DataGeneral

TECHNICAL STATEMENT

TEXT LISTING

068-000539-01

PROGRAM

MICRO NOVA ANALOG TO DIGITAL
INTERFACE DIAGNOSTIC

TEXT TAPE

097-000539-01

ABSTRACT

THIS PROGRAM IS A LOGIC LEVEL TEST OF THE MODEL 4223 MICRO NOVA ANALOG TO DIGITAL INTERFACE.

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!0005 .MAIN
01              ;AN INTERESTING FEATURE OF THE CHANNEL ADDRESSING LOGIC IS
02              ;ITS ABILITY TO "WRAP AROUND" ADDRESS 17 OCTAL.  THUS, THE
03              ;FINAL CHANNEL MAY BE LESS THAN THE INITIAL CHANNEL.  FOR
04              ;EXAMPLE, IF THE INITIAL CHANNEL IS 12 OCTAL AND THE FINAL
05              ;CHANNEL IS 3 OCTAL, CONVERSIONS OCCUR FOR CHANNELS 12,13,
06              ;14,15,16,17,0,1,2,3,12,13,....  THE EIGHT DIFFERENTIAL
07              ;CHANNELS WOULD NORMALLY BE NUMBERED 0-7.  IF IT IS
08              ;DESIRED TO USE THE WRAP-AROUND FEATURE TO CONVERT DIFFERENTIAL
09              ;CHANNELS 6,7,0,1,2, HOWEVER, THE INITIAL CHANNEL MUST
10              ;BE GIVEN AS 16 OCTAL AND THE FINAL AS 2 OCTAL, SINCE THE
11              ;WRAP-AROUND OCCURS AROUND 17 OCTAL.
12
13              ;THE DOA INSTRUCTION SHOULD NOT BE GIVEN IF BUSY IS SET.
14              ;ALL STATUS BITS SET UP BY THE DOA INSTRUCTION REMAIN
15              ;THE SAME UNITL THE NEXT DOA INSTRUCTION FOR /IORST/,
16              ;WHICH CLEARS ALL STATUS BITS.
17
18              ;AN END-OF-CONVERSION SIGNAL FROM THE DAS WHEN CONVERTING
19              ;IN PROGRAMMED I/O MODE, OR A /WCEZ/ SIGNAL FROM THE
20              ;MN6B3 I/O CONTROLLER CHIP IN DATA CHANNEL MODE SETS
21              ;DONE AND WILL REQUEST AN INTERRUPT IF INTERRUPTS
22              ;ARE ENABLED.
23
24              ;A CLOCK OVERRUN WILL OCCUR IF AN END-OF-CONVERSION
25              ;SIGNAL (EOC) OCCURS BEFORE DATA FROM THE PREVIOUS
26              ;CONVERSION IS READ INTO THE CPU.  THIS CAUSES THE CURRENT
27              ;DATA TO BE LOST.  THE CLOCK OVERRUN SIGNAL SETS
28              ;A STATUS BIT WHICH CAN BE READ BY A DIA INSTRUCTION
29              ;AND CAN ALSO, BY SETTING A JUMPER, SET DONE.  THE DIA
30              ;INSTRUCTION ALSO READS IN THE CURRENT MUX CHANNEL, EOC
31              ;AND A BIT INDICATING AN EXTERNAL INTERRUPT REQUEST.
32              ;SUCH A REQUEST, WHICH OCCURS BY PULLING THE /EXTERNAL
33              ;INTERRUPT REQUEST/ LINE LOW, DIRECTLY REQUESTS AN
34              ;INTERRUPT WITHOUT SETTING DONE.  EOC IS LOW DURING AN
35              ;A/D CONVERSION AND OTHERWISE IS HIGH.  READING IN EOC
36              ;BY A DIA INSTRUCTION IS USEFUL IN THE IOPLS DATA CHANNEL
37              ;MODE TO INDICATE THAT NEW DATA IS READY AND THAT,
38              ;AFTER THE APPROPRIATE DATA CHANNEL LATENCY, WILL BE
39              ;READ TO THE CPU.
40
41              ;AN ADC READY SIGNAL (TRUE HIGH OR LOW, JUMPER SELECT-
42              ;ABLE) IS A HANDSHAKING SIGNAL THAT INDICATES TO THE
43              ;USER THAT THE DAS HAS FINISHED THE CURRENT CONVERSION
44              ;AND IS READY TO DO ANOTHER CONVERSION.  AS SOON AS A
45              ;NEW CONVERSION BEGINS, THIS SIGNAL CHANGES STATE UNTIL
46              ;THE NEXT END-OF-CONVERSION SIGNAL.
47
48              ;THE NOMINAL INTERNAL CLOCK RANGE (PERIOD) IS:
49              ;30 US - 500 US (ADJUSTABLE BY POTENTIOMETER R20).
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!0006 .MAIN
01              ;7.2:   PROGRAM OPERATION:
02              ;       THIS DIAGNOSTIC IS INTENDED TO TEST THE FOLLOWING
03              ;       LOGIC AND/OR FUNCTIONS: BUSY, DONE, START, CLEAR
04              ;       IORST (ADC RST), IOPLS, A/D MODE REGISTER (DOA),
05              ;       DCH ADDRESS REGISTER (DOB/DIB), DCH WORD COUNT (DOC),
06              ;       A/D STATUS (EOC, EXTERNAL INTERRUPT, CLK OVERRUN,
07              ;       CURRENT MUX CHANNEL) REGISTER (DIA), MUX CHANNEL
08              ;       SCAN COUNTERS, INTERRUPT REQUESTS, INTERRUPT
09              ;       DISABLE (MSKO), A/D CONVERSIONS (PIO/START,
10              ;       PIO/INTERNAL CLOCK, DCH/IOPLS, DCH/DCHI,
11              ;       DCH/INTERNAL CLOCK), DCH RANDOM ADDRESS EXERCISERS
12              ;       OPTIONAL TESTS ARE INCLUDED TO TEST: EXTERNAL
13              ;       CLOCK OPERATION (PIO/DCH), EXTERNAL INTERRUPT
14              ;       REQUESTS.
15
16              ;       THE PROGRAM CHECKS THE ABOVE THROUGH A SERIES
17              ;       OF SUBTESTS. IF NO ERROR IS FOUND, THE PROGRAM
18              ;       WILL PERFORM THE TESTS IN SEQUENCE UNTIL THE LAST
19              ;       TEST, AT WHICH TIME AN END OF PASS MESSAGE WILL
20              ;       BE PRINTED. IF AN ERROR OCCURS, THE OPERATOR WILL BE
21              ;       INFORMED OF IT. TO FIND THE PROBLEM, REFER TO THE
22              ;       ASSOCIATED ERROR NUMBER AND PROGRAM COUNTER IN
23              ;       THE DIAGNOSTIC LISTING. TO FIND THE ACTUAL HARDWARE
24              ;       FAILURE, SET UP A SCOPE LOOP (SEE SECTION 8)
25              ;       AND TRACE THE FAILURE WITH AN OSCILLOSCOPE.
26              ;       THE COMMENTS IN THE LISTING WILL GIVE THE OPERATOR
27              ;       INFORMATION ABOUT THE PROBLEM AS WELL AS
28              ;       INFORMATION CONCERNING THE ACCUMULATOR CONTENTS.
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!0007 .MAIN
01              ;8.     OPERATING MODES/SWITCH COMMANDS:
02              ;       ==========================.
03              ;       LOCATION "SWREG" IS USED TO SELECT THE PROGRAM OPTIONS
04              ;       (NOT SYSTEM CONFIGURATION). WHILE RUNNING UNDER DTOS,
05              ;       THIS LOCATION WILL BE LOADED BY THE MONITOR.
06              ;       HOWEVER UNDER STAND ALONE AND PROGRAM LOAD MODES THIS
07              ;       LOCATION WILL BE SET ACCORDING TO THE ANSWERS SUPPLIED
08              ;       BY THE OPERATOR. IN ANY CASE THE OPTIONS CAN BE CHANGED
09              ;       OR VERIFIED BY USING ONE OF THE COMMANDS GIVEN IN SEC.
10              ;       8.2
11              ;
12              ;8.1    SWITCH OPTIONS
13              ;       DIFFERENT BITS AND THEIR INTERPRETATION AT LOCATION
14              ;       "SWREG" IS AS FOLLOWS:
15              ;
16              ;       BIT     OCTAL   BINARY  INERPRETATION
17              ;               VALUE   VALUE
18              ;
19              ;       1               0       LOOP ON ERROR
20              ;               40000   1       SKIP LOOPING ON ERROR
21              ;
22              ;       2               0       PRINT TO CONSOLE
23              ;               20000   1       ABORT PRINT OUT TO CONSOLE
24              ;
25              ;       3               0       DO NOT PRINT % FAILURE
26              ;               10000   1       PRINT % FAILURE
27              ;
28              ;       4               0       ALLOW END OF PASS PRINT OUT
29              ;               04000   1       SUPPRESS END OF PASS PRINT OUT
30              ;
31              ;       5               0       DO NOT PRINT ON THE LINE PRINTER
32              ;               02000   1       PRINT ON THE LINE PRINTER
33              ;
34              ;       6               0       DO NOT HALT ON ERROR
35              ;               01000   1       HALT ON ERROR
36              ;
37              ;       7               0       DO NOT PRINT SUMMARY AND/OR
38              ;                               PASSING OF EACH SUBTEST
39              ;               00400   1       PRINT SUMMARY AND/OR
40              ;                               PASSING OF EACH SUBTEST
41              ;
42              ;       8               0       PRINT ONLY THE FIRST ERROR
43              ;               00200   1       PRINT EVERY ERROR
```

```
!0008 .MAIN
01              ;8.2    SWITCH COMMANDS
02              ;       ONCE THE PROGRAM STARTS EXECUTING THE STATE OF ANY OF
03              ;       THE BITS CAN BE CHANGED BY HITTING KEYS 1-9, A-F. THE
04              ;       PROGRAM WILL CONTINUE RUNNING AFTER UPDATING THE OPTIONS
05              ;       EACH KEY WILL COMPLEMENT THE STATE OF THE BIT AFFILIAT-
06              ;       ED WITH IT, THUS BIT 4 CAN BE ALTERED BY HITTING KEY 4.
07              ;       SETTING OF ANY BIT OF LOCATION "SWREG" WILL SET BIT 0.
08              ;       (DEFAULT MODE IS DEFINED AS ALL BITS OF SWREG SET TO 0)
09              ;       THE PROGRAM CAN BE LOCKED INTO SWITCH MODIFICATION MODE
10              ;       BY TYPING A 0, IN WHICH CASE MORE THAN ONE BIT CAN BE
11              ;       CHANGED BEFORE  CONTROL IS ALLOWED TO RETURN TO THE
12              ;       MAIN PROGRAM.
13              ;
14              ;8.2.1  OTHER COMMANDS
15              ;       "CR"    A "RETURN" CAN BE TYPED TO CONTINUE THE PROGRAM
16              ;               AFTER ITS LOCKED IN A SWITCH MODIFICATION MODE
17              ;
18              ;       ^D      THIS COMMAND GIVEN AT ANY TIME WILL RESET "SWREG
19              ;               TO DEFAULT MODE AND RESTART THE PROGRAM.
20              ;
21              ;       ^R      THIS COMMAND GIVEN AT ANY TIME WILL RESTART THE
22              ;               PROGRAM. SWITCHES ARE LEFT WITH THE VALUES THEY
23              ;               HAD BEFORE THE COMMAND WAS ISSUED.
24              ;
25              ;       ^O      THIS COMMAND GIVEN AT ANY TIME WILL CAUSE THE
26              ;               PROGRAM CONTROL TO GO TO ODT (NOTE: THIS IS AN
27              ;               OPTIONAL COMMAND AND IS AVAILBLE ONLY IF
28              ;               ODTPK IS PRESENT)
29              ;
30              ;       M       THIS COMMAND GIVEN AT ANY TIME WILL PRINT THE
31              ;               CURRENT OPERATING MODES.
```

```
 0001 .MAIN    MACRO REV 06.38          12:58:55 08/18/78
01
02
03
04              /*************************************************************
05              /
06              / NAME: MNADC.TX                          PART NUMBER: 097-000539
07              /
08              /
09              / DESCRIPTION: MICRO NOVA ANALOG TO DIGITAL INTERFACE DIAGNOSTIC
10              /
11              /
12              / REVISION HISTORY:
13              /
14              /       REV.            DATE
15              /
16              /       00              11/16/77
17              /       01              08/18/78
18              /
19              /
20              / COPYRIGHT (C) DATA GENERAL CORPORATION, 1977, 1978
21              / ALL RIGHTS RESERVED.
22              / LICENSED MATERIAL - PROPERTY OF DATA GENERAL CORPORATION.
23              /*************************************************************
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 0002 .MAIN
01              /1.     PROGRAM NAME:
02              /       ~~~~~~~~~~~~
03              /       MNADC   -   MICRO NOVA ANALOG TO DIGITAL INTERFACE
04              /                           DIAGNOSTIC
05
06              /2.     REVISION HISTORY:
07              /       ~~~~~~~~~~~~~~~~
08              /       REV 00   -   11/16/77
09              /       REV 01   -   08/18/78
10
11              /3.     MACHINE REQUIREMENTS:
12              /       ~~~~~~~~~~~~~~~~~~~~
13              /       1.  MICRO NOVA CENTRAL PROCESSOR WITH AT LEAST
14              /           4K READ/WRITE (RAM) MEMORY
15              /       2.  MICRO NOVA ASYNCHRONOUS INTERFACE
16              /       3.  TELETYPE OR CRT TERMINAL
17              /       4.  PAPER TAPE READER AND/OR DISKETTE DRIVE
18
19              /4.     TEST REQUIREMENTS:
20              /       ~~~~~~~~~~~~~~~~~
21              /       1.  MICRO NOVA ANALOG TO DIGITAL INTERFACE MODEL 4223
22              /       2.  MICRO NOVA ANALOG TO DIGITAL INTERFACE DIAGNOSTIC
23              /           - AB TAPE PART # 095 - 000539
24              /             LISTING PART # 096 - 000539
25
26              /5.     SUMMARY:
27              /       ~~~~~~~
28              /       THIS PROGRAM IS A LOGIC LEVEL TEST OF THE MODEL 4223
29              /       MICRO NOVA ANALOG TO DIGITAL INTERFACE.
30
31              /6.     RESTRICTIONS:
32              /       ~~~~~~~~~~~~
33              /       1.  THIS DIAGNOSTIC CAN TEST ONE A/D INTERFACE
34              /           AT A TIME.
35              /       2.  THE FOLLOWING SIGNALS ARE NOT TESTED:
36
37              /           HANDSHAKING SIGNALS AND CONTROL FUNCTIONS:
38              /           ADC READY, SINGEND, DIFF, ADC CLOCK, ADC SERIAL
39              /           DATA, ADC CR PLT TEST, INTERNAL CLOCK (HANDSHAKING
40              /           SIGNAL ONLY).
41
42              /           ANALOG SIGNALS:
43              /           ANA0 - ANA17 (ANALOG MULTIPLEXOR INPUT LINES),
44              /           SAMPLE AND HOLD, ADMS8 - ADLS8 (A/D DATA OUTPUT
45              /           LINES - NO ACTUAL DATA VALUES ARE EXPECTED OR
46              /           TESTED. HOWEVER, DURING DATA CHANNEL OPERATIONS,
47              /           A CHECK IS MADE TO THE INPUT DATA BLOCK TO
48              /           INSURE THAT SOMETHING HAS BEEN WRITTEN INTO IT).
49
50              /           THESE FUNCTIONS/SIGNALS ARE EXERCISED IS THE
51              /           "MICRO NOVA ANALOG TO DIGITAL EXERCISER",
52              /            - AB TAPE PART # 095 - 0000637
53              /              LISTING PART # 096 - 0000637
54
55              /           THIS INTERFACE CAN ALSO BE TESTED ON A SYSTEMS
56              /           LEVEL BY USING "MICRO NOVA ANALOG CONVERSION
57              /           SYSTEM EXERCISER",
58              /           - AB TAPE PART # 095 - 0001059
59              /             LISTING PART # 096 - 0001059
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10003 .MAIN
01              ;7.     PROGRAM DESCRIPTION/THEORY OF OPERATION:
02              ;       ---------------------------------------
03              ;NOTE: THE FOLLOWING CONVENTION IS USED IN THE
04              ;       DESCRIPTION TO INDICATE LOW ACTIVE SIGNALS:
05              ;
06              ;                       ----------
07              ;         /SIGNALNAME/ = SIGNALNAME
08              ;
09              ;7.1    ANALOG TO DIGITAL CONVERTER OPERATION:
10              ;
11              ;THE A/D BOARD FOR THE MICRONOVA CONSISTS OF A TWO HYBRID
12              ;PACKAGE DATA ACQUISITION SYSTEM (DAS) ALONG WITH INTERFACE
13              ;AND LOGIC CIRCUITRY.  AN ON-BOARD DC-DC CONVERTER
14              ;WILL PROVIDE +/- 15 VOLTS REQUIRED BY THE ANALOG CIRCUITRY.
15              ;ONE HYBRID PACKAGE OF THE DAS CONSISTS OF TWO EIGHT-TO-ONE
16              ;ANALOG MULTIPLEXERS, ANALOG SWITCH TO SELECT SINGLE ENDED
17              ;OR DIFFERENTIAL CHANNELS, INSTRUMENTATION AMPLIFIER, AND
18              ;SAMPLE AND HOLD.  THE OTHER PACKAGE CONTAINS A 12-BIT A/D
19              ;CONVERTER WITH INTERNAL CLOCK.  THE DAS CAN BE USED EITHER
20              ;WITH 16 SINGLE-ENDED OR, FOR HIGHER COMMON-MODE REJECTION
21              ;RATIO, WITH 8 DIFFERENTIAL ANALOG INPUTS.  THE SELECTION
22              ;OF SINGLE-ENDED OR DIFFERENTIAL CHANNELS IS PROGRAM SELECT-
23              ;ABLE.  VOLTAGE RANGES, WHICH ARE JUMPER SELECTABLE, ARE 0-5,
24              ;0-10, +/- 5, +/- 10 VOLTS.  CONVERSION TIME IS 25 US MAXIMUM
25              ;WITH A THROUGHPUT RATE OF 30 KHZ.  LINEARITY AND DIFFERENTIAL
26              ;NONLINEARITY ERRORS ARE EACH TYPICALLY 1/2 LSB, CONVERSION
27              ;IS MONOTONIC, AND OVERALL RELATIVE ACCURACY AT 25 DEGREES C
28              ;IS 0.025% OF FULL SCALE READING.
29              ;
30              ;THERE ARE SEVEN DIFFERENT CLOCK SOURCES FOR STARTING A/D
31              ;CONVERSIONS.  FOR PROGRAMMED I/O THESE ARE /STRT/, NO
32              ;CLOCK SYNCHRONIZATION; /STRT/, INTERNAL CLOCK SYNC;
33              ;/STRT/, EXTERNAL CLOCK SYNC.  FOR DATA CHANNEL TRANSFERS
34              ;THESE ARE:  /IOPLS/ (ONE CONVERSION FOR EVERY /IOPLS/
35              ;COMMAND - THE TIME BETWEEN /IOPLS/ COMMANDS SHALL BE
36              ;GREATER THAN THE MAXIMUM DATA CHANNEL LATENCY OR 33 US,
37              ;WHICHEVER IS GREATER); /DCHI/, NO CLOCK SYNC (MAXIMUM
38              ;TRANSFER RATE); INTERNAL CLOCK SYNC; EXTERNAL CLOCK SYNC.
39              ;THE EXTERNAL CLOCK SHOULD HAVE A PERIOD GREATER THAN
40              ;33 US.  ALL DATA CHANNEL TRANSFER SEQUENCES BEGIN WITH
41              ;A /STRT/ COMMAND. THE CLOCK SOURCE IS SELECTED BY THREE
42              ;STATUS BITS IN A DOA INSTRUCTION.  THIS INSTRUCTION MUST
43              ;ALSO CONTAIN AN INITIAL AND FINAL MULTIPLEXER ADDRESS.
44              ;A MUX CHANNEL COUNTER FIRST ADDRESSES THE INITIAL CHANNEL
45              ;AND IS INCREMENTED ONCE FOR EVERY CONVERSION.  AFTER
46              ;THE VOLTAGE ON THE FINAL CHANNEL IS CONVERTED, THE
47              ;INITIAL CHANNEL IS AGAIN ADDRESSED.  THIS SEQUENCE THEN
48              ;REPEATS ITSELF. HENCE, FOR CONVERSIONS ON ONLY ONE CHANNEL
49              ;THE FINAL AND INITIAL CHANNELS ARE SET EQUAL TO THE
50              ;DESIRED CHANNEL.
```

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10004 .MAIN
01              ;CHANNEL NUMBERING IS AS FOLLOWS:
02              ;
03              ;CHANNEL ADDRESS  ------- CHANNEL SELECTED ---------
04              ;   (OCTAL)       SINGLE-ENDED            DIFFERENTIAL
05              ;---------------  ------------            ------------
06              ;       0         ANA0 (A49) HI           ANA0 (A49) HI
07              ;                 ANA0 SE RET (A47) LO    ANA8 (A50) LO
08              ;
09              ;       1         ANA1 (A45) HI           ANA1 (A45) HI
10              ;                 ANA1 SE RET (A43) LO    ANA9 (A46) LO
11              ;
12              ;       2         ANA2 (A41) HI           ANA2 (A41) HI
13              ;                 ANA2 SE RET (A39) LO    ANA10 (A42) LO
14              ;
15              ;       3         ANA3 (A37) HI           ANA3 (A37) HI
16              ;                 ANA3 SE SET (A35) LO    ANA11 (A38) LO
17              ;
18              ;       4         ANA4 (A33) HI           ANA4 (A33) HI
19              ;                 ANA4 SE RET (A31) LO    ANA12 (A34) LO
20              ;
21              ;       5         ANA5 (A29) HI           ANA5 (A29) HI
22              ;                 ANA5 SE RET (A27) LO    ANA13 (A30) LO
23              ;
24              ;       6         ANA6 (A25) HI           ANA6 (A25) HI
25              ;                 ANA6 SE RET (A23) LO    ANA14 (A26) LO
26              ;
27              ;       7         ANA7 (A21) HI           ANA7 (A21) HI
28              ;                 ANA7 SE RET (A19) LO    ANA15 (A22) LO
29              ;
30              ;       10        ANA8 (A50) HI           SAME AS CHANNEL 0
31              ;                 ANA8 SE RET (A48) LO
32              ;
33              ;       11        ANA9 (A46) HI           SAME AS CHANNEL 1
34              ;                 ANA9 SE RET (A44) LO
35              ;
36              ;       12        ANA10 (A42) HI          SAME AS CHANNEL 2
37              ;                 ANA10 SE RET (A40) LO
38              ;
39              ;       13        ANA11 (A38) HI          SAME AS CHANNEL 3
40              ;                 ANA11 SE RET (A36) LO
41              ;
42              ;       14        ANA12 (A34) HI          SAME AS CHANNEL 4
43              ;                 ANA12 SE RET (A32) LO
44              ;
45              ;       15        ANA13 (A30) HI          SAME AS CHANNEL 5
46              ;                 ANA13 SE RET (A28) LO
47              ;
48              ;       16        ANA14 (A26) HI          SAME AS CHANNEL 6
49              ;                 ANA14 SE RET (A24) LO
50              ;
51              ;       17        ANA15 (A22) HI          SAME AS CHANNEL 7
52              ;                 ANA15 SE RET (A20) LO
53              ;
54              ;       CODING JUMPERS:
55              ;
56              ;       DAS 0 LO = W7
57              ;       DAS 0 HI = W6
```

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10000 .MAIN
01                ;8.3    SELECTION OF SPECIAL TEST FUNCTIONS:
02                ;        THE FOLLOWING "SWREG" SWITCHES CONTROL THE OPERATION
03                ;        OF CERTAIN OPTIONAL TESTS. FOR ALL OF THE FOLLOWING:
04                ;
05                ;        SWITCH = 0        TEST IS SKIPPED
06                ;        SWITCH = 1        TEST IS PERFORMED
07                ;
08                ;        SWITCH            TEST
09                ;        C                 EXTERNAL CLOCK TEST
10                ;        D                 EXTERNAL INTERRUPT TEST
11                ;
12                ;        NOTE THAT IF THESE FUNCTIONS DO NOT OPEARTE BECAUSE
13                ;        OF A HARDWARE ERROR, IT IS POSSIBLE FOR THE DIAGNOSTIC
14                ;        TO REMAIN IN THE TEST LOOP. HOWEVER, FOR ANY OF THE
15                ;        ABOVE TESTS SELECTED, THE PROGRAM WILL PRINT A MESSAGE
16                ;        TO THE OPERATOR INDICATING WHICH TEST IS BEING
17                ;        PERFORMED (AND INDICATING OPERATOR ACTION). IF THE
18                ;        FUNCTION IS OPERATING PROPERLY, A "COMPLETED SUBTEST"
19                ;        MESSAGE WILL BE PRINTED. THE ABSENCE OF THIS MESSAGE
20                ;        AFTER THE OPERATOR HAS PERFORMED THE OPERATION
21                ;        INDICATES A HARDWARE FAILURE. IN THIS CASE THE ERROR
22                ;        CAN BE FOUND BY USING AN OSCILLOSCOPE FOR ERROR
23                ;        TRACING, AS THE DIAGNOSTIC IS IN A SCOPE LOOP.
24                ;
25                ;        THE FOLLOWING OPERATOR ACTIONS ARE EXPECTED FOR
26                ;        THE ABOVE TESTS (IF SELECTED):
27                ;
28                ;        TEST              ACTION EXPECTED
29                ;        EXT CLK           PULSE THE EXTERNAL CLOCK LINE (A3)
30                ;                          AT LEAST (4) TIMES (A PULSE GENERATOR
31                ;                          CAN BE USED FOR THIS)
32                ;                          EXTERNAL CLOCK IS HIGH ACTIVE.
33                ;        EXT INTERRUPT     GROUND THE EXTERNAL INTERRUPT
34                ;                          REQUEST LINE (A5) ONCE (LOW ACTIVE).
35                ;
36                ;        NOTE: EXTERNAL CLOCK CAN BE SELF-TESTED BY CONNECTING
37                ;        THE INTERNAL CLOCK OUTPUT (A1) TO THE EXTERNAL CLOCK
38                ;        INPUT (A3) AND SELECTING THE OPTIONAL EXTERNAL CLOCK
39                ;        TEST (SEE ABOVE).
40                ;
41                ;8.4    SETTING UP A SCOPE LOOP:
42                ;
43                ;        THIS DIAGNOSTIC CAN BE USED TO TRACE FAILURES ON
44                ;        DETECTION OF AN ERROR. IF, AND WHEN AN ERROR IS
45                ;        DETECTED DURING TESTING, A DIAGNOSTIC SCOPE LOOP CAN
46                ;        BE FORMED BY DOING THE FOLLOWING:
47                ;
48                ;        1) "SWREG" SWITCH 1 MUST BE EQUAL = 0 (LOOP ON ERROR).
49                ;        2) NOTE THE PROGRAM COUNTER (PC) CONTENTS, THE SUB-
50                ;           TEST #, THE ERROR # AND THE ACCUMULATOR CONTENTS.
51                ;        3) SUPRESS ALL TTY/LPT OUTPUTS BY SETTING SWITCH 2 = 1
52                ;           AND SWITCH 5 = 0.
53                ;        4) GO TO THE FAILING ADDRESS (= PROGRAM COUNTER) IN THE
54                ;           DIAGNOSTIC LISTING FOR THE INSTRUCTION SEQUENCE (AND
55                ;           INFORMATION) THAT CAUSED OR DETECTED THE ERROR.
56                ;        5) IF THE SCOPE LOOP CONTAINS AN I/O RESET (MNRST) IN IT
57                ;           THE SCOPE LOOP FORMED WILL BE SLOW. IT CAN BE SPEEDED
58                ;           UP BY FOLLOWING THE INSTRUCTIONS IN SECTION 11.7.
59                ;        6) THE SCOPE LOOP SHOULD NOW BE READY TO USE. (HELPFUL
60                ;           ITEMS ARE AN OSCILLOSCOPE, SCHEMATICS, PHYSICAL).
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```
 0010 .MAIN
01                ;9.     OPERATING PROCEDURE/OPERATOR INPUT
02                ;        ----------------------------------
03                ;        NOTE: POWER SHOULD ALWAYS BE OFF DURING INSERTION
04                ;        AND REMOVAL OF THE A/D INTERFACE (OR ANY BOARD)
05                ;        INTO MICRO NOVA CHASSIS
06                ;
07                ;        TO RUN THIS DIAGNOSTIC:
08                ;
09                ;        1.  INSERT A/D INTERFACE INTO AN I/O SLOT
10                ;            WITH THE INTERRUPT PRIORITY (/INTP/) AND
11                ;            DATA CHANNEL PRIORITY (/DCHP/) I/O LINES
12                ;            PROPERLY JUMPERED.
13                ;        2.  LOAD THE DIAGNOSTIC VIA PAPER TAPE OR
14                ;            DDOS DISKETTE.
15                ;        3.  STARTING ADDRESS IS 200 (OR 500) OCTAL
16                ;        4.  AFTER THE PROGRAM HAS BEEN STARTED, THE
17                ;            MEMORY WILL BE SIZED AND THE MESSAGE
18                ;
19                ;                "TOP OF MEMORY = XXXXXX"
20                ;
21                ;            WILL BE PRINTED WHERE XXXXXX IS THE
22                ;            HIGHEST LOGICAL MEMORY ADDRESS IN
23                ;            OCTAL.
24                ;        5.  ANSWER THE FOLLOWING QUESTIONS:
25                ;
26                ;                "DEVICE CODE = "
27                ;
28                ;                ENTER THE 6-BIT DEVICE CODE OF THE
29                ;                D/A INTERFACE IN OCTAL.
30                ;                (MUST BE < 77 OCTAL).
31                ;
32                ;        "DATA BIT 0 = (0 OR 1)"
33                ;
34                ;        THIS REFERS TO THE CODING TYPE OF THE A/D DATA.
35                ;        (SEE SECTION 7.1)
36                ;        USE BIT 0 = 0 FOR UNIPOLAR AND OFFSET BINARY BIPOLAR
37                ;        USE BIT 0 = 1 FOR TWO'S COMPLEMENT BINARY BIPOLAR
38                ;
39                ;        THE DIAGNOSTIC WILL THEN BEGIN OPERATION ACCORDING TO
40                ;        THE MODES SELECTED BY "SWREG" (SEE SECTION 8). IF
41                ;        IF AN INCORRECT RESPONSE IS MADE TO ANY QUESTION
42                ;        IT WILL BE RE-TYPED.
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```
10011 .MAIN
01                ;18.    PROGRAM OUTPUT/ERROR DESCRIPTION:
02                ;       ================================
03                ;       ALL PROGRAM OUTPUTS, BOTH MESSAGES AND ERROR
04                ;       REPORTS, ARE CONTROLLED BY THE VALUE OF "SWREG"
05                ;       (SEE SECTION 8) SWITCHES 2 AND 5 AS FOLLOWS:
06                ;
07                ;       SWITCH          PRINTOUT TO
08                ;       2    5          TTY/CRT  LPT
09                ;       ======          ==========
10                ;       0    0          YES      NO
11                ;       0    1          YES      YES
12                ;       1    0          NO       NO
13                ;       1    1          NO       YES
14                ;
15                ;       IF AN ERROR IS ENCOUNTERED DURING DIAGNOSTIC
16                ;       OPERATION, THE PROGRAM WILL PRINT OUT THE
17                ;       FOLLOWING ERROR REPORT:
18                ;
19                ;       ERROR NUMBER #  ENCOUNTERED SUBTEST #
20                ;       CRY     AC0     AC1     AC2     AC3     PC
21                ;       X       XXXXXX  XXXXXX  XXXXXX  XXXXXX  XXXXXX
22                ;
23                ;       WHERE:  CRY = CARRY
24                ;               PC = PROGRAM COUNTER (FAILING ADDRESS)
25                ;               AC0, AC1, AC2, AC3 = ACCUMULATOR CONTENTS
26                ;               (CONTENTS DEPEND ON SPECIFIC TEST)
27                ;
28                ;       ALL NUMERIC VALUES ARE IN OCTAL. THE ACTION
29                ;       TAKEN AFTER ERROR MESSAGE PRINTOUT DEPENDS ON
30                ;       THE VALUE OF "SWREG" (SEE SECTION 8). IF SWITCH
31                ;       6 = 1 THEN THE PROGRAM WILL HALT AFTER THE
32                ;       MESSAGE "HALTED ON ERROR" IS PRINTED. IF SWITCH
33                ;       1 = 0 THEN THE PROGRAM WILL LOOP ON THE ERROR
34                ;       AFTER THE MESSAGE "LOOPING ON ERROR" IS PRINTED.
35                ;       THIS FORMS A TEST SCOPE LOOP FOR FAILURE TRACING
36                ;       WITH AN OSCILLOSCOPE. IF SWITCH 1 = 0 AND SWITCH 6 = 1
37                ;       THE PROGRAM WILL FIRST HALT, THEN LOOP ON THE
38                ;       ERROR IF THE PROGRAM IS CONTINUED. IF SWITCH 8
39                ;       = 1 THEN ONLY THE FIRST ERROR WILL BE REPORTED.
40                ;       IF THE PROGRAM IS LOOPING ON AN ERROR AND "SWREG"
41                ;       SWITCH 3 = 1, A SUBTEST FAILURE RATE IS REPORTED
42                ;       AS "SUBTEST (#)  FAILED (X) %", WHERE (#) IS THE
43                ;       LOOP TEST NUMBER IN OCTAL AND (X) IS A DECIMAL %.
44                ;       (NOTE: WHEN LOOPING ON A TEST THAT HAS MORE THAN
45                ;       ONE ERROR BEING DETECTED, AND A % FAILURE RATE IS
46                ;       BEING REPORTED, THE FAILURE RATE WILL APPEAR AS
47                ;       X00% WHERE X IS THE # OF ERRORS OCCURING. FOR
48                ;       EXAMPLE, A SCOPE LOOP WITH 2 ERRORS WOULD REPORT
49                ;       "SUBTEST (#) FAILED 200%").
50                ;
51                ;       AFTER ALL SUBTESTS HAVE BEEN PERFORMED (ONE PASS)
52                ;       THE PROGRAM WILL REPORT "END OF PASS" (#). (#)
53                ;       IS AN OCTAL VALUE.
```

```
10012 .MAIN
01                ;       IF SWITCH 7 = 1, THE PROGRAM WILL INFORM THE
02                ;       OPERATOR WHEN A SUBTEST HAS BEEN COMPLETED BY
03                ;       PRINTING "COMPLETED SUBTEST (#)", WHERE (#) IS
04                ;       THE SUBTEST NUMBER IN OCTAL. IN ADDITION, WHEN
05                ;       SWITCH 7 GOES FROM 0 TO 1, AN ERROR SUMMARY WILL
06                ;       BE PRINTED AS FOLLOWS:
07                ;
08                ;       ERROR SUMMARY REPORT FOLLOWS
09                ;       ERROR NUMBER: (#1)  (#2) ... (#N)
10                ;       END OF SUMMARY
11                ;
12                ;       WHERE (#1)  (#2) ... (#N) IS A LIST OF ALL ERROR
13                ;             NUMBERS THAT HAVE BEEN DETECTED. IF NO
14                ;             ERRORS HAVE OCCURED, THEN THE MESSAGE
15                ;             "NO ERRORS ENCOUNTERED SINCE LAST SUMMARY"
16                ;             WILL BE REPORTED INSTEAD.
17                ;
18                ;       OTHER ERRORS:
19                ;
20                ;       1.  "FATAL SUBTEST SEQUENCE ERROR ENCOUNTERED"
21                ;           IS REPORTED, FOLLOWED BY A HALT. IF ANY
22                ;           TEST IS PERFORMED OUT OF SEQUENCE (I.E.
23                ;           1, 2, 3, 5 INSTEAD OF 1, 2, 3, 4). NO
24                ;           SEQUENCE CHECK IS MADE FOR ANY SELECTED
25                ;           OPTIONAL TESTS (SEE SECTION 8.3).
26                ;
27                ;       2.  "FATAL STACK BOUNDARY VIOLATION. SP = (XXXXXX)"
28                ;           IS REPORTED, FOLLOWED BY A HALT, IF A
29                ;           STACK BOUNDARY IS CROSSED (256 WDS). XXXXXX
30                ;           IS THE VALUE OF THE STACK POINTER (OCTAL).
31                ;
32                ;       3.  "*** RTC FAILURE ***" IS REPORTED, FOLLOWED
33                ;           BY A HALT IF THE REAL-TIME CLOCK FAILS TO
34                ;           CAUSE INTERRUPTS DURING TIMER VALUE CALCULATIONS.
35                ;
36                ;       4.  "UNIDENTIFIED INTERRUPT = (DVC)"
37                ;           FOLLOWED BY AN ERROR PRINTOUT (SEE ABOVE) IS
38                ;           REPORTED IF ANY DEVICE OTHER THAN THE A/D
39                ;           INTERFACE REQUESTS AN INTERRUPT DURING DIAG-
40                ;           NOSTIC OPERATION. DVC = THE OCTAL DEVICE CODE
41                ;           OF THE DEVICE REQUESTING THE INTERRUPT. ALSO,
42                ;           THE PROGRAM WILL ATTEMPT TO CLEAR THE INTERRUPT
43                ;           BY ISSUING AN 'NICC' INSTRUCTION TO THE DEVICE.
44                ;
45                ;       5.  "EXTERNAL INTERRUPT = (DVC)"
46                ;           FOLLOWED BY AN ERROR PRINTOUT (SEE ABOVE) IS
47                ;           REPORTED IF AN UNEXPECTED A/D EXTERNAL INTERRUPT
48                ;           (CAUSED BY GROUNDING THE /EXT INT REQ/ LINE)
49                ;           DURING DIAGNOSTIC OPERATION, THE INTERRUPT
50                ;           IS NOT CLEARED BY THE INTERRUPT SERVICE ROUTINE.
51                ;           HOWEVER, IF THE EXTERNAL INTERRUPT OCCURS
52                ;           DURING THE EXTERNAL INTERRUPT TEST (SEE 8.3)
53                ;           THE MESSAGE WILL BE PRINTED, INDICATING THAT
54                ;           ONE WAS RECEIVED, BUT NO ERROR MESSAGE WILL
55                ;           FOLLOW. DVC IS THE A/D DEVICE CODE (OCTAL).
```

```
10013 .MAIN
01              ;11.    DEBUG HELP:
02              ;       ==========
03              ;       *** OCTAL DEBUG TOOL (ODT) ***
04              ;
05              ;       THE DIAGNOSTIC IS EQUIPED WITH A BUILT IN ODT WHICH CAN
06              ;       BE ACCESSED BY HITTING CONTROL O (^O) AT ANY TIME DURING
07              ;       THE EXECUTION OF THE PROGRAM (AFTER SETTING THE PARA-
08              ;       METERS).
09              ;       ON ENTERING ODT THE ADDRESS OF THE LOCATION HAVING THE
10              ;       NEXT INSTRUCTION TO BE EXECUTED WILL BE TYPED-OUT.
11              ;
12              ;11.1   CONVENTIONS AND SYMBOLS
13              ;       THE FOLLOWING CONVENTIONS ARE USED BY THE ODT:
14              ;       ?       PRESSING ANY ILLEGAL KEY CAUSES THE ODT TO RES-
15              ;               POND WITH A "?".
16              ;       @       ODT IS READY AND AT YOUR SERVICE.
17              ;
18              ;11.2   COMMAND STRUCTURE
19              ;       AN ODT COMMAND HAS THE FOLLOWING FORMAT:
20              ;               [ARGUMENT][COMMAND]
21              ;       AN ARGUMENT MAY BE ONE OF THE FOLLOWING:
22              ;       "EXP"   AN OCTAL EXPRESSION CONSISTING OF OCTAL NUMBERS
23              ;               SEPARATED BY PLUS (+) OR MINUS (-) SIGNS. LEAD-
24              ;               ING ZEROS NEED NOT BE TYPED.
25              ;       "ADR"   AN ADDRESS IS THE SAME AS AN EXPRESSION EXCEPT
26              ;               THAT BIT 0 IS NEGLECTED.
27              ;       A COMMAND IS A SINGLE TELETYPE CHARACTER
28              ;
29              ;11.3   ODT COMMANDS
30              ;       THE LOCATIONS THAT CAN BE EXAMINED AND MODIFIED BY THE
31              ;       USER ARE CALLED CELLS. THESE CELLS ARE OF TWO TYPES:
32              ;       INTERNAL CPU CELLS AND MEMORY LOCATIONS.
33              ;
34              ;11.3.1 OPENING INTERNAL CELLS
35              ;       THE COMMAND TO OPEN ONE OF THE INTERNAL REGISTERS IS OF
36              ;       THE FORM "NA" WHERE N IS ANY OCTAL EXPRESSION BETWEEN
37              ;       0 AND 7
38              ;       0-3     FOR ACCUMULATORS 0-3
39              ;       4       FOR PC OF THE NEXT INSTRUCTION TO BE EXECUTED IN
40              ;               THE EVENT OF A "P" COMMAND.
41              ;       5       CPU AND TTO STATUS
42              ;               BIT     INTERPRETATION
43              ;               15      STATUS OF TTO DONE FLAG
44              ;               14      STATUS OF INTERRUPTS (ION FLAG)
45              ;               13      STATUS OF CARRY BIT
46              ;       6       ADDRESS OF THE LOCATION HAVING THE BREAK POINT (
47              ;               ANY)
48              ;       7       INSTRUCTION AT THE BREAK POINT LOCATION
49
```

```
10014 .MAIN
01              ;       OTHER COMMANDS TO OPEN CELLS ARE:
02              ;
03              ;       "ADR"/  OPEN THE CELL AND PRINT ITS CONTENTS
04              ;       ./      OPEN THE CELL CURRENTLY POINTED TO BY THE POINTE
05              ;               AND PRINT ITS CONTENTS.
06              ;       .+"ADR"/        ADD "ADR" TO THE POINTER, OPEN THE CELL
07              ;               ITS CONTENTS.
08              ;       .-"ADR"/        SUBTRACT "ADR" FROM THE POINTER, OPEN TH
09              ;               PRINT ITS CONTENTS.
10              ;       "CR"    THE RETURN KEY IS USED TO CLOSE THE OPEN CELL
11              ;               WITH OR WITHOUT MODIFICATION.
12              ;       "LF"    LINE FEED IS USED TO CLOSE THE OPEN CELL WITH OR
13              ;               WITHOUT MODIFICATION AND TO OPEN THE SUCCEEDING
14              ;               CELL.
15              ;       ^       CLOSE THE OPEN CELL WITH OR WITHOUT MODIFICATION
16              ;               AND OPEN THE PRECEDING CELL
17              ;       /       CLOSE THE OPEN CELL WITHOUT MODIFICATION, AND
18              ;               OPEN THE CELL POINTED TO BY ITS CONTENTS.
19              ;       +"ADR"/ CLOSE THE OPEN CELL WITHOUT MODIFICATION, AND
20              ;               OPEN THE CELL POINTED TO BY ITS CONTENTS + "ADDR
21              ;       -"ADR"/ CLOSE THE OPEN CELL WITHOUT MODIFICATION, AND
22              ;               OPEN THE CELL POINTED TO BY ITS CONTENTS - "ADR"
23              ;
24              ;11.3.2 MODIFICATION OF A CELL
25              ;       ONCE A CELL HAS BEEN OPENED ITS CONTENTS CAN BE MODIFIED
26              ;       BY TYPING THE NEW VALUE THE CELL IS TO CONTAIN IN THE
27              ;       FORM OF AN OCTAL EXPRESSION FOLLOWED BY "CR" OR "LF".
28              ;       IF A + OR - IS TYPED AS THE FIRST CHARACTER OF THE EX-
29              ;       PRESSION THEN THE VALUE OF THE EXPRESSION IS ADDED TO OR
30              ;       SUBTRACTED FROM THE OLD CONTENTS OF THE CELL. THE
31              ;       ADDRESS ITSELF OR AN EXPRESION RELATIVE TO THE ADDRESS
32              ;       CAN BE DEPOSITED BY TYPING A "." OR ".+/-OCTAL EXPRESS-
33              ;       ION". A RUBOUT COMMAND GIVEN RIGHT AFTER OPENING A CELL
34              ;       ALLOWS THE MODIFICATION OF ITS CONTENTS AS IF THEY WERE
35              ;       TYPED IN JUST BEFORE THE COMMAND WAS ISSUED.
36              ;
```

```
10015 .MAIN
01              ;11.3.3 OTHER ODT COMMANDS
02              ;       RUBOUT  THIS KEY IS USED TO DELETE ERRONEOUSLY TYPED
03              ;               DIGITS. EACH TIME THE KEY IS PRESSED THE RIGHT M
04              ;               DIGIT IS DELETED AND ECHOED ON THE TERMINAL. IF
05              ;               THE RUBOUT KEY IS PRESSED RIGHT AFTER OPENING A
06              ;               CELL THEN IT DELETES THE RIGHT MOST DIGIT OF THE
07              ;               CONTENTS. THIS ALLOWS THE MODIFICATION OF THE CE
08              ;               AS IF ITS CONTENTS WERE TYPED IN JUST BEFORE THE
09              ;               KEY WAS PRESSED.
10              ;       "ADR"B  INSERT A BREAK POINT AT LOCATION "ADR".
11              ;               ONLY ONE BREAK POINT CAN BE INSERTED AND ANY
12              ;               ENTRY TO ODT AFTER EXECUTING A BREAK POINT WILL
13              ;               CAUSE IT TO BE DELETED.
14              ;       D       DELETE THE BREAK POINT IF ANY.
15              ;       P       RESTART THE EXECUTION OF THE PROGRAM AT LOCATION
16              ;               POINTED BY 4A.
17              ;       "ADR"R  START EXECUTING THE PROGRAM AT "ADR" AFTER AN
18              ;               IO=RESET.
19              ;       K       KILL THE STRING TYPED SO FAR. THE ODT RESPONDS
20              ;               WITH A "?" AND THE OPEN CELL IS CLOSED WITHOUT
21              ;               MODIFICATION.
22              ;       =       PRINT THE OCTAL VALUE OF THE INPUT ONLY.
23              ;               THIS WILL CLOSE ANY OPEN CELLS WITHOUT
24              ;               MODIFICATION AND WILL NOT OPEN A CELL
25              ;
26              ;
27              ;       NOTE:   IN PROGRAMS WHICH RELOCATE THEMSELVES THE
28              ;               THE USER SHOULD PLACE BREAK POINTS ONLY IN THE
29              ;               THE ORIGINAL PROGRAM AREA. IF A BREAK POINT IS
30              ;               PLACED OUTSIDE THIS AREA THE RESULTS WILL
31              ;               BE UNPREDICTABLE.
```

```
10016 .MAIN
01              ;11.4   INSTRUCTION SET:
02
03              ;DOA:   OUTPUTS INITIAL DOA MUX CHANNEL, FINAL MUX
04              ;       CHANNEL, AND STATUS BITS TO THE INTERFACE.
05
06              ;       D0, D1, D2 ARE THE CLOCK SOURCE SELECT BITS:
07
08              ;          D0  D1  D2  CLOCK SOURCE TO START A/D CONVERSIONS
09              ;          --  --  --  ------------------------------------
10
11              ;          0   0   0   /STRT/, NO SYNC
12
13              ;PROGRAMMED 0   0   1   NO CONVERSIONS
14
15              ;   I/O     0   1   0   /STRT/, INTERNAL CLOCK SYNC
16              ;                       (FALLING EDGE)
17
18              ;           0   1   1   /STRT/, EXTERNAL CLOCK SYNC
19              ;                       (FALLING EDGE)
20
21
22              ;           1   0   0   /IOPLS/, (1 DATA CHANNEL CONVERSION
23              ;                       FOR EVERY /IOPLS/, NO SYNC
24
25              ;DATA       1   0   1   /DCHI/, NO SYNC
26              ;                       (MAXIMUM TRANSFER RATE)
27
28              ;CHANNEL    1   1   0   INTERNAL CLOCK SYNC
29              ;                       (FALLING EDGE)
30
31              ;           1   1   1   EXTERNAL CLOCK SYNC
32              ;                       (FALLING EDGE)
33
34              ;ALL DATA CHANNEL SEQUENCES BEGIN WITH THE NEXT CLOCK
35              ;SOURCE SIGNAL AFTER STRT.  SYNCHRONIZATION OCCURS ON
36              ;THE FALLING EDGE OF THE INTERNAL OR EXTERNAL CLOCK.
37
38              ;           D3          SINGLE-ENDED/DIFFERENTIAL
39              ;                       CHANNEL SELECT
40              ;                       0 =  DIFFERENTIAL
41              ;                       1 =  SINGLE-ENDED
42
43              ;           D4-D7       FINAL MUX CHANNEL, BIT 4 MSB
44
45              ;           D12-D15     INITIAL MUX CHANNEL, BIT 12 MSB
46
47              ;TO READ DATA ON ONLY ONE CHANNEL, BOTH THE FINAL AND
48              ;INITIAL CHANNELS SHOULD EQUAL THE DESIRED CHANNEL.
49              ;/IORST/ CLEARS ALL STATUS BITS.  THE DOA INSTRUCTION
50              ;SHOULD NOT BE GIVEN IF BUSY IS SET.
```

```
!0017 .MAIN
01              ;DOB:  OUTPUTS TO ADDRESS REGISTER FOR DATA CHANNEL
02              ;      TRANSFERS
03
04              ;DOC:  OUTPUTS TO WORD-COUNT REGISTER FOR DATA CHANNEL
05              ;      TRANSFERS
06
07              ;DIA:  INPUTS CURRENT MUX CHANNEL AND STATUS BITS:
08
09              ;           D0          1 IF EXTERNAL INTERRUPT REQUEST
10              ;                       HAS OCCURRED, 0 OTHERWISE
11
12              ;           D1          1 IF EOC IS HIGH (CONVERSION
13              ;                       IS FINISHED), 0 OTHERWISE
14
15              ;           D8          1 IF CLOCK OVERRUN HAS OCCURRED,
16              ;                       0 OTHERWISE.
17
18              ;           D12-D15     CURRENT MUX CHANNEL
19
20              ;      ALL OTHER BITS ARE CLEARED.  EXTERNAL INTERRUPT
21              ;      REQUEST BIT AND CLOCK OVERRUN BIT ARE CLEARED
22              ;      BY I/O CLEAR INSTRUCTION OR IORST.
23
24              ;DIB:  INPUTS DCH ADDRESS REGISTER
25
26              ;DIC:  INPUTS DATA FROM A/D CONVERTER.  DATA IS LEFT
27              ;      JUSTIFIED IN BITS 0-11, WITH BIT 0 THE MSB.
```

```
!0018 .MAIN
01              ;11.5   PROGRAM SUBROUTINES:
02
03              ;11.5.1 INTERRUPT SERVICE ROUTINE:
04              ;THE CALL TO THE INTERRUPT WAIT/SERVICE ROUTINE IS "IWAIT".
05              ;THE ROUTINE WILL WAIT FOR THE TIME SPECIFIED BY THE
06              ;TIMER CONSTANT "DELAY" (60 US IN PIO MODE) FOR AN INTERRUPT.
07              ;THE PROGRAM WILL RETURN TO:
08              ; = CALL + 1 IF NO INTERRUPT/UNIDENTIFIED INTERRUPT
09              ; = CALL + 2 IF A/D EXTERNAL INTERRUPT
10              ; = CALL + 3 IF A/D I/O INTERRUPT
11
12              ;ACCUMULATOR CONTENTS ARE AS FOLLOWS ON RETURN:
13
14              ;       TYPE            AC0     AC1     AC2
15              ;       ================================
16              ;       NONE            DVC     0       NC
17              ;       UNIDENTIFIED    DVC     BAD     NC
18              ;       A/D EXTERNAL    DVC     DVC     DIA
19              ;       A/D I/O INTR    DVC     DVC     DIA
20
21              ;WHERE:
22              ;DVC = A/D DEVICE CODE
23              ;BAD = UNIDENTIFIED DEVICE CODE
24              ;NC  = NO CHANGE
25              ;DIA = A/D STATUS WORD
26              ;       BIT 0 = 0 FOR A/D I/O INTERRUPT
27              ;       BIT 0 = 1 FOR A/D EXT INTERRUPT
28              ;       OTHER STATUS BITS ARE
29              ;       BIT 1 = EOC
30              ;       BIT 8 = CLOCK OVERRUN
31
32              ;"UNIDENTIFIED INTERRUPT = (##)" IS REPORTED IF
33              ;ANY DEVICE OTHER THAN THE A/D OR TTY IS REQUESTING
34              ;AN INTERRUPT WHERE (##) IS THE INTERRUPTING DEVICE
35              ;CODE. THE ROUTINE WILL ATTEMPT TO CLEAR THE INTERRUPT
36              ;WITH AN 'NIOC' INSTRUCTION ISSUED TO THE DEVICE.
37
38              ;"EXTERNAL INTERRUPT = (##)" IS REPORTED IF AN
39              ;EXTERNAL INTERRUPT IS REQUESTED FROM THE A/D.
40              ;(##) IS THE A/D DEVICE CODE. IN ADDITION, BIT
41              ;0 OF AC2 SHOULD BE = 1, INDICATING AN A/D
42              ;EXTERNAL INTERRUPT. THE INTERRUPT IS NOT CLEARED.
43
44              ;TTI/TTO IS HANDLED BY THE DTCS ROUTINE "SWPAK" ON A
45              ;NON-INTERRUPT BASIS. TTI/TTO INTERRUPTS ARE MASKED OUT
46              ;DURING DIAGNOSTIC OPEARTION. THE ONLY EXCEPTION TO THIS
47              ;IS IF THE PAGE ZERO CONSTANT "TTYSW" = -1. IN THIS CASE
48              ;ANY TTI/TTO INTERRUPTS RECEIVED WILL BE CLEARED AND
49              ;CONTROL WILL BE RETURNED TO THE INTERRUPT WAIT LOOP.
50              ;IF "TTYSW" = 0 AND A TTI/TTO INTERRUPT IS RECEIVED,
51              ;IT WILL BE TREATED AS UNIDENTIFIED (THIS INDICATES AN
52              ;ERROR IS THE TTI/TTO INTERRUPT MASK REGISTERS).
```

```
10019 .MAIN
01              ;11.5.2 TTY INPUT/OUTPUT INTERRUPT MASK OUT:
02              ;       THE CALL IS "NOTTY" AND WHEN PERFOMRED, WILL MASK OUT
03              ;       ALL TTY (TTI/TTO) INTERRUPTS. THE INTERRUPT MASK
04              ;       BITS FOR TTI/TTO ARE BITS 14/15 RESPECTIVELY.
05
06              ;11.5.3 DCH STARTING ADDRESS/WORD COUNT GENERATOR:
07              ;       THE CALL IS "DSAWC".
08
09              ;       ON RETURN TO CALL + 1:
10              ;       AC0 = DCH RANDOM WORD COUNT (2'S COMPLEMENT)
11              ;       AC1 = DCH RANDOM STARTING ADDRESS
12              ;       AC2 = DCH FINAL ADDRESS (AFTER DCH CYCLE)
13
14              ;       IF THE SUBTEST ERROR SWITCH IS SET, THEN THE LAST
15              ;       DCH WORD COUNT/STARTING ADDRESS/FINAL ADDRESS BEFORE
16              ;       THE ERROR OCURRED WILL BE RETURNED IN AC'S 0,1 & 2
17              ;       RESPECTIVELY.
18
19              ;       THE RANDOM STARTING ADDRESSES/WORD COUNTS ARE
20              ;       DETERMINED SUCH THAT NO PROGRAM OR BINARY LOADER
21              ;       DESTRUCTION WILL OCCUR FOR PROPERLY FUNCTIONING
22              ;       DATA CHANNEL LOGIC, NOR WILL ANY MEMORY LOCATIONS
23              ;       RESERVED FOR THE CONSOLE DEBUG OPTION OR HAND
24              ;       HELD CONSOLE (077777-077377) BE ADDRESSED.
```

```
10020 .MAIN
01              ;11.6   A/D CONVERTER SYSTEM MODEL 4223
02              ;       JUMPER CONFIGURATION INFORMATION:
03
04              ;       JUMPER(S)       FUNCTION(S)/NOTES
05              ;       =========       ================
06
07              ;       W1              IF INSERTED, A13 CONTAINS THE
08              ;                       "Y" INFORMATION FOR ADC CROSS PLOT
09              ;                       TEST. IT SHOULD NOT BE INSERTED
10              ;                       NORMALLY.
11
12              ;       W2, W3          A/D CONVERTER RANGE/POLARITY SELECT
13              ;                       AS FOLLOWS:
14
15              ;                       RANGE/POLARITY  JUMPERS (INSERTED)
16              ;                       --------------  ------------------
17              ;                       +/- 10 VDC      W3, W4
18              ;                       +/- 5 VDC       W2, W4
19              ;                       0 - 5 VDC       W2, W5
20              ;                       0 - 10 VDC      W2
21
22              ;       W6, W7          A/D CODING TYPE SELECT AS FOLLOWS:
23
24              ;                       W6 IN = TWO'S COMPLEMENT CODING
25              ;                       W7 IN = OFFSET BINARY CODING
26              ;                       (ONLY ONE MAY BE INSERTED).
27
28              ;       W8 - W13        A/D DEVICE CODE SELECT AS FOLLOWS:
29
30              ;                       -------- DATA BIT ---------
31              ;                       10   11   12   13   14   15
32              ;                       --------------------------
33              ;                       W10  W11  W9   W12  W13  W8
34              ;                       DS0 (MSB)             DS5 (LSB)
35
36              ;                       INSERT CORRESPONDING JUMPER FOR
37              ;                       A "1" IN ANY OF ABOVE DEVICE CODE
38              ;                       SELECT ("DS") BITS.
39
40              ;       W14, W15        "ADC READY" HANDSHAKING SIGNAL SELECT
41              ;                       AS FOLLOWS:
42
43              ;                       W14 IN = TRUE LOW
44              ;                       W15 IN = TRUE HIGH
45              ;                       (ONLY ONE MAY BE INSERTED).
46
47              ;       W16             IF INSERTED, A "CLOCK OVERRUN" ERROR
48              ;                       STATUS SIGNAL WILL SET DONE.
49
50              ;       A/D CONVERTER POTENTIOMETER INFORMATION:
51
52              ;       POTENTIOMETER           FUNTION
53              ;       =============           =======
54
55              ;       R26                     INTERNAL CLOCK FREQUENCY
56              ;                               (NOMINAL RANGE: 30 US - 500 US)
57              ;       R21                     A/D CONVERTER GAIN ADJUST
58              ;       R20                     A/D CONVERTER OFFSET ADJUST
```

```
!0021 .MAIN
01                ;11.7   SCOPE LOOP SPEED-UP INFORMATION:
02                ;
03                ;       TESTS THAT HAVE AN I/O RESET IN THEM (MNRST) USE
04                ;       "L?OPX" (JSR @ICY?C) AS THE SCOPE LOOP HANDLER ROUTINE.
05                ;       WHEN LOOPING ON AN ERROR, THIS ROUTINE ADDS A
06                ;       RATHER LARGE DELAY IN THE SCOPE LOOP IN ORDER TO ALLOW
07                ;       TTY INPUTS TO BE RECOGNIZED AND PROCESSED WITHOUT BEING
08                ;       CLEARED BY THE I/O RESET COMMAND IN THE LOOP. TO SHORTEN
09                ;       THE SCOPE TRACE TIME SIGNIFICANTLY WHEN LOOPING ON AN
10                ;       ERROR OCCURING IN ONE OF THESE TYPE OF LOOPS, SIMPLY
11                ;       CHANGE THE "L?OPX" INSTRUCTION TO A "L?OOP" (JSR @ICYC?E
12                ;       INSTRUCTION. THIS CAN BE DONE BY ENTERING THE OCTAL
13                ;       DEBUG TOOL (ODT). THE CONSTANTS "ICY?C" AND ICYC?E" ARE
14                ;       IN PAGE ZERO. REFER TO THESE LABELS IN THE LISTING TO
15                ;       OBTAIN THEIR RESPECTIVE ADDRESSES FOR THE COMMAND.
16
17                ;12.    SPECIAL NOTES/SPECIAL FEATURES:
18                ;       ------------------------------
19                ;       SEE SECTION 8.3 FOR SPECIAL TEST INFORMATION.
20
21                ;13.    RUN TIME:
22                ;       --------
23                ;       THE FIRST TWO PASSES TAKE APPROXIMATELY 1 MINUTE.
```

```
!0022 .MAIN

**00000 TOTAL ERRORS, 00000 PASS 1 ERRORS
```