  0000        CCONTB, 0
0007  0000        CCONTC, 0
0010  0000        BAD,0
0011  4000        INLL,   4000
0012  0000        LOOP,   0
0013  0000                0
0014  0000        XER,    0
0015  0000        TEMP01, 0
0016  0000        TEMP02, 0
0017  0000        TEMP03, 0
0100  0000        TEMP04, 0
0101  0000        TEMP05, 0
0102  0000        TEMP06, 0
0103  0000        MSKHI,  0
0104  0000        CHXL,   0
0105  0000        CHYL,   0
      4454        LOH=JMS I MSSG
0106  0000        STALL,  0
0107  0040        K0040,  0040
0110  2405        XINIT3, INIT3
0111  4223        XSCOPE, SCOPEA
      4511        SCOPE=JMS I XSCOPE
0112  4261        XERADD, ERADD
0113  4320        XTYPE,  MESAGE
0114  4235        XIPRIN, IPRINT
0115  1542        XSIXTY, SIXTY
0116  4252        XCRLF,  CRLF
0117  1560        XTEXTB, TEXTB
0120  0000        AC,     0
0121  2000        XSWTCH, SWITCH
      7000        OPR=7000
      7402        XX=/402
      4512        HALT=JMS I XERADD
```

```
0122  2147              STURA,  STURS
0123  2237              DLDLA,  DLDLS
0124  2256              DRDLA,  DRDLS
0125  2100              DVLTA,  DVLTS
0126  2200              DVLBA,  DVLBS
0127  2212              DHLRA,  DHLRS
0130  2224              DHLLA,  DHLLS

0131  0500              K0500,    500
0132  6324              K6324,  6324
0133  0377              K377,     377
0134  0000              XPOSR,    0
0135  0000              YPOSR,    0
0136  0400              K400,     400
0137  0777              K777,     777
0140  0002              P2,       2
0141  7400              M400,   -400
0142  7600              M200,   -200
0143  0000              COUNT,  0

      4522              STOR=JMS I STURA
      4525              DVLT=JMS I DVLTA
      4526              DVLB=JMS I DVLBA
      4527              DHLR=JMS I DHLRA
      4530              DHLL=JMS I DHLLA
      4523              DLDL=JMS I DLDLA
      4524              DRDL=JMS I DRDLA
                        /SR
                        /01

                        /00=LEFT DIAGONAL        0=REPEAT          BRIGHTNESS
                        /01=RIGHT DIAGONAL
                        /10=ANGLE          1=NEW TEST
                        /11=XBOX
      0200              *. 17/+1
```

```
                    /START KEY SHOULD CLEAR SYNC PULSE CHANNEL

0200  7200   BEGIN, CLA
0201  6351          XRIN            /READ PULSE REGISTER
0202  0021          AND K7400       /BIT 0 TO 3
0203  7440          SZA
0204  4212          HALT            /NOT CLEARED BY START KEY
0205  4211          SCOPE
                    /DOES START KEY CLEAR ERROR FLAG?
0206  6322          SKER            /SKIP ON ERROR FLAG
0207  7410          SKP
0210  4212          HALT            /ERROR FLAG SKIPED
0211  4211          SCOPE
                    /TEST FOR NO INTERRUPT /START KEY SHOULD CLEAR ALL INTERRUPT ENABLES
0212  1225          TAD .+11
0213  3001          DCA 1
0214  1224          TAD .+10
0215  3002          DCA 2
0216  6001          ION
0217  7410          SKP
0220  4212          HALT            /INTERRUPT UP, START KEY
0221  6002          IOF             /SHOULD CLEAR ALL INTERRUPT ENABLES
0222  5223          JMP .+3
0223  5402          JMP I 2         /GO TO MEMORY LOCATION ONE
0224  0220          .-4             /GO TO MEMORY LOCATION TWO
0225  4211          SCOPE
                    /DOES START KEY CLEAR RC CLOCK FLAG
0226  6341          SKRC            /SKIP ON RC CLOCK
0227  7410          SKP
0230  4212          HALT            /START KEY DID NOT CLEAR FLAG
0231  4211          SCOPE
                    /TEST FOR NO RC CLOCK INTERRUPT
0232  1032          TAD K1000       /SET RC INTERRUPT ENABLE
0233  6346          RTEN DTEN
0234  1243          TAD .+7
0235  3002          DCA 2
0236  6001          ION             /THERE SHOULD BE NO INTERRUPT
0237  7410          SKP
0240  4212          HALT            /RC CLOCK INTERRUPT UP
0241  6002          IOF
0242  7410          SKP
0243  0240          .-3
0244  4211          SCOPE
                    /TEST READ BUFFER (Y REGISTER) AC=ZERO
0245  6311   LOOPA, DYC             /CLEAR Y REGISTER
0246  6362          RADC            /READ BUFFER
0247  7650          SNA CLA         /TEST
0250  5253          JMP .+3         /GOOD
0251  6362          RADC            /BAD
0252  4212          HALT            /AC SHOULD EQUAL 0000
0253  4211          SCOPE
                    /TEST READ BUFFER (Y REGISTER) AC=SEVEN
0254  7240          CLA CMA         /SET AC TO SEVENS
0255  6311          DYC             /CLEAR Y REGISTER
```

```
0256  6362          RADC            /READ BUFFER
0257  7450          SNA             /TEST
0260  5264          JMP .+4         /GOOD
0261  7240          CLA CMA         /BAD .
0262  6362          RADC            /AC SHOULD EQUAL 0000
0263  4512          HALT            /BAD AC CLEAR PULSE
0264  4511          SCOPE
```

```
                        /TEST READ BUFFER (Y REGISTER)
0265  7240                      CLA CMA           /AC EQUAL SEVENS
0266  6312                      DYL               /SET Y REGISTER
0267  6302                      RADC              /READ BUFFER
0270  7001                      IAC
0271  7650                      SNA CLA           /TEST
0272  5275                      JMP .+3           /GOOD
0273  6362                      RADC              /BAD
0274  4212                      HALT              /AC SHOULD EQUAL 7777
0275  4211                      SCOPE
                        /TEST CONTINGENCY AND PULSE CHANNEL FOR ZERO
0276  7240                      CLA CMA           /AC=SEVENS
0277  6334                      XRCL              /CLEAR CHANNEL
0300  7200                      CLA
0301  6331                      XRIN              /READ CHANNELS
0302  7440                      SZA               /TEST FOR ZERO
0303  4212                      HALT              /FAILED TO CLEAR
0304  4211                      SCOPE
                        /WILL CONVERT INSTRUCTION SET THE FLAG?
0305  6364                      ADCV              /START
0306  5106                      DCA STALL
0307  2106                      ISZ STALL                 /TIME FOR FLAG TO SET
0310  5307                      JMP .-1
0311  6332                      SKAD              /SKIP ON DONE FLAG
0312  4212                      HALT              /DONE FLAG NOT SET OR SKIP FAILED
0313  6362                      RADC              /CLEAR FOR SCOPE
0314  4211                      SCOPE
                        /TEST THAT (RADC) CLEARS DONE FLAG
0315  6364                      ADCV              /START CONVERT TO SET FLAG
0316  6332                      SKAD
0317  5316                      JMP .-1           /WAIT FOR FLAG
0320  6362                      RADC              /CLEAR FLAG
0321  6332                      SKAD              /IS FLAG CLEARED
0322  7410                      SKP               /YES
0323  4212                      HALT              /NO, FLAG IS SET OR SKIP FAILED
0324  4211                      SCOPE
                        /TEST THAT (CLER) CLEARS THE DONE FLAG
0325  6364                      ADCV              /START CONVERT TO SET FLAG
0326  6332                      SKAD              /SKIP ON DONE
0327  5326                      JMP .-1           /WAIT FOR FLAG
0330  6351                      CLER              /CLEAR DONE FLAG
0331  6332                      SKAD              /TEST THAT FLAG IS CLEARED
0332  7410                      SKP
0333  4212                      HALT              /(CLER) DID NOT CLEAR DONE FLAG
0334  4211                      SCOPE
                        /TEST THAT (OTEN) CLEARS THE AC
0335  7240                      CLA CMA           /AC=SEVENS
0336  6344                      OTEN              /CLEAR AC
0337  7440                      SZA               /TEST
0340  4212                      HALT              /OTEN DID NOT CLEAR AC
0341  4211                      SCOPE
0342  6342                      ETEN              /CLEAR ALL INTERRUPT ENABLES
                        /WILL INC MUX SET DONE FLAG
0343  2106                      ISZ STALL
```

```
0344  5343          JMP .-1
0345  6351          CLEAR
0346  0361          ICMX              /INCREMENT MUX
0347  2106          ISZ STALL
0350  5347          JMP .-1
0351  0352          SKAU              /SKIP ON FLAG
0352  7410          SKP
0353  4212          HALT              /ICMX SET DONE FLAG
0354  0302          RAUC
0355  4211          SCOPE
```

```
                        /WILL MULTIPLEXER INSTRUCTION CHANGE AC
0356  6361                      ICMX              /INCREMENT MUX
0357  7440                      SZA
0360  4512                      HALT              /ICMX, SET AC
0361  7240                      CLA CMA
0362  6361                      ICMX              /INCREMENT MUX
0363  7450                      SNA
0364  4512                      HALT              /ICMX+10, SET AC
0365  0362                      RADC
0366  4511                      SCOPE
                        /ROUTINES USING IOT 637X
                        /TEST READ BUFFER (Y REGISTER) AC=ZERO
0367  6311                      DYC               /CLEAR Y REGISTER
0370  6372                      RADC+10           /READ BUFFER
0371  7650                      SNA CLA           /TEST
0372  5375                      JMP .+3           /GOOD
0373  6372                      RADC+10           /BAD
0374  4512                      HALT              /AC SHOULD EQUAL 0000
0375  4511                      SCOPE
0376  5777                      JMP I .+1
0377  0400                      . 177+1
                        /TEST READ BUFFER (Y REGISTER) AC=SEVEN
0400  7240                      CLA CMA           /SET AC TO SEVENS
0401  6311                      DYC               /CLEAR Y REGISTER
0402  6372                      RADC+10           /READ BUFFER
0403  7450                      SNA               /TEST
0404  5210                      JMP .+4           /GOOD
0405  7240                      CLA CMA           /BAD
0406  6372                      RADC+10           /AC SHOULD EQUAL 0000
0407  4512                      HALT              /BAD AC CLEAR PULSE
0410  4511                      SCOPE
                        /TEST READ BUFFER (Y REGISTER)
0411  7240                      CLA CMA           /AC EQUAL SEVENS
0412  6312                      DYL               /SET Y REGISTER
0413  6372                      RADC+10           /READ BUFFER
0414  7001                      IAC
0415  7650                      SNA CLA           /TEST
0416  5221                      JMP .+3           /GOOD
0417  6372                      RADC+10           /BAD
0420  4512                      HALT              /AC SHOULD EQUAL 7777
0421  4511                      SCOPE
                        /WILL CONVERT INSTRUCTION SETS THE FLAG
0422  6374                      ADCV+10           /START
0423  3106                      DCA STALL
0424  2106                      ISZ STALL         /TIME FOR FLAG TO SET
0425  5224                      JMP .-1
0426  6332                      SKAD              /SKIP ON DONE FLAG
0427  4512                      HALT              /DONE FLAG NOT SET OR SKIP FAILED
0430  4511                      SCOPE
```

```
                        /TEST THAT (RADC) CLEARS DONE FLAG
0431  6374                      ADCV+10         /START CONVERT TO SET FLAG
0432  6332                      SKAD
0433  5232                      JMP .-1         /WAIT FOR FLAG
0434  6372                      RADC+10         /CLEAR FLAG
0435  6332                      SKAD            /IS FLAG CLEARED
0436  7410                      SKP             /YES
0437  4512                      HALT            /NO, FLAG IS SET OR SKIP FAILED
0440  4511                      SCOPE
                        /GENERATE TIMING ERROR CONDITION
0441  6374                      ADCV+10         /CONVERT
0442  6374                      ADCV+10         /TWO ADCV SET ERROR CONDITION
0443  6322                      SKER            /SKIP ON ERROR
0444  4512                      HALT            /ERROR NOT UP
0445  6332                      SKAD
0446  5245                      JMP .-1
0447  4511                      SCOPE
                        /DOES (CLER) CLEAR ADCIP "FF"
0450  6374                      ADCV+10
0451  6374                      ADCV+10         /SET ERROR CONDITION
0452  6332                      SKAD
0453  5252                      JMP .-1         /WAIT FOR FLAG
0454  6351                      CLER            /CLEAR ADCIP "FF"
0455  6374                      ADCV+10         /CONVERT
0456  6332                      SKAD            /SKIP ON FLAG
0457  5256                      JMP .-1         /WAIT FOR FLAG
0460  6322                      SKER            /SKIP ON ERROR
0461  7410                      SKP             /NO ERROR
0462  4512                      HALT            /(CLER) DID NOT CLEAR ADCIP FF
0463  4511                      SCOPE
```

```
                        /TEST FOR ADC TIMING ERROR
0404  6351                CLER              /CLEAR ERROR CONDITION
0405  6322                SKER              /SKIP ON ERROR
0406  7410                SKP
0407  4512                HALT              /ERROR CONDITION UP
0410  4511                SCOPE
                        /GENERATE TIMING ERROR CONDITION
0411  6364                ADCV              /CONVERT
0412  6364                ADCV              /TWOADCV SET ERROR CONDITION
0413  6322                SKER              /SKIP ON ERROR
0414  4512                HALT              /ERROR NOT UP
0415  6332                SKAD
0416  5215                JMP .-1
0417  4511                SCOPE
                        /DOES (CLER) CLEAR ERROR FLAG
0500  6351                CLER              /CLEAR ERROR
0501  6322                SKER              /SKIP ON ERROR
0502  7410                SKP               /NO ERROR
0503  4512                HALT              /ERROR FLAG NOT CLEARED
0504  4511                SCOPE
                        /DOES (CLER) CLEAR ADCIP "FF"
0505  6364                ADCV
0506  6364                ADCV              /SET ERROR CONDITION
0507  6332                SKAD
0510  5307                JMP .-1           /WAIT FOR FLAG
0511  6351                CLER              /CLEAR ADCIP "FF"
0512  6364                ADCV              /CONVERT
0513  6332                SKAD              /SKIP ON FLAG
0514  5313                JMP .-1           /WAIT FOR FLAG
0515  6322                SKER              /SKIP ON ERROR
0516  7410                SKP               /NO ERROR
0517  4512                HALT              /(CLER) DID NOT CLEAR ADCIP FF
0520  4511                SCOPE
```

```
                        /SET DONE AND TEST FOR INTERRUPT WITH NO INTERRUPT ENABLES
0021  6364                ADCV              /START CONVERT
0022  6352                SKAD
0023  5322                JMP .-1           /WAIT FOR DONE FLAG
0024  7200                CLA
0025  6342                ETEN              /INHIBIT INTERRUPTS
0026  1335                TAD .+7
0027  3002                DCA 2
0030  6001                ION
0031  7410                SKP
0032  4212                HALT              /INTERRUPT UP
0033  6002                IOF
0034  7410                SKP
0035  0032                .-3
0036  4211                SCOPE

                        /SET ERRR FLAG AND TEST FOR INTERRUPT WITH NO INTERRUPT ENABLE
0037  6364                ADCV
0040  6364                ADCV              /GENERATE ERROR FLAG
0041  6352                SKAD
0042  5341                JMP .-1
0043  1332                TAD .+7
0044  3002                DCA 2
0045  6001                ION
0046  7410                SKP
0047  4212                HALT              /INTERRUPT UP
0050  6002                IOF
0051  7410                SKP
0052  0047                .-3
0053  4211                SCOPE
                        /WILL DONE FLAG RAISE AN INTERRUPT
0054  7200                CLA
0055  1031                TAD K0100
0056  6346                ETEN OTEN                 /ENABLE ADC INTERRUPT
0057  6364                ADCV              /START CONVERT
0060  6352                SKAD
0061  5360                JMP .-1           /WAIT FOR FLAG
0062  1371                TAD .+7
0063  3002                DCA 2
0064  6001                ION
0065  7000                NOP
0066  6002                IOF
0067  4212                HALT              /DONE FLAG DID NOT RAISE INTERRUPT
0070  7410                SKP
0071  0072                .+1
0072  4211                SCOPE
0073  5774                JMP I .+1
0074  0600                . 177+1
```

```
                        /WILL TIMING ERROR RAISE AN INTERRUPT
0570  7200              CLA
0571  1446              TAD K0206
0572  6546              ETEN OTEN
0573  6504              ADCV
0574  6504              ADCV
0575  6532              SKAD
0576  5276              JMP .-1
0577  1213              TAD .+7
0600  7041              CIA 2
0601  6001              ION
0602  7000              NOP
0603  6002              IOF
0604  4212              HALT                /NO INTERRUPT
0605  7410              SKP
0606  5212              .-1
0607  6551              CLER
0610  4211              SCOPE
                        /MICRO PROGRAMED IOT
0611  6562              RADC                /CLEAR DONE
0612  7240              CLA CMA
0613  6567              ICMX RADC ADCV      /INC MUX, READ BUFFER, CONVERT
0614  2146              ISZ STALL
0615  5214              JMP .-1
0616  6532              SKAD                /SKIP ON                    DONE
0617  4212              HALT                /DONE FLAG NOT SET
0620  4211              SCOPE
                        /SET TIMING ERROR FLAG
0621  6551              CLER
0622  6503              ICMX ADCV
0623  6503              ICMX ADCV
0624  2146              ISZ STALL
0625  5224              JMP .-1
0626  6532              SKAD
0627  4212              HALT                /DONE FLAG NOT SET
0630  6522              SKER
0631  4212              HALT                /NO TIMING ERROR FLAG
0632  4211              SCOPE
0633  6562              RADC
0634  6577              ACMX RADC ADCV            /SET MUX, READ BUFFER, CONVERT
0635  2146              ISZ STALL
0636  5235              JMP .-1
0637  6532              SKAD
0640  4212              HALT                /DONE FLAG NOT SET
0641  4211              SCOPE
```

```
                        /SET TIMING ERROR FLAG
0647  6351                      CLER
0650  6377                      ACMX RADC ADCV  /SET MUX, READ BUFFER, CONVERT
0651  6375                      ACMX ADCV
0652  2106                      ISZ STALL
0653  5252                      JMP .-1
0654  6332                      SKAD            /SKIP ON DONE
0655  4212                      HALT            /DONE NO SET
0656  6322                      SKER            /SKIP ON ERROR
0657  4212                      HALT            /ERROR SHOULD BE UP
0660  4511                      SCOPE
```

```
                        /TEST USING RC CLOCK CONVERTING + INTERRUPT
                        /TEST RC CLOCK
                        /ENABLE RC CLOCK AND SKIP ON FLAG
0001  7200                      CLA
0002  1033                      TAD K06002
0003  6546                      ETEN OTEN               /TURN ON RC CLOCK
0004  2005                      ISZ STALL
0005  5204                      JMP .-1
0006  6541                      SKRK                    /RC CLOCK FLAG SHOULD BE SET
0007  4012                      HALT                    /DID NOT SKIP ON RC CLOCK FLAG
0010  6554                      CLRK                    /CL RC CLOCK AND FLAG
0011  4011                      SCOPE
                        /TEST FOR ADC TIMING ERROR
0012  6551                      CLER
0013  7200                      CLA
0014  1034                      TAD K02002
0015  6546                      ETEN OTEN
0016  2006                      ISZ STALL
0017  5216                      JMP .-1
0020  6522                      SKER                    /SKIP ON ADC TIMING ERROR
0021  4012                      HALT                    /ERROR SHOULD BE SET
0022  4011                      SCOPE                   /RC TIME ADJ SET FOR MIN
                        /TEST CLEAR RC CLOCK INSTRUCTION
0023  6554                      CLRK                    /CLEAR RC CLOCK AND FLAG
0024  6541                      SKRK
0025  5224                      JMP .-1                 /SYNC ON CLOCK
0026  6554                      CLRK
0027  6541                      SKRK                    /SKIP ON RC CLOCK
0030  7410                      SKP
0031  4012                      HALT                    /CLEAR DID NOT WORK
0032  4011                      SCOPE
                        /WILL RC CLOCK RAISE AN INTERRUPT
0033  6541                      SKRK
0034  5233                      JMP .-1                 /WAIT FOR RC CLOCK FLAG
0035  1035                      TAD K03002
0036  6546                      ETEN OTEN               /RC CLOCK INTERRUPT ENABLE ON
0037  1526                      TAD .+7
0040  3002                      DCA 2
0041  6001                      ION
0042  7200                      NOP                     /SHOULD INTERRUPT HERE
0043  6002                      IOF
0044  4012                      HALT                    /NO INTERRUPT
0045  7410                      SKP
0046  0045                      .-1
0047  6554                      CLRK
0050  4011                      SCOPE
```

```
                        /WILL RC CLOCK SET ADC DONE FLAG
0/51  6354                      CLRK
0/52  6341                      SKRK
0/53  5352                      JMP .-1
0/54  6354                      CLRK
0/55  6341                      SKRK            /SKIP ON RC FLAG
0/56  5355                      JMP .-1         /WAIT FOR RC FLAG
0/57  2106                      ISZ STALL
0/60  5357                      JMP .-1         /ADC DONE SHOULD BE SET
0/61  6352                      SKAD            /SKIP ON ADC DONE
0/62  4512                      HALT            /ADC DONE NOT SET
0/63  4511                      SCOPE
                        /CLEAR RC CLOCK AND TEST FOR NO SKIP
0/64  7200                      CLA
0/65  6342                      ETEN            /TURN CLOCK OFF
0/66  6354                      CLRK            /CL CLOCK FLAG
0/67  2106                      ISZ STALL
0/70  5347                      JMP .-1
0/71  6341                      SKRK            /SKIP ON RC CLOCK
0/72  7410                      SKP
0/73  4512                      HALT            /CLOCK SHOULD BE OFF
0/74  4511                      SCOPE
                        /TEST RC CLOCK (ONE EIGHT SPEED)
0/75  7200                      CLA
0/76  1043                      TAD K4002
0/77  6346                      ETEN OTEN               /SLOW SPEED RC CLOCK ENABLE
0/100 6354                      CLRK                    /CLEAR RC CLOCK FLAG
0/101 6341                      SKRK                    /SKIP ON RC FLAG
0/102 7410                      SKP
0/103 4512                      HALT                    /RC FLAG SET TOO SOON
0/104 2106                      ISZ STALL
0/105 5364                      JMP .-1                 /WAIT FOR FLAG TO SET
0/106 6341                      SKRK                    /SKIP ON RC FLAG
0/107 4512                      HALT                    /FLAG NOT SET
0/110 4511                      SCOPE
0/111 5772                      JMP I .+1
0/112 1000                      . 177+1
      1000              *. 177+1
                        /TEST THAT RC CLOCK GENERATES INTERRUPTS
1000  7000                      OPR
1001  7200                      CLA
1002  1051                      TAD K1002               /RC INTERRUPTS AND RC TIMING
1003  6346                      ETEN OTEN
1004  2106                      ISZ STALL
1005  5204                      JMP .-1
1006  1215                      TAD .+7
1007  3002                      DCA 2
1010  6001                      ION
1011  7000                      OPR
1012  6002                      IOF
1013  4512                      HALT            /NO INTERRUPT
1014  7410                      SKP
1015  1014                      .-1
1016  6351                      CLER
```

1017 6354 CLRK
1020 4511 SCOPE

```
                        /TEST USING CRYSTAL CLOCK TO SET FLAG
1021  6106                      DCA STALL       /FLAG SHOULD BE SET 150 USEC
1022  2106                      ISZ STALL
1023  5226                      JMP .+3
1024  4012                      HALT            /CRYSTAL CLOCK FLAG NOT SET
1025  5230                      JMP .+3
1026  6321                      SKXK            /SKIP ON CRYSTAL FLAG
1027  5222                      JMP .-5         /NOT SET
1030  4011                      SCOPE
                        PAUSE
```

```
                        /TAPE 2
                        /CLEAR CRYSTAL CLOCK FLAG WITH "IOT"
1050  6352                      CLXK
1051  6321                      SKXK
1052  5252                      JMP .-1
1053  6352                      CLXK
1054  6321                      SKXK
1055  7410                      SKP
1056  4512                      HALT
1057  4511                      SCOPE
                        /TEST THAT FLAG DOES NOT SET TOO SOON
1060  6352                      CLXK
1061  6321                      SKXK
1062  5241                      JMP .-1           /SYNC ON CLOCK
1063  6352                      CLXK
1064  2105                      ISZ STALL
1065  2105                      ISZ STALL
1066  2105                      ISZ STALL
1067  6321                      SKXK
1070  7410                      SKP
1071  4512                      HALT              /FLAG SET TOO SOON
1072  4511                      SCOPE
                        /TEST THAT FLAG DOES NOT TAKE TOO LONG TO SET
1073  6352                      CLXK
1074  6321                      SKXK
1075  5254                      JMP .-1           /SYNC ON CLOCK
1076  6352                      CLXK              /CLEAR XTAL CLOCK FLAG
1077  1021                      TAD KM0043
1100  3105                      DCA STALL
1101  2105                      ISZ STALL                 /150 MICRO SEC
1102  5261                      JMP .-1
1103  6321                      SKXK              /SKIP ON XTAL CLOCK FLAG
1104  4512                      HALT              /XTAL CLOCK FL TAKES TOO LONG
1105  4511                      SCOPE
                        /WILL CRYSTAL CLOCK GENERATE AN INTERRUPT
1106  7200                      CLA
1107  1022                      TAD K0400                 /ENABLE XTAL CLOCK INTERRUPT
1110  6346                      ETEN OTEN
1111  2105                      ISZ STALL                 /XTAL CLOCK FLAG SHOULD BE SET
1112  5272                      JMP .-1
1113  1302                      TAD .+7
1114  3002                      DCA 2
1115  6001                      ION               /INTERRUPT ON
1116  7000                      NOP               /SHOULD INTERRUPT HERE
1117  6002                      IOF
1120  4512                      HALT              /NO XTAL INTERRUPT UP
1121  7410                      SKP
1122  1123                      .+1
1123  4511                      SCOPE
                        /SET CHANNEL FLAG
1124  7124                      STL RAL           /0001 TO AC
1125  6346                      OTEN ETEN         /SET CHANNEL FLAG
1126  6331                      XRIN              /SENSE REGISTER TO AC
```

```
1110  7500          SMA             /AC SHOULD=4000
1111  4212          HALT            /BIT 0 NOT SET
1112  7200          CLA
1113  4211          SCOPE
```

```
                        /CLEAR XTAL FLAG AND TEST FOR NO INTERRUPT WITH ENABLE UP
1114  6352                      CLXK              /CLEAR CRYSTAL CLOCK FLAG
1115  1524                      TAD ,+7
1116  6002                      DCA 2
1117  6001                      ION
1120  7410                      SKP
1121  4512                      HALT              /INTERRUPT UP
1122  6002                      IOF
1123  7410                      SKP
1124  1121                      ,-3
1125  4511                      SCOPE
1126  1030                      TAD K0034
1127  6371                      ACMX              /MULTIPLEXER CHANNEL 34

                        /TEST THAT DISPLAY COMMANDS DO NOT NTERFERE WITH A/D CONVERSIONS
                        /THIS TEST ASSUMES THAT CHANNEL 34 IS SELECTED AND THAT
                        /AND THAT A FIXED NON ZERO VOLTAGE IS SUPPLIED TO CHANNEL 34
1130  6364                      ADCV              /START CONVERSION
1131  7000                      NOP
1132  7000                      NOP               /CONVERSION IN PROGRESS
1133  6311                      DYC       /THIS INSTRUCTION SHOULD BE INHIBITED
1134  6362                      RADC              /IF ZERO (DYC) NOT INHIBITED
1135  7450                      SNA               /TEST
1136  4512                      HALT              /DYC WAS NOT INHIBITED AND CLEARED CONVERTER
1137  4511                      SCOPE
```

```
                  /TEST DYL IS INHIBITED DURING A/D CONVERSIONS-CH 34 SET TO HALF POSITIVE SCAL
1140   6364              ADCV              /START CONVERSION
1141   6332              SKAD
1142   5341              JMP .-1           /WAIT FOR FLAG
1143   7240              CLA CMA           /AC=7777
1144   6312              DYL               /(DYL) SHOULD BE INHIBITED UNTILL RADC
1145   6362              RADC              /IF AC=7777 DYL NOT INHIBITED
1146   7001              IAC
1147   7450              SNA               /TEST AC NOT EQUAL 7777
1150   4512              HALT              /DYL NOT INHIBITED
1151   4511              SCOPE             /CHANNEL 34 SHOULD HAVE A NON ZERO VOLTAGE

                  /TEST THAT (DXL) IS INHIBITED DURING A/D CONVERSION
1152   7240              CLA CMA           /AC=SEVEN
1153   6364              ADCV              /START CONVERSION
1154   6302              DXL               /SHOULD BE INHIBITED AN NOT LOAD "X" WITH SEVENS
1155   6332              SKAD              /IF "X" IS LOADED, DONE WILL SET TOO SOON
1156   7410              SKP
1157   4512              HALT              /DONE SET TOO SOON
1160   4511              SCOPE

                  /TEST THAT DXC IS INHIBITED BETWEEN (ADCV) AND (RADC)
1161   6364              ADCV              /START CONVERSION
1162   6332              SKAD
1163   5362              JMP .-1           /WAIT FOR FLAG
1164   6301              DXC               /"DXC" SHOULD BE INHIBITED
1165   6332              SKAD              /IF NOT INHIBITED WILL CLEAR ADC FLAG
1166   4512              HALT              /DXC CLEARED DONE
1167   4511              SCOPE
                  /THIS ROUTINE IS FOR SCOPEING RELAY ENABLES R1, R2 AND R4
1170   1106              TAD STALL
1171   0037              AND C0070
1172   6346              ZTEN OTEN
1173   2106              ISZ STALL
1174   5370              JMP .-4
1175   5776              JMP I .+1
1176   1200              . 1/7+1
       1200       *. 17/+1
```

```
                        /TEST RC CLOCK SLOW (ONE EIGHT SPEED)
1200  7200      RCX,    CLA
1201  1043              TAD K4002
1202  6346              EIEN OTEN
1203  3106              DCA STALL
1204  6354              CLRK
1205  6341              SKRK
1206  5205              JMP .-1
1207  6354              CLRK
1210  2106              ISZ STALL
1211  6341              SKRK
1212  5210              JMP .-2
1213  1106              TAD STALL
1214  3025              DCA SL1
1215  3106              DCA STALL
1216  6354              CLRK
1217  6341              SKRK
1220  5217              JMP .-1
1221  6354              CLRK
1222  2106              ISZ STALL
1223  6341              SKRK
1224  5222              JMP .-2
1225  1106              TAD STALL
1226  7041              CIA
1227  1025              TAD SL1
1230  7450              SNA
1231  5241              JMP RCX1          /EQUAL
1232  7040              CMA
1233  7450              SNA
1234  5241              JMP RCX1          /MINUS ONE
1235  7001              IAC
1236  7040              CMA
1237  7440              SZA               /PLUS ONE
1240  4012              HALT
1241  4011      RCX1,   SCOPE
                        /TEST RC CLOCK FAST
1242  7200              CLA
1243  1043              TAD K0002
1244  6346              EIEN OTEN
1245  3106              DCA STALL
1246  6354              CLRK
1247  6341              SKRK
1250  5247              JMP .-1
1251  6354              CLRK
1252  2106              ISZ STALL
1253  6341              SKRK
1254  5252              JMP .-2
1255  1106              TAD STALL
1256  3026              DCA FT1
1257  3106              DCA STALL
1260  6354              CLRK
1261  6341              SKRK
1262  5261              JMP .-1
1263  6354              CLRK
1264  2106              ISZ STALL
```

```
1265  6341                    SKRK
1266  5264                    JMP .-2
1267  1106                    TAD STALL
1270  7041                    CIA
1271  1026                    TAD FT1
1272  7450                    SNA
1273  5303                    JMP RCX2          /EQUAL
1274  7040                    CMA
1275  7450                    SNA
1276  5303                    JMP RCX2          /MINUS ONE
1277  7001                    IAC
1300  7040                    CMA
1301  7440                    SZA               /PLUS ONE
1302  4512                    HALT
1303  4511              RCX2, SCOPE
                        /TEST FAST--SLOW RATIO OF RC CLOCK
1304  7300                    CLA CLL           /IF THIS TEST FAILS
1305  1025                    TAD SL1           /RATIO OF CLOCK IS
1306  7110                    RAR CLL           /NOT 8 TO 1
1307  7110                    RAR CLL
1310  7110                    RAR CLL
1311  7041                    CIA
1312  1026                    TAD FT1
1313  7450                    SNA
1314  5324                    JMP RCX3
1315  7040                    CMA
1316  7450                    SNA
1317  5324                    JMP RCX3
1320  7001                    IAC
1321  7040                    CMA
1322  7440                    SZA
1323  4512                    HALT              /RATIO NOT 8 TO 1
1324  4511              RCX3, SCOPE             /THIS IS NOT TRUE
1325  6342                    CTEN              /CLEAR ENABLES
1326  6354                    CLRK              /CLEAR RC FLAG
1327  5730                    JMP I .+1         /USES DISPLAY TO CHECK ICMX
1330  1400                    CHIST             /INSTRUCTION
```

```
                        /SELECT MUX WITH SWITCHS, DISPLAY CONVERTED VALUE IN AC
1351  4340      CON3,   JMS CON1
1352  4353              JMS CON2
1353  5351              JMP .-2
1354  4340              JMS CON1              /USE ACMX, RADC, ADCV
1355  5354              JMP .-1
1356  4353              JMS CON2              /USE ICMX RADXC ADCV
1357  5356              JMP .-1

                        /DISPLAY CONVERTER VALUE IN AC, SW REGISTER 7-11 SELECT MUX
1340  7000      CON1,   NOP
1341  7604              LAS
1342  6375              ACMX ADCV
1343  6362              RADC
1344  6352              SKAD
1345  5344              JMP .-1
1346  2106              ISZ STALL
1347  5346              JMP .-1
1350  2106              ISZ STALL
1351  5350              JMP .-1
1352  5740              JMP I CON1
1353  7000      CON2,   NOP
1354  7604              LAS
1355  1053              IAU K7777             /MINUS ONE
1356  6371              ACMX
1357  6361              ICMX
1360  6364              ADCV
1361  6362              RADC
1362  6352              SKAD
1363  5362              JMP .-1
1364  2106              ISZ STALL
1365  5364              JMP .-1
1366  2106              ISZ STALL
1367  5366              JMP .-1
1370  5753              JMP I CON2
1371  5772              JMP I .+1
1372  1400              . 177+1
```

```
      1400          *. 17/+1
                    /TEST FOR NUMBER OF CHANNELS ON MULTIPLEXER
1400  7200  CHTST,  CLA
1401  3057          DCA MUXNUM              /CHANNEL ZERO
1402  6371          ACMX
1403  6364          ADCV              /FIRST CONVERT
1404  6332          SKAD
1405  5204          JMP .-1
1406  6367          ICMX RADC ADCV          /SECOND CONVERT FIRST READ
1407  3062          DCA CTEMA
1410  6332  CHTST2, SKAD
1411  5210          JMP .-1
1412  6367          ICMX RADC ADCV          /3RD CONVERT 2ND READ
1413  2057          ISZ MUXNUM
1414  3070          DCA BAD
1415  1070          TAD BAD
1416  7041          CIA
1417  1062          TAD CTEMA               /FIRST READ
1420  7650          SNA CLA
1421  5241          JMP CHTST1
1422  1070          TAD BAD
1423  7040          CMA
1424  1062          TAD CTEMA               /FIRST READ
1425  7650          SNA CLA
1426  5241          JMP CHTST1
1427  1062          TAD CTEMA
1430  7040          CMA
1431  1070          TAD BAD
1432  7650          SNA CLA           /
1433  5210          JMP CHTST2        /TEST THE REST
1434  1057          TAD MUXNUM        /NOT EQUAL +/- 1/2 LSB
1435  7041          CIA               /CHANNEL
1436  1107          TAD K0040         /EQUAL TO MAXIMUM
1437  7640          SZA CLA
1440  5210          JMP CHTST2        /NO--NOT 40
1441  1050  CHTST1, TAD KM0020
1442  3106          DCA STALL
1443  4517          JMS I XTEXTB            /SAME VALUE IN X ICMX
1444  2106          ISZ STALL
1445  5243          JMP .-2
1446  4511          SCOPE
```

```
                        /TEST CONTINGENCY REGISTER WAIT 36 MILL SEC
1447  7240                      CLA CMA
1450  6354                      XRCL              /CLEAR CONTINGENCY CHANNEL
1451  7200                      CLA
1452  2106                      ISZ STALL         /WAIT 36 MSEC FOR
1453  5252                      JMP .-1           /EXTERNAL STIMULUS
1454  2106                      ISZ STALL
1455  5254                      JMP .-1
1456  6361                      XRIN              /READ CHANNELS
1457  7440                      SZA               /TEST FOR ZERO
1460  4512                      HALT              /EXTERNAL STIMULUS WAS APPLIED
1461  7240                      CLA CMA
1462  6354                      XRCL              /CLEAR CHANNELS
1463  4511                      SCOPE
1464  6354                      CLRK
                        /LET S1, S2, OR S3 TRIGGER EXTERNAL INTERRUPT
                        /VALUE OF Y REGISTER CONSTANTLY INCREASING
                        /VALUE OF Y REGISTER IN AC IF INTERRUPT OCCUR

1465  1041                      TAD K1004         /EXTERNAL INTERRUP ENABLE
1466  6346                      ETEN OTEN         /SELECT ENABLES
1467  1305                      TAD VAL1          /INTERRUPT RETURN
1470  3002                      DCA 2
1471  3106                      DCA STALL         /EQUAL (Y REGISTER)
1472  6001                      ION               /INTERRUPT ON
1473  6313                      DYC DYL           /LOAD Y REGISTER
1474  7000                      NOP
1475  7000                      NOP               /TIME FOR INTERRUPT
1476  7001                      IAC               /INCREMENT (Y VALUE)
1477  2106                      ISZ STALL         /DONE ALL VALUES
1500  5273                      JMP .-5           /NO
1501  5303                      JMP .+2           /YES -- TURN INTERRUPT OFF
1502  4512                      HALT              /INTERRUPT OCCURED, AC=(Y-REGISTER)
1503  6002                      IOF
1504  7410                      SKP
1505  1502            VAL1,     .-3
1506  6342                      ETEN
1507  7240                      CLA CMA
1510  6354                      XRCL              /CLEAR CONTINGENCY CHANNEL
1511  4511            SCOPE
                        /TEST THAT RC CLOCK DOES NOT INHIBIT ADCV
                        /ECO    SEP 11,1968

1512  6354                      CLRK
1513  6351                      CLER
1514  1034                      TAD K2002               /CLER CV AND CM
1515  6346                      ETEN OTEN               /RC CLOCK INITIATE CONVERT
1516  6341                      SKRK
1517  5316                      JMP .-1                 /WAIT FOR FLAG
1520  6364                      ADCV                    /NOW DO A ADCV, GENERATE ERROR
1521  6354                      CLRK                    /CLEAR CLOCK FLAG
1522  6322                      SKER                    /SKIP ON ERROR
1523  4512                      HALT                    /ERROR NOT UP
1524  6342                      ETEN
1525  6332                      SKAD
```

```
1325  5325                JMP .-1                 /WAIT FOR FLAG
1326  6354                CLRK
1327  6362                RADC                    /CLEAR A/D FLAG
1330  4511                SCOPE
1331  6351                CLER
1332  6342                ETEN
                  /CR,LF AT END OF PASS IF ERROR

1333  7200                CLA
1334  1315                TAD I XTYPE             /TEST FLAG
1335  7440                SZA
1336  4516                JMS I XCRLF             /CRLF TO TTY
1337  3315                DCA I XTYPE             /CLEAR FLAG
1340  7604                LAS
1341  7006                RTL
1342  7710                SPA CLA
1343  5321                JMP I XSWTCH            /TO DISPLAY TEST
1344  5746                JMP I .+1               /LOOP ON INSTRUCTION TEST
1345  0245                LOOPA
```

```
      1600              *. 17/+1
1600  7402    TEXTB,    XX
1601  6351              CLER
1602  1060              TAD K0003
1603  3104              DCA CHXL
1604  1044              TAD K0015
1605  3105              DCA CHYL
1606  4515              JMS I XSIXTY
1607  0057              MUXNUM
1610  1635              TEXTB1
1611  1635              TEXTB1
1612  4454              JMS I MSSG        /DISPLAY OUTPUT
1613  4543              4543              /DIAGNOSTIC RUNNING
1614  0411              0411
1615  0107              0107
1616  1617              1617
1617  2524              2524
1620  1103              1103
1621  4022              4022
1622  2516              2516
1623  1611              1611
1624  1607              1607
1625  4543              4543
1626  2301              2301              /SA
1627  1505              1505              /ME
1630  4026              4026              /SPACE V
1631  0114              0114              /AL
1632  2505              2505              /UE
1633  4011              4011              /SPACE I
1634  1640              1640              /N SPACE
1635  3030    TEXTB1,   3030              /XX
1636  4011              4011              /IC
1637  0315              0315              /MX
1640  3000              3000
1641  5600              JMP I TEXTB
```

```
1642  7402  SIXTY,  HLT
1643  7000          NOP
1644  7000          NOP                 /STORE INIT NEXT TIME
1645  7200          CLA
1646  1642          TAD I .-4                   /ADDRESS OF OPERAND
1647  3251          DCA .+2
1650  5652          JMP I .+2
1651  0000          0                   /ADDRESS OPERAND
1652  1654          SIXTY+12                    /CHANGING REFERENCE (P)
1653  5245          JMP SIXTY+3
1654  1651          TAD I SIXTY+7       /AC (OPERAND)
1655  0327          AND K0007
1656  3322          DCA MASKA                   /000X
1657  1651          TAD I SIXTY+7       /AC (OPERAND)
1660  0330          AND K00/0
1661  3323          DCA MASKB                   /00X0
1662  1651          TAD I SIXTY+7       /AC (OPERAND)
1663  0331          AND K0700
1664  3324          DCA MASKC                   /0X00
1665  1651          TAD I SIXTY+7       /AC (OPERAND)
1666  0332          AND K7000
1667  3325          DCA MASKD                   /X000
1670  1324          TAD MASKC                   /0X00
1671  7112          RTR CLL
1672  7010          RAR                 /0X00 RS3 00X0
1673  1325          TAD MASKD                   /X0X0
1674  7012          RTR
1675  7010          RAR
1676  1326          TAD MASKD+1         /X0X0 RS3 0X0X
1677  3324          DCA MASKC                   /TEMP STORAGE
1700  2242          ISZ SIXTY                   /INCREMENT FOR STORAGE
1701  4252          JMS SIXTY+10        /FIND STORAGE ADDRESS
1702  1324          TAD MASKC                   /6X6X
1703  3651          DCA I SIXTY+7       /STORE OPERAND AS SPECIFIED
1704  1323          TAD MASKB                   /00X0
1705  7004          RAL
1706  7006          RTL                 /00X0 SL3 0X00
1707  1322          TAD MASKA                   /0X00+000X=0X0X
1710  1326          TAD MASKD+1         /0X0X+6060=6X6X
1711  3325          DCA MASKD                   /TEMP STORAGE ADDRESS
1712  2242          ISZ SIXTY                   /INCREMENT FOR STORAGE
1713  4252          JMS SIXTY+10        /FIND STORAGE ADDRESS
1714  1325          TAD MASKD                   /6X6X
1715  3651          DCA I SIXTY+7       /STORE OPERAND AS SECIFIED
1716  1333          TAD SIX12                   /HOUSE KEEPING
1717  3252          DCA SIXTY+10
1720  2242          ISZ SIXTY                   /INCREMENT FOR RETURN
1721  5642          JMP I SIXTY         /RETURN
```

```
1/22  0000            MASKA,  0
1/23  0000            MASKB,  0
1/24  0000            MASKC,  0
1/25  0000            MASKD,  0
1/26  6060                    6060
1/27  0007            K0007,  0007
1/30  0070            K0070,  0070
1/31  0700            K0700,  0700
1/32  7000            K7000,  7000
1/33  1654            SIX12,  SIXTY+12
```

```
      2000              *. 17/+1
2000  7604    SWTCH,    LAS                 /DISCOVER WHAT TEST OPERATOR WANTS
2001  7104              CLL RAL             /MOVE SR0,1 INTO LINK AC FOR TEST
2002  7530              SZL SPA
2003  7410              SKP
2004  5237              JMP LDIAG                   /HE WANTS LEFT DIAGONAL
2005  7040              CMA
2006  7530              SZL SPA
2007  7410              SKP
2010  5243              JMP RDIAG                   /HE WANTS RIGHT DIAGONAL
2011  7060              CMA CML
2012  7730              SZL SPA CLA
2013  5247              JMP ANGLE                   /HE WANTS THE ANGLE
2014  5271              JMP XBOX

2015  0000    KEYS,     0
2016  7604              LAS
2017  0131              AND K0600           /SAVE ITENSITY BITS
2020  7106              CLL RTL             /MOVE TO AC 10, 11
2021  7006              RTL
2022  7006              RTL                 /
2023  1132              TAD K6324           /ADD BASIC IOT TO BITS
2024  3225              DCA EXECUT          /STORE
2025  0000    EXECUT,   0                   /EXECUTE
2026  7604              LAS                 /GET SWITCHES
2027  7106              CLL RTL
2030  7710              SPA CLA             /SHALL WE REPEAT
2031  5200              JMP SWTCH           /NO
2032  7604              LAS
2033  0107              AND K0040
2034  7640              SZA CLA
2035  5510              JMP I XINT3
2036  5615              JMP I KEYS          /YES
                        /LEFT DIAGONAL SUBROUTINE
2037  4326    LDIAG,    STUL                /SET TOO UPPER LEFT
2040  4523              DLDL                /DRAW LEFT DIAGONAL LINE
2041  4215              JMS KEYS            /CHECK THE KEYS
2042  5237              JMP LDIAG           /REDRAW

2043  4522    RDIAG,    STUR                /SET TOO UPPER RIGHT
2044  4524              DRDL                /DRAW RIGHT DIAGONAL LINE
2045  4215              JMS KEYS            /CHECK THE KEYS
2046  5243              JMP RDIAG           /REDRAW

2047  7300    ANGLE,    CLA CLL
2050  6303              DXC DXL             /CLEAR X
2051  6313              DYC DYL             /CLEAR Y
2052  1142              TAD M200
2053  3143              DCA COUNT           /SET COUNTER
2054  1140              TAD P2
2055  6307              DXC DXL DIS         /DRAW
2056  2143              ISZ COUNT           /DONE YET
2057  5254              JMP .-3             /NO
```

```
2060  7300          CLA CLL
2061  1142          TAD M200          /SET UP COUNTER
2062  3143          DCA COUNT
2063  1140          TAD P2
2064  6317          DYC DYL DIS       /DRAW
2065  2143          ISZ COUNT
2066  5263          JMP .-3           /DONE YET
2067  4215          JMS KEYS          /EXIT
2070  5247          JMP ANGLE         /REDRAW

2071  4316    XBOX, STLL
2072  4525          DVLT
2073  1133          TAD K377
2074  6303          DXC DXL
2075  3134          DCA XPOSR
2076  4526          DVLB
2077  4336          STLR
2100  4525          DVLT
2101  6313          DYC DYL
2102  3135          DCA YPOSR
2103  4530          DHLL
2104  4326          STUL
2105  4523          DLUL
2106  4522          STUR
2107  4524          DRUL
2110  4326          STUL
2111  4527          DHLR
2112  4336          STLR
2113  4530          DHLL

2114  4215          JMS KEYS
2115  5271          JMP XBOX
```

```
2116  0000          SILLS,  0
2117  7300                    CLA CLL
2120  6303                    DXC DXL
2121  3134                    DCA XPOSR
2122  1136                    TAD K400
2123  6313                    DYC DYL                 /SET TO 0400
2124  3135                    DCA YPOSR
2125  5716                    JMP I STLLS
2126  0000          SIULS,  0
2127  7300                    CLA CLL
2130  6301                    DXC
2131  3134                  DCA XPOSR
2132  1133                    TAD K377
2133  6313                    DYC DYL
2134  3135                    DCA YPOSR
2135  5726                    JMP I STULS
2136  0000          STLRS,  0
2137  7300                    CLA CLL
2140  1136                    TAD K400
2141  6313                    DYC DYL
2142  3135                    DCA YPOSR
2143  1137                    TAD K777
2144  6303                    DXC DXL
2145  3134                    DCA XPOSR
2146  5736                    JMP I STLRS
2147  0000          STURS,  0
2150  7300                  CLA CLL
2151  1137                    TAD K777
2152  6303                    DXC DXL
2153  3134                    DCA XPOSR
2154  1133                    TAD K377
2155  6313                  DYC DYL
2156  3135                  DCA YPOSR
2157  5747                    JMP I STURS
2160  0000          DVLTS,    0
2161  1141                  TAD M400
2162  3143                   DCA COUNT
2163  1135                  TAD YPOSR
```

```
2164  1140                        TAD P2
2165  6317                        DYC DYL DIS
2166  2143                        ISZ COUNT
2167  5364                      JMP .-3
2170  7300                      CLA CLL
2171  5760                        JMP I DVLTS
      4316              STLL=JMS STLLS
      4326              STUL=JMS STULS
      4336              STLR=JMS STLRS
      2200              *, 17/+1

2200  0000              DVLBS,    0
2201  1141                      TAD M400
2202  3143                        DCA COUNT
2203  1135                        TAD YPOSR
2204  1052                      TAD K7776                 /MINUS 2
2205  6317                        DYC DYL DIS
2206  2143                        ISZ COUNT
2207  5204                        JMP .-3
2210  7300                      CLA CLL
2211  5600                        JMP I DVLBS


2212  0000              DHLRS,    0

2213  1141                        TAD M400
2214  3143                        DCA COUNT
2215  1134                        TAD XPOSR
2216  1140                        TAD P2
2217  6307                      DXC DXL DIS
2220  2143                        ISZ COUNT
2221  5216                        JMP .-3
2222  7300                      CLA CLL
2223  5612                        JMP I DHLRS
```

```
2224  0000  DHLLS,   0
2225  7300           CLA CLL
2226  1141           TAD M400
2227  3143           DCA COUNT
2230  1134           TAD XPOSR

2231  1052          TAD K7776
2232  6307            DXC DXL DIS
2233  2143            ISZ COUNT
2234  5231            JMP .-3
2235  7300          CLA CLL
2236  5624            JMP I DHLLS

2237  0000  DLDLS,   0
2240  7300           CLA CLL
2241  1141           TAD M400
2242  3143           DCA COUNT
2243  1134  MYPX,    TAD XPOSR
2244  1140             TAD P2
2245  6303             DXC DXL
2246  3134             DCA XPOSR

2247  1135             TAD YPOSR
2250  1052           TAD K7776
2251  6317             DYC DYL DIS
2252  3135             DCA YPOSR

2253  2143             ISZ COUNT
2254  5243             JMP MYPX
2255  5637           JMP I DLDLS
2256  0000  DRDLS,   0
2257  7300           CLA CLL
2260  1141           TAD M400
2261  3143           DCA COUNT
2262  4522             STUR
2263  1134  MYMX,    TAD XPOSR
2264  1052           TAD K7776
2265  6303             DXC DXL
2266  3134           DCA XPOSR
2267  1135           TAD YPOSR
2270  1052           TAD K7776
2271  6317           DYC DYL DIS
2272  3135           DCA YPOSR

2273  2143           ISZ COUNT
2274  5263           JMP MYMX
2275  5656           JMP I DRDLS
```

```
      2400              *, 177+1
2400  5205                    JMP INIT3
      0010              PNTR=10
2401  0000              X,        0
2402  0000              Y,        0
2403  0000              RCNT,     0
2404  2514              ADBUFR,   ADBUF+1
                        PAUSE
```

```
                        /TAPE 3
                        /THREE STATE SCOPE DISPLAY
2405  7326              INIT3,  CLA STL RTL             /POSITIVE TWO
2406  6346                      ETEN OTEN
2407  6354                      CLRK
2410  1047              INISAM, TAD KM1000
2411  3143                      DCA COUNT
2412  1204                      TAD ADBUFR
2413  3010                      DCA PNTR
2414  7604              SAMLOP, LAS
2415  6375                      ACMX ADCV             /LOAD MUX WITH SWITCHES, CONVERT
2416  6332                      SKAD
2417  5216                      JMP .-1               /WAIT FOR FLAG
2420  6362                      RADC                  /READ BUFFER
2421  3410                      DCA I PNTR            /STORE  SKP
                        /FOR SCOPING WITHOUT INDEXING MUX REPLAC PLACE A WITH A NOP
2422  5235                      JMP SAM1
2423  7604                      LAS                   /READ SWITCHES, SUBTRACT ONE
2424  1053                      TAD K7777             /LOAD MUX, INCREMENT MVX
2425  6371                      ACMX
2426  6361                      ICMX                  /CONVERT
2427  6364                      ADCV
2430  6332                      SKAD
2431  5230                      JMP .-1               /WAIT FOR FLAG
2432  6362                      RADC                  /READ BUFFER
2433  3410                      DCA I PNTR            /STORE
2434  2143                      ISZ COUNT
2435  2143              SAM1,   ISZ COUNT
2436  5214                      JMP SAMLOP            /MORE SAMPLES
2437  1050                      TAD KM0020
2440  3203                      DCA RCNT

2441  1204              INIDIS, TAD ADBUFR            /BUFFER
2442  3010                      DCA PNTR
2443  1024                      TAD KM0777

2444  3143                      DCA COUNT
2445  3201                      DCA X                 /X REFERENCE SETUP
2446  1410                      TAD I PNTR
2447  7041                      CMA IAC
2450  3202                      DCA Y                 /Y REFERENCE SETUP
```

```
2451  4276                    JMS STATE       /VALUE OF CONVERTED WORD
2452  1410          DISLOP,   TAD I PNTR      /NEXT WORD
2453  1202                    TAD Y           /REFERENCE IT
2454  7006                    RTL
2455  7006                    RTL
2456  7006                    RTL
2457  0045                    AND K7700
2460  6313                    DYC DYL         /LOAD Y
2461  7200                    CLA
2462  1201                    TAD X
2463  6307                    DXC DXL DIS     /LOAD X
2464  7001                    IAC
2465  3201                    DCA X           /RESTORE X INCREMENTED
2466  2143                    ISZ COUNT       /DONE
2467  5252                    JMP DISLOP      /NO
2470  6341                    SKRK            /SKIP ON RC CLOCK
2471  5241                    JMP INIDIS      /RC CLOCK IS REFRESH RATE
2472  6354                    CLRK            /CLEAR CLOCK
2473  2203                    ISZ RCNT        /BASIC TIME COUNT
2474  5241                    JMP INIDIS      /REFRESH DISPLAY
2475  5210                    JMP INISAM      /FILL BUFFER WITH NEW
2476  7402          STATE,    XX
2477  6351                    CLER
2500  1060                    TAD K0003
2501  3104                    DCA CHXL
2502  1042                    TAD K0340
2503  3105                    DCA CHYL
2504  4515                    JMS I XSIXTY
2505  2515                    ADBUF
2506  2511                    .+3
2507  2512                    .+3
2510  4454                    JMS I MSSG
2511  6060                    6000
2512  6060                    6000
2513  0000                    0
2514  5676                    JMP I STATE
2515  0000          ADBUF,    0
      3515          *ADBUF+1000
```

```
3600            *. 17/+1                        /FILE NAME: DSCPAK

                /DISPLAY STRIPPED ASCII CHAR IN AC:  DSC
                /SAMPLE CALLING SEQUENCE -
                /       LDM             /GET HALFWORD
                /       DSC             /DISPLAY IF NON ZERO
                /       JMP .-2         /DISPLAY THE NEXT HALFWORD

4455                    DSC=JMS I CHDSCI

                /TEMPORARY STORAGE:
0076                    CHCNT3=TEMP02
0077                    CHCNT2=TEMP03
0100                    CHCNT1=TEMP04
0101                    CHRUT=TEMP05
0075                    CHFAC=TEMP01
0102                    CHPNT=TEMP06
0075                    CHYS=TEMP01

                /DISPLAY TABLE EXCEPTIONS
7777                    SPACE=-1
0005                    ENDIS=5
0001                    BKSPC=1
0002                    RESET=2
0003                    LFEED=3
0004                    CRETN=4
0000                    IGNOR=0
```

```
0000 0000          CHUSC,  0
0001 7104                  CLL RAL
0002 1056                  TAD ADSTBL
0003 3102                  DCA CHPNT
0004 1502                  TAD I CHPNT
0005 2102                  ISZ CHPNT
0006 7440                  SZA
0007 5223                  JMP CHSET1      /NOT SPECIAL CHARACTER
0010 1502                  TAD I CHPNT
0011 1360                  TAD CHJMP
0012 3213                  DCA .+1
0013 5600                  JMP I CHUSC

                   /DISPATCH TABLE FOR ABOVE JMP
0014 3676          CHJMPL, CHSPA          /JUMP TABLE: SPACE
0015 3671                  CHEND+1         /IGNORE
0016 3700                  CHBKS           /BACKSPACE
0017 3715                  CHREST          /NEXT 4 CHARACTERS RESET X, Y, DELTA, INTENSITY
0020 3751                  CHLF            /DO A LINE FEED
0021 3747                  CHCR            /DO A CARRIAGE RETURN
0022 3670                  CHEND           /END OF TEXT

0023 3101          CHSET1, DCA CHROT
0024 1104                  TAD CHXL
0025 6303                  DXC DXL
0026 7344                  MTW             /NUMBER OF WORDS IS TWO
0027 3076                  DCA CHCNT3
0030 7344          CHSET2, MTW             /NUMBER OF LINES IS TWO
0031 3077                  DCA CHCNT2
0032 1061          CHSET3, TAD KM0006      /NUMBER OF POINTS IN A LINE IS SIX
0033 3100                  DCA CHCNT1
0034 1105                  TAD CHYL        /REPOSITION Y AT BOTTOM OF CHARACTER
0035 3075                  DCA CHYS        /RECORD PRESENT Y POSITION
0036 1101          CHDIS,  TAD CHROT
0037 7104                  CLL RAL         /NO, GET FIRST BIT INTO LINK
0040 3101                  DCA CHROT       /STORE CODE WORD FOR NEXT BIT
0041 1075                  TAD CHYS        /INTENSIFICATION POSITION
0042 6313                  DYC DYL
0043 7430                  SZL             /DISPLAYS IF LINK=1
0044 6304                  DIS
0045 1361                  TAD CHSIZ       /GO  NEXT POSSIBLE DOT-
0046 3075                  DCA CHYS        /KEEP RECORD OF PRESENT POSITION
0047 2100                  ISZ CHCNT1      /DO ALL THIS SIX TIMES
0050 5236                  JMP CHDIS
0051 1104                  TAD CHXL
0052 1361                  TAD CHSIZ
0053 6303                  DXC DXL
0054 3104                  DCA CHXL
0055 2077                  ISZ CHCNT2      /HAS SECOND HALF BEEN DONE?
0056 5232                  JMP CHSET3      /NO, DO IT
0057 1502                  TAD I CHPNT     /GET SECOND WORD
0060 3101                  DCA CHROT
0061 2076                  ISZ CHCNT3
0062 5230                  JMP CHSET2
```

```
3663  1361          TAD CHSIZ       /BOTH DONE
3664  7104          CLL RAL
3665  1104          TAD CHXL
3666  3104          DCA CHXL        /SPACE 2 INCREMENTS
3667  5600          JMP I CHDSC
```

```
0570  2200          CHEND,  ISZ CHOSC
0571  6303                  DXC DXL
0572  1364                  TAD K0401
0573  6313                  DYC DYL
0574  7200                  CLA
0575  5600                  JMP I CHOSC
                    /SPACE:  MOVE X RIGHT 6 INCREMENTS
0576  4305          CHSPA,  JMS GET6        /GET X FOR WHOLE CHARACTER
0577  5302                  JMP CHBKS+2

                    /BACKSPACE:  MOVE X LEFT ONE CHARACTER
0600  4305          CHBKS,  JMS GET6
0601  7041                  CMA IAC
0602  1104                  TAD CHXL                  /MOVE X POINTER LEFT
0603  3104                  DCA CHXL        /ONE CHARACTER
0604  5600                  JMP I CHOSC

                    /GETS SIX TIMES CHAR SIZE
0605  0000          GET6,   0
0606  1361                  TAD CHSIZ
0607  7106                  CLL RTL         /4 TIMES SIZE
0610  3075                  DCA CHFAC
0611  1361                  TAD CHSIZ
0612  7104                  CLL RAL         /PLUS 2 TIMES SIZE
0613  1075                  TAD CHFAC       /IS SIX TIMES SIZE
0614  5705                  JMP I GET6

                    /SELECT NEW X POSITION
0615  4454          CHREST, LDH
0616  1362                  TAD KM0001
0617  0363                  AND K0017
0620  7106                  CLL RTL
0621  7006                  RTL
0622  7004                  RAL
0623  3104                  DCA CHXL

                    /SELECT NEW Y POSITION
0624  4454          CHYPOS, LDH
0625  0363                  AND K0017
0626  7106                  CLL RTL
0627  7006                  RTL
0630  7004                  RAL
0631  7041                  CMA IAC
0632  1364                  TAD K0401
0633  3105                  DCA CHYL
```

```
                        /CHARACTER SIZE SELECTION
3/54  4454              CHCSZ,  LDH
3/55  0363                      AND K0017       /ELIMINATE ALL BUT BITS 8-11
3/56  7104                      CLL RAL
3/57  3361                      DCA CHSIZ       /STORE DESIRED CHARACTER SIZE

                        /INTENSIFICATION SELECTION
3/60  4454              CHINT,  LDH
3/61  0060                      AND K0003       /ELIMINATE ALL BUT BITS 10 AND 11
3/62  1365                      TAD KDSB        /SET INTENSITY
3/63  3344                      DCA .+1
3/64  6324                      DSB             /WILL BE DSB X
3/65  5600                      JMP I CHDSC

3/66  5600                      JMP I CHDSC

                        /CARRIAGE RETURN:  RETURN X TO LEFT MARGIN
3/67  3104              CHCR,   DCA CHXL
3/70  5600                      JMP I CHDSC

                        /LINE FEED:  MOVE Y DOWN 8 INCREMENTS
3/71  1361              CHLF,   TAD CHSIZ       /8 TIMES CHAR SIZE
3/72  7106                      CLL RTL
3/73  7004                      RAL
3/74  7041                      CMA IAC         /SUBTRACT FROM Y POSITION
3/75  1105                      TAD CHYL
3/76  3105                      DCA CHYL        /NEW Y POSITION
3/77  5600                      JMP I CHDSC

                        /CONSTANTS USED THIS PAGE ONLY
4/00  5015              CHJMP,  JMP I CHJMPL+1

                        /VARIABLES FOR THIS PAGE
4/01  0004              CHSIZ,  4       /CHARACTER SIZE CONSTANT


4/02  7777              K7777,  -1
4/03  0017              K0017,  17
4/04  0401              K0401,  401

4/05  6324              KDSB,   DSB
```

```
3766  0000        DSCTBL, 0                 /@ SPECIAL, MEANS END OF TEXT
3767  0005                ENDIS

3770  7711              //11          /A
3771  1177              1177

3772  7745              //45          /B
3773  4532              4532

3774  3641              3641          /C
3775  4122              4122

3776  7741              //41          /D
3777  4136              4136

4000  7751              //51          /E
4001  5141              5141

4002  7711              //11          /F
4003  1101              1101

4004  3641              3641          /G
4005  5132              5132

4006  7710              //10          /H
4007  1077              1077

4010  0077              0077          /I
4011  0000              0000

4012  2040              2040          /J
4013  4037              4037

4014  7714              //14          /K
4015  2241              2241

4016  7740              //40          /L
4017  4040              4040

4020  7706              //06          /M
4021  0677              0677

4022  7704              //04          /N
4023  1077              1077

4024  7741              //41          /O
4025  4177              4177

4026  7711              //11          /P
4027  1106              1106

4030  1621              1621          /Q
4031  3156              3156
```

```
13    /11              7711         /R
13    3146             3146

134   2245             2245         /S
135   4531             4531

13    0101             0101         /T
137   7701             7701

14    7740             7740         /U
14    4077             4077

142   3740             3740         /V
14    2017             2017

14    7730             7730         /W
145   4077             4077

14    6314             6314         /X
14    1463             1463

050   0770             0770         /Y
0:    7007             7007

052   6151             6151         /Z
053   4543             4543

0     0617             0617         /[ DISPLAYED AS #
0     1706             1706

0     1057             1057         /\ DISPLAYED AS DOWN ARROW
0     1000             1000

060   2313             2313         /] DISPLAYED AS %
061   6462             6462

0 2   0475             0475         /↑
063   0400             0400

                 /SPECIAL, DOES BACKSPACE
0 4   0000             0
065   0001             BKSPC

0 5   0000             0            /SPACE IS A SPECIAL CHARACTER
0 7   7777             SPACE

070   0057             0057         /!
0 1   0000             0000

0 2   0000             0            /" SPECIAL, MARKS PROG INPUT TO TEXT BUFFER, NOT DISPL
073   0000             IGNOR

0 4   0000             0            /# SPECIAL, DOES LINE FEED
0 5   0003             LFEED
```

```
/   ØØØØ          Ø          /$ SPECIAL, DISPLAY RESET FOLLOWS
     ØØ2          RESET

 1  ØØØØ          Ø          /% SPECIAL, DOES CARRIAGE RETURN
Ø1  ØØØ4          CRETN

    Ø717          Ø717       /&
    751Ø          751Ø

Ø4  ØØØØ          Ø          /' SPECIAL, MARKS KBD INPUT TO TEXT BUFFER, NOT DISPLA
    ØØØØ          IGNOR

    7741          7741       /( DISPLAYED AS [
Ø7  41ØØ          41ØØ

 1  ØØ41          ØØ41       /) DISPLAYED AS ]
    4177          4177

12  2214          2214       /* DISPLAYED AS LITTLE X
    1422          1422

14  Ø416          Ø416       /+
15  Ø4ØØ          Ø4ØØ

    ØØ5Ø          ØØ5Ø       /,
17  3ØØØ          3ØØØ

    Ø4Ø4          Ø4Ø4       /-
    Ø4ØØ          Ø4ØØ

22  ØØ4Ø          ØØ4Ø       /.
    ØØØØ          ØØØØ

     Ø1Ø          2Ø1Ø       //
25  Ø4Ø2          Ø4Ø2

 5  3641          3641       /Ø
 7  4136          4136

3Ø  ØØ42          ØØ42       /1
    774Ø          774Ø

32  6251          6251       /2
33  5146          5146

 4  2241          2241       /3
 5  4532          4532

 5  1412          1412       /4
 7  771Ø          771Ø

4Ø  2745          2745       /5
41  4531          4531
```

```
4142  3645                    3645          /6
4143  4550                    4550

4144  6111                    6111          /7
4145  0503                    0503

4146  3245                    3245          /8
4147  4552                    4552

4150  0651                    0651          /9
4151  5136                    5136

4152  0033                    0033    /:
4153  0000                    0000

4154  0053                    0053          /;
4155  3000                    3000

4156  1422                    1422          /<
4157  4100                    4100

4160  0012                    0012          /=
4161  1212                    1212

4162  4122                    4122          />
4163  1400                    1400

4164  0251                    0251          /?
4165  0502                    0502

      4200              *. 17/+1

                        /LOAD HALF WORD AN DISPLAY
4200  /402              MESG,   XX
4201  7240                      CLA CMA
4202  1200                      TAD MESG
4203  3010                      DCA 10
4204  1410                      TAD I 10
4205  3103                      DCA MSRHT
4206  1103                      TAD MSRHT
4207  7012                      RTR
4210  7012                      RTR
4211  7012                      RTR
4212  0046                      AND K0077
4213  4455                      DSC
4214  7610                      SKP CLA
4215  5410                      JMP I 10
4216  1103                      TAD MSRHT
4217  0046                      AND K0077
4220  4455                      DSC
4221  5204                      JMP MESG+4
4222  5410                      JMP I 10
```

```
                        /SCOPE LOOP CHECK
                        /SCOPE WITH SWITCH BIT 10=1
4223  7402              SCOPEA, XX
4224  7604                      LAS
4225  0033                      AND K0002
4226  7640                      SZA CLA
4227  5633                      JMP I RETURN
4230  1223                      TAD SCOPEA
4231  3233                      DCA RETURN
4232  5623                      JMP I SCOPEA

4233  0200              RETURN, BEGIN
4234  5633                      JMP I RETURN

                        /INHIBIT PRINT OUT WHEN BIT 11=1

4235  7402              IPRINT, XX
4236  3120                      DCA AC                    /SAVE AC
4237  7604                      LAS
4240  7010                      RAR
4241  7620                      SNL CLA
4242  5250                      JMP .+6
4243  1235                      TAD IPRINT
4244  1052                      TAD K7776                 /MINUS 2
4245  3235                      DCA IPRINT
4246  1635                      TAD I IPRINT
4247  3235                      DCA IPRINT
4250  1120                      TAD AC                    /RESTORE AC
4251  5635                      JMP I IPRINT
                        /GENERATE CR,LF
4252  7402              CRLF,   XX
4253  4513                      JMS I XTYPE
4254  4543                      4543
4255  0000                      0000
4256  6032                      KCC
4257  6042                      TCF
4260  5652                      JMP I CRLF
```

```
                        /PRINTOUT CONTENTS OF AC AND ERROR ADDRESS
4261  7402              ERADD,  XX
4262  4514                      JMS I XIPRIN          /TEST FOR INHIBIT PRINT
4263  6002                      IOF
4264  4515                      JMS I XSIXTY
4265  4261                      ERADD
4266  4272                      .+4
4267  4273                      .+4
4270  4513                      JMS I XTYPE           /TYPE ERROR ADDRESS
4271  4543                      4543
4272  6060                      6060
4273  6060                      6060
4274  4000                      4000
4275  4515                      JMS I XSIXTY
4276  0120                      AC
4277  4303                      .+4
4300  4304                      .+4
4301  4513                      JMS I XTYPE           /TYPE  AC
4302  4040                      4040
4303  6060.                     6060
4304  6060                      6060
4305  0000                      0000
4306  6042                      ICF
4307  6032                      KCC
4310  7604                      LAS                   /TEST FOR HALT
4311  7012                      RTR                   /BIT 9=1, (0004)
4312  7010                      RAR
4313  7620                      SNL CLA
4314  5661                      JMP I ERADD
4315  1120                      TAD AC
4316  7402                      HLT
4317  5661                      JMP I ERADD

                        PAUSE
```

```
                        /TAPE 4
                        /DIGITAL 8-18-U
                        /MESSAGE TYPE-OUT
                        /CALL WITH A JMS MESAGE
                        /WITH DATA FOLLOWING
                        /RETURN FOLLOWING END OF MESSAGE
                        /CODE(00)

4520  0000      MESAGE,   0
4521  7240                CLA CMA             /SET C(AC)=-1
4522  1520                TAD MESAGE          /ADD LOCATION
4523  3010                DCA 10              /AUTO-INDEX REGISTER
4524  1410                TAD I 10            /FETCH FIRST WORD
4525  3336                DCA MSRGHT          /SAVE IT
4526  1336                TAD MSRGHT
4527  7312                RTR
4530  7012                RTR                 /ROTATE 6 BITS RIGHT
4531  7012                RTR
4532  4337                JMS TYPECH          /TYPE IT
4533  1336                TAD MSRGHT          /GET DATA AGAIN
4534  4337                JMS TYPECH          /TYPE RIGHT HALF
4535  5324                JMP MESAGE+4        /CONTINUE
4536  0000      MSRGHT,   0                   /TEMPORARY STORAGE

4537  0000      TYPECH,   0                   /TYPE CHARACTER IN C(AC)6-11
4540  0370                AND MASK77
4541  7450                SNA                 /IS IT END OF MESSAGE?
4542  5410                JMP I 10            /YES: EXIT
4543  1371                TAD M40             /SUBTRACT 40
4544  7500                SMA                 /<40?
4545  5350                JMP .+3             /NO
4546  1372                TAD C340            /YES: ADD 300
4547  5365                JMP MTP             /TO CODES <40
4550  1373                TAD M3              /SUBTRACT 3
4551  7440                SZA                 /IS IT ZERO?
4552  5353                JMP .+3             /NO
4553  1374                TAD C212            /YES: CODE 43 IS
4554  5365                JMP MTP             /LINE-FEED (212)
4555  1375                TAD M2              /SUBTRACT 2
4556  7440                SZA                 /IS IT ZERO?
4557  5362                JMP .+3             /NO
4560  1376                TAD C215            /YES: CODE 45 IS
4561  5365                JMP MTP             /CARRIAGE-RETURN (215)
4562  1377                TAD C245            /ADD 200 TO OTHERS >40
4563  6046      MTP,      TLS                 /TRANSMIT CHARACTER
4564  6041                TSF                 /WAIT FOR FLAG
4565  5364                JMP .-1             /NOT SET YET
4566  7200                CLA                 /SET: CLEAR C(AC)
4567  5737                JMP I TYPECH        /RETURN
```

```
4570  0077
4571  7740
4572  0340
4573  7775
4574  0212
4575  7776
4576  0215
4577  0245

/CONSTANTS
MASK77,   77
M40,      -40
C340,     340
M3,       -3
C212,     212
M2,       -2
C215,     215
C245,     245

$
```

THERE ARE NO ERRORS

SYMBOL TABLE

AC	0120
ACMX	6371
ADBUF	2515
ADBUFR	2404
ADCV	6364
ADSTBL	0026
ANGLE	2047
BAD	0070
BEGIN	0200
BKSPC	0001
CCONTA	0065
CCONTB	0066
CCONTC	0067
CHBKS	3700
CHCNT1	0100
CHCNT2	0077
CHCNT3	0076
CHCR	3747
CHCSW	3734
CHDIS	3636
CHDSC	3600
CHDSC1	0033
CHEND	3670
CHFAC	0075
CHINT	3740
CHJMP	3750
CHJMPL	3614
CHLF	3751
CHPNT	0102
CHRES1	3715
CHROT	0101
CHSET1	3623
CHSET2	3630
CHSET3	3632
CHSTK	3751
CHSPA	3676
CHTST	1400
CHTST1	1441
CHTST2	1410
CHXL	0104
CHYL	0105
CHYPOS	3724
CHYS	0075
CLER	6331
CLRK	6334
CLXK	6332
CON1	1340
CON2	1333
CON3	1331
COUNT	0143
CRETN	0004
CRLF	4232
CTEMA	0052

SYMBOL TABLE

CTEMB	0063
CTEMC	0064
C0073	0037
C212	4374
C215	4376
C245	4377
C34B	4372
DMLL	4530
DMLLA	0130
DMLLS	2224
DMLR	4527
DMLRA	0127
DMLRS	2212
DIS	6324
DISLOP	2452
DLDL	4523
DLDLA	0123
DLDLS	2237
DRDL	4524
DRDLA	0124
DRDLS	2256
DSB	6324
DSC	4455
DSCTBL	3766
DVLB	4526
DVLBA	0126
DVLBS	2200
DVLI	4525
DVLIA	0125
DVLIS	2160
DXC	6301
DXL	6302
DYC	6311
DYL	6312
ENDIS	0005
ERADD	4261
EXECUT	2025
FI1	0026
GET6	3705
HALT	4512
IGMX	6361
IGNOR	0000
INIDIS	2441
INISAM	2410
INIT3	2405
INLL	0071
IPRINT	4235
KUSB	3765
KEYS	2015
KM0001	3762
KM0006	0061
KM0020	0050
KM0043	0022

SYMBOL TABLE

KM0777	0024
KM1000	0047
K0002	0035
K0003	0050
K0004	0036
K0007	1/27
K0015	0044
K0017	3/63
K0034	0056
K0043	0107
K0070	1/30
K0077	0046
K0100	0031
K0200	0040
K0342	0042
K0400	0025
K0401	3/54
K0600	0131
K0700	1/31
K1000	0052
K1002	0051
K1004	0041
K2002	0034
K3002	0055
K377	0133
K400	0136
K4002	0045
K6324	0132
K7000	1/32
K7400	0021
K7700	0045
K777	0137
K7776	0052
K7777	0053
LOH	4454
LOIAG	2037
LPEED	0003
LOOP	0072
LOOPA	0245
MASKA	1/22
MASKB	1/23
MASKC	1/24
MASKD	1/25
MASK77	4370
MESAGE	4320
MESG	4200
MSRGHI	4336
MSRHT	0103
MSSG	0054
MIP	4363
MIW	7344
MUXNUM	0057
MYMX	2263

SYMBOL TABLE

MYPX	2243
M0377	0027
M2	4375
M200	0142
M3	4373
M40	4371
M400	0141
M7400	0020
OPR	7000
OTEN	6344
PNTR	0010
P2	0140
RADC	6352
RCNT	2403
RCX	1200
RCX1	1241
RCX2	1303
RCX3	1324
RDIAG	2043
RESET	0002
RETURN	4233
SAMLOP	2414
SAM1	2435
SCOPE	4511
SCOPEA	4223
SIXIY	1642
SIX12	1733
SRAD	6352
SRER	6322
SRRK	6341
SRXR	6321
SL1	0025
SPACE	7777
STALL	0106
STATE	2476
STLL	4316
STLLS	2116
STLR	4336
STLRS	2136
STUL	4326
STULS	2126
STUR	4322
STURA	0122
STURS	2147
SWTCH	2000
TEMP01	0075
TEMP02	0076
TEMP03	0077
TEMP04	0100
TEMP05	0101
TEMP06	0102
TEXTB	1600
TEXTB1	1635

SYMBOL TABLE

TYPECH	4337
VAL1	1505
X	2401
XGOX	2071
XORLF	0116
XER	0674
XERADD	0112
XINIS	0110
XIPRIN	0114
XPOSR	0134
XRCL	6334
XRIN	6331
XSCOPE	0111
XSIXTY	0115
XSWICH	0121
XTEXIB	0117
XTYPE	0113
XX	7402
Y	2402
YPOSR	0135
ZIEN	6342

SYMBOL TABLE

IGNOR	0000
BKSPC	0001
RESET	0002
LFEED	0003
CRETN	0004
ENDTS	0005
PNTR	0010
M/400	0020
K/400	0021
KM0043	0022
K0401	0023
KM777	0024
SL1	0025
F11	0026
M0377	0027
K0034	0030
K0100	0031
K1000	0032
K0002	0033
K2002	0034
K3002	0035
K0004	0036
C007A	0037
K0200	0040
K1004	0041
K0340	0042
K4002	0043
K0015	0044
K/700	0045
K007/7	0046
KM1000	0047
KM0020	0050
K1002	0051
K/776	0052
K/777	0053
MSSG	0054
CMDSCI	0055
AUSTBL	0056
MUXNUM	0057
K0003	0060
KM0000	0061
CIEMA	0062
CIEMB	0063
CIEMC	0064
CCONTA	0065
CCONTB	0066
CCONTC	0067
BAD	0070
INLL	0071
LOOP	0072
XER	0074
CMYS	0075
TEMP01	0075

SYMBOL TABLE

CMFAC	0075
CMCNT3	0076
TEMP02	0076
CMCNT2	0077
TEMP03	0077
CMCNT1	0100
TEMP04	0100
TEMP05	0101
CMROT	0101
CMPNT	0102
TEMP06	0102
MSRNT	0103
CMXL	0104
CMYL	0105
STALL	0106
K0042	0107
XINIS	0110
XSCOPE	0111
XERASD	0112
XTYPE	0113
XTPRIN	0114
XSIXTY	0115
XCRLF	0116
XTEXTB	0117
AC	0120
XSWITCH	0121
STORA	0122
ULDLA	0123
UNDLA	0124
UVLTA	0125
UVLBA	0126
UHLRA	0127
UHLLA	0130
K0600	0131
K0524	0132
K577	0133
XPOSR	0134
YPOSR	0135
K400	0136
K777	0137
P2	0140
M400	0141
M200	0142
COUNT	0143
BEGIN	0200
LOOPA	0245
RCX	1200
RCX1	1241
RCX2	1303
RCX3	1324
CON3	1331
CON1	1340
CON2	1353

SYMBOL TABLE

CHTST	1400
CHTST2	1410
CHTST1	1441
VAL1	1505
TEXTB	1600
TEXTB1	1635
SIXTY	1642
MASKA	1722
MASKB	1723
MASKC	1724
MASKD	1725
K0007	1727
K0072	1730
K0700	1731
K7000	1732
SIX12	1733
SWTCH	2000
KEYS	2015
EXECUT	2025
LDIAG	2037
RDIAG	2043
ANGLE	2047
XBOX	2071
SILLS	2116
SIDLS	2126
SILRS	2136
SIDRS	2147
DVLIS	2150
DVLBS	2200
DMLRS	2212
DMLLS	2224
DLDLS	2237
MYPX	2243
DRDLS	2256
MYMX	2263
X	2401
Y	2402
RCNT	2403
ADBUFR	2404
INIT3	2405
INISAM	2410
SAMLOP	2414
SAM1	2435
INIDIS	2441
DISLOP	2452
STATE	2476
ADBUF	2515
CHDSC	3600
CHJMPL	3614
CHSET1	3623
CHSET2	3630
CHSET3	3632
CHDIS	3636

SYMBOL TABLE

CMEND	3670
CMSPA	3676
CMBKS	3700
GET6	3705
CMRES1	3715
CMYPOS	3724
CMCSZ	3734
CMINT	3746
CMCR	3747
CMLF	3751
CMJMP	3760
CMSIZ	3761
KM0001	3762
K0017	3763
K0401	3764
KUSR	3765
USCIBL	3766
MESG	4200
SCOPEA	4223
RETURN	4233
IPRINT	4235
CRLF	4252
ERADD	4261
SILL	4316
MESAGE	4320
SIUL	4326
SILR	4336
MSRGHT	4336
TYPECH	4337
MIP	4363
MASK77	4370
M40	4371
C340	4372
M3	4373
C212	4374
M2	4375
C215	4376
C245	4377
LDH	4404
USC	4405
SCOPE	4411
HALT	4412
SIUR	4422
ULDL	4423
URDL	4424
UVLT	4425
UVLB	4426
UMLR	4427
UMLL	4430
UXC	6301
UXL	6302
UIS	6304
UYC	6311

SYMBOL TABLE

DYL	6312
SAXR	6321
SAER	6322
DSB	6324
XAIN	6331
SAAD	6332
XACL	6334
SARR	6341
ZIEN	6342
DIEN	6344
CLER	6351
CLXR	6352
CLRR	6354
TCMX	6361
RADC	6362
AUCV	6364
ACMX	6371
DPR	7000
MIW	7344
XX	7402
SPACE	7777