TEXT LISTING

068-000638-01

PROGRAM

MICRO-NOVA DIGITAL TO ANALOG INTERFACE EXERCISER

TEXT TAPE

097-000638-01

ABSTRACT

THE PURPOSE OF THIS EXERCISER IS TO PROVIDE A MEANS OF FINDING AND TROUBLE-SHOOTING PROBLEMS IN THE ANALOG SECTION OF THE D-A BOARD. THIS IS ACCOMPLISHED BY A SERIES OF TESTS WHICH ARE WRITTEN AS SCOPE LOOPS AND DISPLAY A PATTERN ON THE FACE OF THE "O" SCOPE FOR VISUAL VERIFICATION.

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 0001 MNDAE    MACRO REV 06.30          10:59:44 08/09/78
                        .TITL   MNDAE
02
03
04
05
06
07              ;*********************************************************************
08              ;
09              ; PROGRAM NAME: MNDAE.TX                 PART NUMBER: 097-000638
10              ;
11              ;
12              ; DESCRIPTION: MICRO-NOVA DIGITAL TO ANALOG INTERFACE EXERCISER
13              ;
14              ;
15              ; REVISION HISTORY:
16              ;
17              ;       REV.            DATE
18              ;
19              ;       00              04/28/78
20              ;       01              08/18/78
21              ;
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24              ; LICENSED MATERIAL-PROPERTY OF DATA GENERAL CORPORATION.
25              ;*********************************************************************
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!0002 MNDAE
01              ;1.PROGRAM NAME:
02              ;       MNDAE - MICRO NOVA DIGITAL TO ANALOG EXERCISER
03              ;               SOURSE FILE= MNDAE.SR (094-001-058-RR)
04              ;
05              ;2.REVISION HISTORY:
06              ;       REV. 00 - 04/28/78
07              ;       REV. 01 - 08/18/78 (TO ALLOW FOR SHORT TIME-
08              ;                       OUTS IN "Z-PULSE" CKTS.)
09
10              ;3.MACHINE REQUIRMENTS:
11              ;       A) MICRO NOVA CPU WITH MINIMUM OF 4K READ/WRITE
12              ;          MEMORY IN ADDRESSES 0-7777 (OCTAL)
13              ;       B) ASYNCRONOUS INTERFACE FOR THE MICRO NOVA
14              ;       C) TTY OR CRT TERMINAL WITH DEVICE CODE 10 FOR INPUT
15              ;          AND DEVICE CODE 11 FOR OUTPUT
16              ;       D) PAPER TAPE READER, OR DISKETTE DRIVE
17              ;
18              ;4.TEST REQUIRMENTS:
19              ;       A) MICRO NOVA D-A INTERFACE BOARD
20              ;       B) THIS TEST:   MNDAE.AB - 095-000638
21              ;                       MNDAE.LS - 096-000638
22              ;       C) EITHER W22 OR W21 ON THE D-A BOARD MUST BE IN
23              ;          FOR THE INTENSITY TEST (Z MODE)
24              ;       D) AN OSCILLOSCOPE COMPARABLE TO THE TEKTRONIX 465
25              ;          IS NEEDED TO RUN ALL THE TESTS; HOWEVER, PROVISIONS
26              ;          HAVE BEEN MADE SO THAT PRELIMINARY TESTING CAN BE
27              ;          DONE WITH A VOLT METER.
28              ;       E) FOR CALIBRATION AT LEAST A FOUR AND A HALF DIGIT
29              ;          VOLT METER WILL BE NEEDED.
30              ;       F) THE DIGITAL TO ANALOG INTERFACE DIAGNOSTIC
31              ;               (PN. 095-000-540-RR) MUST FIRST RUN ON
32              ;               THE BOARD UNDER TEST BEFOR STARTING THIS
33              ;               EXERCISER
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!0003 MNDAE
01              ;5. SUMMARY:
02              ;     THE PURPOSE OF THIS EXERCISER IS TO PROVIDE A MEANS
03              ;   OF FINDING AND TROUBLE-SHOOTING PROBLEMS IN THE ANALOG
04              ;   SECTION OF THE D-A BOARD.  THIS IS ACCOMPLISHED BY A
05              ;   SERIES OF TESTS WHICH ARE WRITTEN AS SCOPE LOOPS AND
06              ;   DISPLAY A PATTERN ON THE FACE OF THE "O" SCOPE FOR
07              ;   VISUAL VERIFICATION.
08              ;
09              ;6. RESTRICTIONS:
10              ;       1) THIS TEST IS APPLICABLE TO ONE D-A INTERFACE AT
11              ;          A TIME.
12              ;       2) ALL DEVICES CONNECTED TO THE D-A SHOULD BE RE-
13              ;          MOVED
14              ;       3) WITH THE EXCEPTION OF DONE NOT SETTING WITHIN A
15              ;          REASONABLE TIME OR A LATE CONVERSION, NO ERROR
16              ;          DETECTION OR REPORTING TAKES PLACE.  ALL ERROR
17              ;          DETECTION IS BY OBSERVATION OF THE "O" SCOPE
18              ;          FOR THE PROPER DISPLAY(S).
19              ;
20              ;7. PROGRAM DISCIPTION / THEORY OF OPERATION:
21              ;
22              ;       ----------------------------------------
23              ;       NOTE: THE FOLLOWING CONVENTION IS USED IN THE
24              ;             DESCRIPTION TO INDICATE LOW ACTIVE SIGNALS:
25              ;
26              ;                                 ----------
27              ;                    /SIGNALNAME/ = SIGNALNAME
28              ;
29              ;  1)   DIGITAL TO ANALOG CONVERTER OPERATION:
30              ;    A) THE D/A INTERFACE FOR THE MICRO NOVA CONSISTS OF
31              ;       TWO 12-BIT HYBRID D/A CONVERTERS WITH SCOPE CONTROL,
32              ;       LOGIC AND INTERFACE CIRCUITRY. VOLTAGE RANGES FOR
33              ;       THE DACS (JUMPER SELECTABLE) ARE 0-5, 0-10,
34              ;       +/- 5, +/- 10 VOLTS DC. THE VOLTAGE RANGES OF THE TWO
35              ;       DACS ARE INDEPENDENT OF EACH OTHER. MAXAMUM SETTLING
36              ;       TIME TO 0.01% OF FULL SCALE READING IS TYPICALLY 7 US.
37              ;       LINEARITY AND DIFFERENTIAL LINEARITY ARE EACH +/-
38              ;       1/2 LSB AND CONVERSION IS MONOTONIC. EACH DAC HAS
39              ;       AN OUTPUT AMPLIFIER ENABLING IT TO DRIVE 5 MA LOADS.
40              ;       AN ON BOARD DC-DC CONVERTER PROVIDES THE +/- 15 VDC
41              ;       NECESSARY FOR THE ANALOG CIRCUITRY. CODING FOR THE
42              ;       CONVERTERS (JUMPER SELECTABLE) ARE EITHER OFFSET BINARY
43              ;       OR TWO'S COMPLEMENT.
44              ;
45              ;    B) A DOUBLE BUFFERING SCHEME ALLOWS SYNCHRONIZATION OF
46              ;       OUTPUT DATA TO THE D/A CONVERTERS WITH EITHER AN
47              ;       INTERNAL OR EXTERNAL CLOCK. THE FIRST BUFFER IS LOADED
48              ;       BY A DOC INSTRUCTION FOR PROGRAMMED I/O (PIO) OR
49              ;       /DCHO/ FOR DATA CHANNEL (DCH) CONVERSIONS. AT THIS
50              ;       POINT, BOTH THE DAC DATA READY STATUS BIT
51              ;       (READABLE BY A DIA INSTRUCTION) AND OUTPUT SIGNAL
52              ;       (JUMPER SELECTABLE ACTIVE HIGH OR LOW) BECOME ACTIVE.
53              ;       THEY REMAIN ACTIVE UNTIL A CLOCK SIGNAL OCCURS TO
54              ;       LOAD THE SECOND BUFFER WHICH SENDS THE DATA TO
55              ;       ONE OF THE DACS FOR CONVERSION TO ITS EQUIVALENT
56              ;       ANALOG VOLTAGE OUTPUT. APPROXIMATELY 7 US LATER,
57              ;       AFTER THE DAC HAS SETTLED TO ITS NEW VALUE, THE DAC
58              ;       DATA VALID OUTPUT SIGNAL BECOMES ACTIVE (ALSO JUMPER
59              ;       SELECTABLE ACTIVE HIGH OR LOW) AND REMAINS ACTIVE
60              ;       UNTIL THE NEXT CONVERSION IS STARTED.
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 0004 MNDAE
01
02              ;    C) THERE ARE SEVEN DIFFERENT CLOCK SOURCES FOR SENDING
03              ;       DATA TO THE DACS. FOR PROGRAMMED I/O (PIO) THEY ARE:
04              ;       /STRT/ - NO CLOCK SYNCRONIZATION, INTERNAL CLOCK
05              ;       SYNCHRONIZATION, EXTERNAL CLOCK SYNCHRONIZATION.
06              ;       FOR DATA CHANNEL (DCH) TRANSFERS THEY ARE: /IOPLS/
07              ;       (ONE CONVERSION FOR EVERY /IOPLS/ ISSUED TO THE D/A),
08              ;       DATA READY (OCCURS ONE FSTROBE AFTER /DCHO/ AND
09              ;       REPRESENTS THE MAXIMUM TRANSFER RATE), INTERNAL
10              ;       CLOCK SYNCRONIZATION, EXTERNAL SYNCHRONIZATION.
11              ;       FOR /IOPLS/ DCH TRANSFERS, THE TIME BETWEEN
12              ;       SUBSEQUENT IOPLS'S SHOULD BE GREATER THAN THE
13              ;       MAXIMUM DATA CHANNEL LATENCY. ALSO, AN I/O
14              ;       INSTRUCTION WITH AN IOPLS APPENDED (I.E. NIOP)
15              ;       SHOULD NOT BE GIVEN TO THE D/A UNTIL DATA READY
16              ;       IS ACTIVE (DATA LOADED INTO FIRST BUFFER). THIS
17              ;       CAN BE CHECKED BY READING THE D/A STATUS (DIA).
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10005 MNDAE
01              ;     D) IF AN EXTERNAL CLOCK IS USED, THE CLOCK SIGNAL
02              ;        MUST BE HIGH FOR AT LEAST 2 US AND LOW FOR AT
03              ;        LEAST 2 US AND HAVE A PERIOD GREATER THAN THE
04              ;        SETTLING TIME OF THE DACS (7 US TYPICAL),
05              ;        AND FOR DATA CHANNEL TRANSFERS, HAVE A PERIOD
06              ;        GREATER THAN THE MAXIMUM DATA CHANNEL LATENCY.
07              ;
08              ;     E) THE CLOCK SOURCE IS SELECTED BY THREE STATUS BITS
09              ;        IN A DOA INSTRUCTION. THE DOA INSTRUCTION ALSO
10              ;        CONTAINS AN ALTERNATE BIT, WHICH IS SET TO INDICATE
11              ;        ALTERNATING CONVERSIONS BETWEEN THE TWO DACS, A DAC
12              ;        SELECT BIT TO SELECT WHICH DAC RECEIVES THE FIRST
13              ;        DATA AND FOUR SELECTABLE SCOPE FUNTION BITS. THEY
14              ;        ARE /SCOPE MODE/, /NON-STORE/, /WRITE-THROUGH/
15              ;        AND /ERASE/. THE ERASE STATUS BIT CAUSES A PULSE
16              ;        OF DURATION APPROXIMATELY 2 MS ON THE /ERASE/ LINE
17              ;        (A13, LOW ACTIVE OPEN COLLECTOR SIGNAL), WHICH CAN BE
18              ;        USED TO ERASE A SCOPE. THE DOA COMMAND SHOULD NOT
19              ;        BE GIVEN IF BUSY IS SET AND MUST APPEAR FIRST BEFORE
20              ;        DOB AND DOC IN A DATA CHANNEL SETUP SEQUENCE. ALL
21              ;        STATUS BITS REMAIN THE SAME UNTIL THE NEXT DOA
22              ;        INSTRUCTION OR /IORST/, WHICH CLEARS ALL STATUS BITS.
23              ;        SYNCHRONIZTION TO A CLOCK OCCURS ON THE FALLING
24              ;        EDGE OF THE CLOCK.
25              ;
26              ;     F) WHEN POWER IS FIRST APPLIED TO THE DAC BOARD
27              ;        THE DIGITAL CODE FOR 0 VOLTS IS APPLIED TO EACH DAC
28              ;        UNTIL THE FIRST CONVERSION. /IORST/ AGAIN CAUSES 0
29              ;        VOLTS TO BE OUTPUTTED FROM EACH DAC. OTHERWISE, THE
30              ;        VOLTAGE OUTPUT OF EACH DAC IS THAT OF THE LAST
31              ;        CONVERSION.
32              ;
33              ;     G) IF THE /SCOPE MODE/ IN A DOA INSTRUCTION (D4) IS 0
34              ;        (ACTIVE LOW SIGNAL), A Z-AXIS PULSE WILL OCCUR EVERY
35              ;        TIME A NEW DIGITAL CODE IS SENT TO EITHER DAC X
36              ;        OR DAC Y (JUMPER SELECTABLE). THE Z PULSE,
37              ;        WHICH IS AN INTENSIFICATION PULSE, ACTUALLY OCCURS
38              ;        AFTER A 7 US DELAY TO ALLOW DAC SETTLING.
39              ;        THE Z PULSE MAY BE AC OR DC COUPLED (JUMPER
40              ;        SELECTABLE). THE DC LEVEL OF THE Z-AXIS SIGNAL
41              ;        SHOULD BE ADJUSTED BY THE POT PROVIDED SO THAT
42              ;        THE CRT OR OSCILLOSCOPE TRACE IS JUST BARELY
43              ;        BLANKED. THE Z PULSE CAN BE UP TO THREE 0.5
44              ;        VOLT LEVELS ABOVE OR BELOW THIS DC LEVEL (UP-DOWN
45              ;        IS JUMPER SELECTABLE). THE AMPLITUDE OF THE Z
46              ;        PULSE CAN BE INCREASED TO THREE 2 VOLT LEVELS
47              ;        BY CHANGING THE 3.3K RESISTOR TO 680 OHMS AND
48              ;        THE 8.2K TO 3.3K. THE BRIGHTNESS OF THE Z PULSE
49              ;        IS DETERMINED BY BITS 14 AND 15 OF THE DATA WORD
50              ;        WHICH CAUSES THE Z PULSE (NOTE THAT BITS 0-11
51              ;        CONTAIN D/A DATA). THE FOLLOWING CODES DETERMINE
52              ;        THE BRIGHTNESS:
53              ;
54              ;        D14     D15            BRIGHTNESS LEVEL
55              ;        0       0       1.5 VOLTS +/- DC LEVEL
56              ;        0       1       1.0 VOLTS +/- DC LEVEL
57              ;        1       0       0.5 VOLTS +/- DC LEVEL
58              ;        1       1       NO CHANGE IN DC LEVEL DURING Z PULSE
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10006 MNDAE
01              ;     H) ALL PROGRAMMED I/O DIGITAL-TO-ANALOG CONVERSIONS
02              ;        SHOULD NORMALLY BEGIN WITH A DOCS INSTRUCTION. THE
03              ;        DOC INSTRUCTION WILL LOAD THE FIRST BUFFER WITH DATA.
04              ;        PIO CONVERSIONS THAT ARE SYNCHRONIZED TO AN INTERNAL
05              ;        OR EXTERNAL CLOCK WILL OCCUR WITHOUT THE START COMMAND,
06              ;        ON THE FIRST FALLING EDGE OF THE CLOCK PULSE AFTER
07              ;        THE DOC COMMAND HAS BEEN ISSUED. HENCE, IF IT IS
08              ;        DESIRED TO DO PROGRAMMED, SYNCHRONIZED CONVERSIONS
09              ;        WITHOUT SETTING DONE, THE DOC COMMAND ALONE MAY BE
10              ;        GIVEN. FOR NON-SYNCHRONIZED PROGRAMMED I/O CONVERSIONS,
11              ;        THE I/O START COMMAND MUST BE GIVEN TO SEND THE DATA
12              ;        FROM THE FIRST BUFFER TO THE SECOND BUFFER AND OUT
13              ;        TO THE DACS FOR CONVERSION.
14              ;
15              ;     I) FOR DATA CHANNEL TRANSFERS, THE I/O START COMMAND CAUSES
16              ;        THE FIRST DATA CHANNEL TRANSFER TO THE FIRST BUFFER.
17              ;        SUBSEQUENTLY, THE CLOCK SOURCE SELECTED BY THE
18              ;        DOA INSTRUCTION OUTPUTS THE DATA TO THE APPROPRIATE
19              ;        DAC AND REQUESTS ANOTHER DATA CHANNEL TRANSFER.
20              ;
21              ;     J) THE EVENT WHICH CAUSES DONE TO BE SET VARIES, DEPENDING
22              ;        ON THE MODE IN WHICH INTERFACE IS BEING USED. FOR
23              ;        UNSYNCHRONIZED CONVERSIONS IN WHICH THE SCOPE MODE IS
24              ;        NOT BEING USED (NO Z-AXIS PULSES TRIGGERED AFTER THE
25              ;        CONVERSION), THE DOCS COMMAND TO START A CONVERSION
26              ;        WILL, OF COURSE, SET BUSY BUT DONE WILL NEVER BE SET
27              ;        IN THIS MODE BECAUSE OF THE FAST SPEED OF THE CON-
28              ;        VERSION (BUSY WILL REMAIN SET). BEFORE NEW STATUS BITS
29              ;        ARE SELECTED (VIA A DOA INSTRUCTION), BUSY SHOULD BE
30              ;        CLEARED (VIA AN I/O CLEAR). DONE IS SET AS FOLLOWS:
31              ;
```

```
;       DOA INSTRUCTION STATUS BITS     DONE SETTING SOURCE
;       ===========================     ===================
;       MODE    CLOCK   /SCOPE
;       DCH     SYNC    MODE/
;       --      --      --
;       D0      D1      D4
;       --      --      --
;
;       0       0       0               END OF Z PULSE
;
;       0       0       1               NONE
;
;       0       1       0               END OF Z PULSE
;
;       0       1       1               2ND BUFFER CLOCK PULSE
;                                       (FALLING EDGE OF
;                                       EXTERNAL/INTERNAL CLK
;                                       INDICATES DATA SENT
;                                       TO DAC)
;
;       1       0       0               END OF Z PULSE AFTER
;                                       /WCEZ/ (NOTE: LAST
;                                       DATA CHANNEL WORD MUST
;                                       CAUSE Z PULSE OR ELSE
;                                       DONE WILL NOT SET)
;
;       1       0       1               2ND BUFFER CLOCK PULSE
;                                       AFTER /WCEZ/(SYCHRONIZED
;                                       TO FALLING EDGE OF
;                                       /IOPLS/ OR /DATA READY/
;                                       - INDICATES LAST DATA
;                                       IN DCH TRANSFER HAS
;                                       BEEN SENT TO DAC
;
;       1       1       0               END OF Z PULSE AFTER
;                                       /WCEZ/ (SEE NOTE ABOVE)
;
;       1       1       1               2ND BUFFER CLOCK PULSE
;                                       AFTER /WCEZ/. SYNCHRO-
;                                       NIZED TO FALLING EDGE
;                                       OF INTERNAL/EXTERNAL
;                                       CLOCK - INDICATES LAST
;                                       DATA IN DCH TRANSFER HAS
;                                       BEEN SENT TO DAC
;
;       NOTE - IN THE DATA CHANNEL MODES ABOVE, DONE MAY
;       ALSO BE SET BY THE LATE CONVERSION SIGNAL, IF THE
;       APPROPRIATE JUMPER CONNECTION IS MADE.
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;   K) IF THE PERIOD OF THE SYNCHRONIZING CLOCK IN DATA
;      CHANNEL MODE IS LESS THAN THE DATA CHANNEL LATENCY
;      TIME, DATA WILL NOT BE LOST, BUT IT WILL NOT APPEAR
;      AT THE DAC AT THE CORRECT SYNCHRONIZING CLOCK EDGE.
;      RATHER, IT WILL APPEAR AT THE APPROPRIATE DAC AT THE
;      TIME OF THE FIRST TRAILING EDGE OF THE CLOCK AFTER
;      THE FIRST BUFFER HAS BEEN LOADED WITH NEW DATA. THE
;      DATA APPEARING AT THE DACS IS LATE FOR SYN-
;      CHRONIZATION, HOWEVER, AND THE LATE CONVERSION SIGNAL
;      IS SET. THIS SIGNAL MAY BE READ IN AS A STATUS
;      BIT BY A DIA INSTRUCTION AND MAY, BY
;      SETTING A JUMPER, SET DONE. THE LATE CONVERSION
;      SIGNAL IS CLEARED BY AN I/O CLEAR OR DOA INSTRUCTION.
;
;   L) IF THIS INTERFACE IS BEING USED TO DISPLAY ON A SCOPE
;      AN ARRAY OF POINTS LOCATED IN MEMORY, DATA CHANNEL
;      MODE SHOULD BE USED WITH THE ALTERNATE BIT SET, THE
;      /SCOPE MODE/ BIT RESET (THIS IS AN ACTIVE-LOW SIGNAL)
;      AND DATA ARRAYED IN MEMORY XYXYXYXY...OR YXYXYXYX...
;      IN THE FORMER CASE, DAC X IS SELECTED AS THE FIRST
;      DAC TO RECEIVE DATA AND THE SCOPE CIRCUITRY IS JUMPED
;      SO THAT A Z PULSE OCCURS AFTER CLOCK Y, AND THE
;      BRIGHTNESS CIRCUIT IS JUMPERED FOR BRTYMSB AND
;      BRTYLSB. FOR THE YXYXYXYX... ORIENTATION, SET UP
;      IS REVERSED. THE Z DELAY (7 US) + THE Z PULSE
;      WIDTH MAY NOT EXCEED THE CLOCK PERIOD. HENCE,
;      THE Z INTENSIFICATION PULSE IS DONE BEFORE ANY DAC IS
;      UPDATED WITH NEW DATA.
;
;   M) AN EXTERNAL INTERRUPT MAY BE REQUESTED BY PULLING THE
;      /EXTERNAL INTERRUPT/ LINE LOW, WHICH WILL REQUEST AN
;      INTERRUPT WITHOUT SETTING DONE. THE EXTERNAL
;      INTERRUPT REQUEST IS CLEARED BY AN I/O CLEAR OR DOA
;      INSTRUCTION.
;
;   N) A DIA INSTRUCTION INPUTS FOUR STATUS BITS TO THE CPU:
;      AN EXTERNAL ERASE INPUT BIT WHICH IS SET BY PULLING
;      THE /EXTERNAL ERASE INPUT/ LINE LOW; A DATA READY BIT
;      TO INDICATE THAT NEW DATA HAS BEEN LOADED INTO THE
;      FIRST BUFFER (USEFUL FOR THE IOPLS DATA CHANNEL MODE)
;      A LATE CONVERSION ERROR BIT; AND A BIT INDICATING
;      THE PRESENCE OF AN EXTERNAL INTERRUPT.
;
;   O) THE FOLLOWING ARE THE NOMINAL RANGES (PERIODS) FOR
;      THE INTERNAL CLOCK AND THE ZPULSE (ADJUSTABLE BY
;      POTENTIOMETERS ON THE D/A BOARD):
;
;        WHAT            MIN     MAX     POT.
;        ----            ---     ---     ----
;        INTERNAL CLOCK  16 US   190 US  R43
;        ZPULSE          4 US    150 US  R32
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10009 MNDAE
01              ;       2) PROGRAM OPERATION:
02              ;          THE PURPOSE OF THIS EXERCISOR IS TO PROVIDE A CON-
03              ;          TINUOUS STREAM OF "KNOWN" DATA IN ORDER TO ASSURE
04              ;          PROPER OUTPUT FROM THE D/A AND A MEANS OF SCOPING
05              ;          THE PROBLEM SHOULD THERE BE ONE.  THE THIRTEEN
06              ;          TESTS WERE DESIGNED TO EXERCISE THE FOLLOWING:
07              ;               1 - PULSE AMPLITUDE
08              ;               2 - PULSE WIDTH
09              ;               3 - SWITCH DUMP
10              ;               4 - STAIRCASE
11              ;               5 - INTENSITY ("Z"-AXIS)
12              ;               6 - SLEW RATE
13              ;               7 - EXERCISE THE 3 SCOPE CONTROL BITS
14              ;               8 - CALIBRATION
15              ;
16              ;          EACH TEST RUNS UNTIL STOPPED BY THE OPERATOR, SO AS
17              ;          TO PROVIDE A SYNC AND SCOPE LOOP.
18              ;
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10010 MNDAE
01              ;8. OPERATING MODES/SWITCH SETTINGS:
02              ;       SWITCH PACK-N/A
03              ;       STARTING ADDRESSES ARE 200 OR 500
04              ;9. OPERATING PROCEDURES/OPERATOR INPUT:
05              ;       (NOTE:  WHEN REMOVING AND/OR INSERTING
06              ;       PC BOARDS THE POWER SHOULD BE OFF IN THE SYSTEM)
07              ;
08              ;       TO RUN THTS DIAGNOSTIC:
09              ;       1) THE D-A MUST BE IN THE SYSTEM WITH INTP AND
10              ;          DCHP PROPERLY CONNECTED.
11              ;       2) CONNECT THE OUTPUT OF THE X CONVERTER TO CH 1
12              ;          OF THE SCOPE.
13              ;       3) CONNECT THE OUTPUT OF THE Y CONVERTER TO THE
14              ;          CH 2 SCOPE INPUT.
15              ;       4) PLACE THE "0" SCOPE HORIZONTAL SWEEP RATE TO
16              ;          THE X-Y POSITION.
17              ;       5) THE CH 2 VERTICAL CHANNEL IS TO BE SELECTED
18              ;       6) TURN THE SYSTEM ON, LOAD THE PROGRAM, START
19              ;          AT LOC 200 (OR 500).
20              ;       7) ANSWER THE FOLLOWING QUESTIONS:
21              ;               A) DEVICE CODE OF D-A IS -. (ENTER THE
22              ;               SIX BIT DEVICE CODE OF THE D-A INTER-
23              ;               FACE IN OCTAL-MUST BE GREATER THAN 5
24              ;               AND LESS THAN 77)
25              ;
26              ;               B) DOES THE Z PULSE COME FROM X (0) OR Y (1)
27              ;
28              ;               C) IS THE X-DAC JUMPERED FOR OFFSET BINARY (0)
29              ;                 OR TWO'S COMPLEMENT (1) ?
30              ;
31              ;               D) IS THE Y-DAC JUMPERED FOR OFFSET BINARY (0)
32              ;                 OR TWO'S COMPLEMENT (1) ?
33              ;
34              ;               (SEE TABLE 1 FOR FULL JUMPER INFO.)
35              ;
36              ;       8) AT THIS TIME A PROMPT (!) WILL BE ISSUED AND THE
37              ;          OPERATOR IS SETUP FOR TESTS 1, 2, AND 3.  HE MAY
38              ;          START THE TESTS BY TYPING T"N" WHERE "N" IS
39              ;          1, 2, OR 3.  THE TEST WILL START AND
40              ;          DISPLAY A SQUARE OF FULL DEFLECTION (FROM BOTH
41              ;          DACS) ON THE FACE OF THE "0" SCOPE.
42              ;
43              ;       9) TEST 1 IS A BASIC SQUARE FORMED AS FOLLOWS:
44              ;        START BY SETTING X AND Y TO THEIR MINIMUM VALUE (IF THE
45              ;          D-A'S ARE SET TO DIFFERENT VOLTAGE RANGES A REC-
46              ;          TANGLE WILL OCCUR--STILL MEASUREABLE ON THE CRT),
47              ;          X IS THEN INCREMENTED TO 77 (OCTAL) SHORT OF THE
48              ;          MAX (1.5%) WITH Y HELD @ 0.  NEXT Y IS INCREMENTED
49              ;          THE SAME WAY W/X HELD AT IT'S LAST VALUE.  WITH
50              ;          Y AT 98.5% OF MAX X IS THEN DECREMENTED TO MINIMUM,
51              ;          FOLLOWED IN SIMILAR MANNER BY Y. (IN THE + OR -
52              ;          10 RANGE, 98.5% IS .3 VOLTS FROM MAX) IT GOES TO
53              ;          THE D-A IN THE DATA CHANNEL, DATA READY MODE (THE
54              ;          FASTEST);IT IS IN SCOPE MODE SENDING AN ERASE; ALTER-
55              ;          NATING BETWEEN X + Y; W/X FIRST
56              ;
57              ;       10) TEST 2 IS LIKE TEST 1 WITH TWO EXCEPTIONS:  THE
58              ;           SCOPE MODE IS WRITE TROUGH; AND THE "Z" AXIS
59              ;           (INTENSITY) IS STEPPED FOR EACH SIDE OF THE
60              ;           SQUARE (RECTANGLE)
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 0011 MNDAE
01                ;
02                ;       11) TEST 3 IS LIKE TEST 1 WITH TWO EXCEPTIONS :
03                ;           IT IS OUTPUT TO THE D-A IN THE PROGRAMMED I/O
04                ;           MODE WITH START SYNC FOR TRIGGERING; AND THE
05                ;           SCOPE MODE IS NON-STORE.
06                ;               (NOTE: TO OBSERVE THE SCOPE CONTROLE BITS
07                ;               (ERASE,WRITE THROUGH,NON-STORE,+THE "Z"-AXIS)
08                ;               CALL THE TEST IT APPERS IN(1-3).THEN SET THE
09                ;               SCOPE AS FOLLOWS: HORZ. SWEEP- 1(OR 2) MS/CM
10                ;               SYNC ON CH1;VERT. SELECT- CH2(OR CHOP) AND
11                ;               USE THE CH2 PROBE TO SEE THE BIT COMMING OFF
12                ;               THE INTERFACE. ALL SIGNALS ARE DIGITAL
13                ;               (EXEPT "Z") SO 2V/CM ON THE VERT AMP WILL DO.
14                ;               THE "Z" PULSE IS .5V - 1.5V PER STEP AS
15                ;               DICTATED BY THE RESISTORS DISCRIBED
16                ;               IN SECTION 7.1 PARAGRAPH G)
17
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10012 MNDAE
01                ;       12)   THE OTHER TESTS (4-12) USE ONE OF TWO MODES:
02                ;              1) THE SINGLE CHANNEL TESTS ARE DCH, DATA
03                ;              READY; NO "Z" PULSE; NO ALTERNATE; OUTPUT
04                ;              TO X (OR Y).
05                ;              2) THE DUAL TRACE TESTS (6,11,12) USE,DCH,
06                ;              DATA READY; ALTERNATE W/X FIRST; NO "Z"
07                ;              PULSE.
08                ;
09                ;              FOR TESTS 4-12 THE OPERATOR IS TO SET THE "O"
10                ;                 SCOPE HORIZONTAL SWEEP RATE AND VERTICAL CH
11                ;                 SELECTION AS FOLLOWS:
12                ;
13                ;              TEST     HORZ. SWEEP RATE          VERT. SELECT
14                ;
15                ;              4        .5 MS/CM                  CH1
16                ;              5        .5 MS/CM                  CH2
17                ;              6         1 MS/CM                  CHOP
18                ;              7        .5 MS/CM                  CH1
19                ;              8        .5 MS/CM                  CH2
20                ;              9        .5 MS/CM                  CH1
21                ;              10       .5 MS/CM                  CH2
22                ;              11        1 MS/CM                  CHOP
23                ;              12        1 MS/CM                  CHOP
24                ;
25                ;       13) TEST 4 IS A STAIRCASE OF 16 STEPS, MINIMUM TO
26                ;        MAXIMUM SCALE FROM THE X CONVERTER.
27                ;       14) TEST 5 IS THE SAME AS TEST 4 BUT FROM THE Y
28                ;       CONVERTER.
29                ;       15) TEST 6 IS TEST 4 & 5 TOGETHER FOR COMPARISON.
30                ;       16) TEST 7 IS AN ADJUSTABLE SQUARE WAVE FROM THE X
31                ;       CONVERTER
32                ;           WITH DEFAULT VALUE OF 3/4 SCALE.
33                ;       17) TEST 8 IS AS TEST 7 FROM THE Y CONVERTER.
34                ;       18) TEST 9 IN A MULTI-LEVEL, ADJUSTABLE SQUARE
35                ;        WAVE FROM THE X CONVERTER WITH MINIMUM SCALE
36                ;        AS REFERENCE WITH 1/4 AND 3/4 SCALE AS DEFAULT
37                ;        FOR THE ADJUSTABLE VALUES.
38                ;       19) TEST 10 AS IS TEST 9 WITH Y OUTPUTTING.
39                ;       20) TEST 11 IS TESTS 7 & 8 TOGETHER.
40                ;       21) TEST 12 IS TESTS 9 & 10 TOGETHER.
41                ;
42                ;       TO GET A TEST STARTED , AGAIN TYPE T"N",
43                ;       WHERE "N" IS 4,5,6,7,8,9,10,11, OR 12.
```

```
10013 MNDAE
01              ;       22) TO RUN THE TESTS IN SEQUENCE, THE OPERATOR NEED
02              ;           ONLY TYPE A "C" (CONTINUE) TO START THE NEXT TEST.
03              ;           (THIS WILL START TEST 1 IF THE PRESENT TEST
04              ;           IS 12 OR WHEN JUST STARTING UP)
05              ;       23) IN TESTS 7-12 THE OPERATOR IS ASKED IF DEFAULT VALUES
06              ;           ARE TO BE USED; IF SO A CARRIAGE RETURN WILL START
07              ;           THE TEST, OTHERWISE TYPE A 1, CARRIAGE RETURN, AND NEW
08              ;           VALUE(S) WILL BE ASKED FOR.  THE PROGRAM LEFT JUSTIFIES
09              ;           THE 12 BIT DATA TO THE D-A SO THE RANGE TO RESPOND TO IN
10              ;           THESE QUERRIES IS 0-7777 (OCTAL).  AS THE PROGRAM ISN'T
11              ;           CONCERNED ABOUT THE VOLTAGE RANGE OF THE D-A THE FOL-
12              ;           LOWING CHART MAY BE USEFUL HERE. (THESE ARE ABSOLUTE
13              ;           VALUES AS THE PROGRAM CONVERTS TO BI-POLAR WHEN
14              ;           NECESSARY.)
15              ;
16              ;       D-A VOLT RANGE  0>5V    -5V>+5V*        0>10V   -10V>+10V*
17              ;
18              ;               7777: +5V       +5V             +10V    +10V
19              ;               7000: +4.375V   +3.75V          +8.75V  +7.5V
20              ;               6000: +3.75V    +2.5V           +7.5V   +5V
21              ;               5000: +3.125V   +1.25V          +6.25V  +2.5V
22              ;               4000: +2.5V     0V              +5V     0V
23              ;               3000: +1.875V   -1.25V          +3.75V  -2.5V
24              ;               2000: +1.25V    -2.5V           +2.5V   -5V
25              ;               1000: +.625V    -3.75V          +1.25V  -7.5V
26              ;               0000:   0V      -5V             0V      -10V
```

```
10014 MNDAE
01              ;       24) THE PROGRAM HAS ONLY 3 ERROR REPORTS (AS THE D-A
02              ;            DIAGNOSTIC IS TO BE RUN FIRST) WHICH ARE:
03              ;           DONE NOT SETTING AFTER ^ REASONABLE TIME(TWO CASES);
04              ;           AND ALSO "LATE CONVERSION".  IF ONE OF THESE ERRORS
05              ;           IS ENCOUNTERED THE TEST WILL CONTINUE TO LOOP BUT
06              ;           WILL ALSO PRINT OUT THE MESSAGE EACH TIME.  IN ORDER
07              ;           TO AVOID THIS, THE OPERATOR MAY HIT AN "I" ON THE
08              ;           TTY (OR DISPLAY) TO INHIBIT THE REPORT.
09              ;
10              ;       25) THE TOTAL COMMAND SUMMARY IS:
11              ;
12              ;               T"N" - START TEST "N" (1-13) AND RUN UNTIL STOPPED
13              ;               C - END THE CURRENT TEST AND START THE NEXT
14              ;                   SEQUENTIAL ONE - UNLESS THE CURRENT
15              ;                   TEST IS 12 - THEN START 1
16              ;               ESC - (ESCAPE) STOPS THE PROGRAM AND EXITS TO
17              ;                   THE PROMPT (!)
18              ;               I - INHIBIT THE ERROR PRINTOUT
19              ;               O - (AND ^O)-EXIT TO THE OCTAL DEBUG TOOL.(ODT)
20              ;               D - INHIBIT ALL .TXT MESSAGES
21              ;               E - ENABLE ALL .TXT MESSAGES
```

```
!0015 MNDAE
01              ;10. PROGRAM OUTPUT/ERROR DESCRIPTION
02              ;
03              ;       1) THE TWO ERROR REPORTS IN SECTION 9.24 ARE
04              ;          DETECTED AS FOLLOWS:
05              ;          1) D-A NOT SETTING DONE WITHIN .2 MS
06              ;          FROM TEST 3 + 13 WHERE THE PIO START SYNC
07              ;          FAILED TO SET DONE WITHIN 200 MICRO-SECONDS.
08              ;          AS IT IS THE "Z" PULSE THAT SETS DONE, IT
09              ;          SHOULD HAVE HAPPENED BETWEEN 3 AND 100
10              ;          MICRO-SECONDS - SO THE 200 MS IS VERY
11              ;          LIBERAL - THE D-A DIAGNOSTIC (094-957 IS THE
12              ;          .SR FILE NO.) SHOULD BE USEFUL IN FIXING
13              ;          THIS SITUATION IF NECESSARY.
14              ;
15              ;       2) TIME OUT ERROR.  DCH FAILED TO RESPOND IN LESS
16              ;          THAN 30 MS.
17              ;          MAY BE ISSUED IN TESTS 1,2,4-12(INCLUSIVE).
18              ;          DONE SHOULD SET AT COMPLETION OF THE DATA CHAN-
19              ;          NEL CYCLE, WHICH AT MAX (TESTS 1,2,6,11,+12)
20              ;          SHOULD BE LESS THAN 10 MS - ONCE AGAIN LIBERATE
21              ;          ENOUGH SO THAT THE DIAGNOSTIC SHOULD HAVE
22              ;          DETECTED IT.
23              ;
24              ;       3) LATE CONVERSION!
25              ;               WORD COUNT =
26              ;               NNNNN
27              ;          HAPPENS WHEN THE DATA CHANNEL CYCLE GETS OUT OF
28              ;          SYNC WITH THE D-A.  ONCE AGAIN THE DIAGNOSTIC
29              ;          SHOULD HAVE DETECTED THE CONDITION AND MAY BE
30              ;          USEFUL IN CORRECTING THE PROBLEM.
31              ;               THE WORD COUNT (NNNNN) IS GIVEN IN THE
32              ;               EVENT THAT THE LATE CONVERTION SET DONE
33              ;               BEFOR THE WHOLE BUFFER WAS OUTPUT.
34              ;               THE FULL BUFFER COUNT FOR ALL TEST ARE:
35              ;
36              ;               TEST #          WORD COUNT (OCTAL)
37              ;
38              ;               1               1000
39              ;               2               1000
40              ;               3               N/A (PROGRAM I/O)
41              ;               4               400
42              ;               5               400
43              ;               6               1000
44              ;               7               400
45              ;               8               400
46              ;               9               400
47              ;               10              400
48              ;               11              1000
49              ;               12              1000
50              ;               13              N/A (PROGRAM I/O)
51
```

```
!0016 MNDAE
01              ;       4) THE ONLY OTHER PROGRAM OUTPUT IS IN THE FORM OF
02              ;          QUESTIONS DESCRIBED EARLIER.
03              ;
04              ;
05              ;11.    DEBUG HELP:
06              ;       ----------
07              ;       *** OCTAL DEBUG TOOL (ODT) ***
08              ;
09              ;       THE DIAGNOSTIC IS EQUIPED WITH A BUILT IN ODT WHICH CAN
10              ;       BE ACCESSED BY HITTING CONTROL O (^O) AT ANY TIME DURING
11              ;       THE EXECUTION OF THE PROGRAM (AFTER SETTING THE PARA-
12              ;       METERS).
13              ;       ON ENTERING ODT THE ADDRESS OF THE LOCATION HAVING THE
14              ;       NEXT INSTRUCTION TO BE EXECUTED WILL BE TYPED-OUT.
15              ;
16              ;11.1   CONVENTIONS AND SYMBOLS
17              ;       THE FOLLOWING CONVENTIONS ARE USED BY THE ODT:
18              ;       ?       PRESSING ANY ILLEGAL KEY CAUSES THE ODT TO RES-
19              ;               POND WITH A "?".
20              ;       @       ODT IS READY AND AT YOUR SERVICE.
21              ;
22              ;11.2   COMMAND STRUCTURE
23              ;       AN ODT COMMAND HAS THE FOLLOWING FORMAT:
24              ;               [ARGUMENT][COMMAND]
25              ;       AN ARGUMENT MAY BE ONE OF THE FOLLOWING:
26              ;       "EXP"   AN OCTAL EXPRESSION CONSISTING OF OCTAL NUMBERS
27              ;               SEPARATED BY PLUS (+) OR MINUS (-) SIGNS. LEAD-
28              ;               ING ZEROS NEED NOT BE TYPED.
29              ;       "ADR"   AN ADDRESS IS THE SAME AS AN EXPRESSION EXCEPT
30              ;               THAT BIT 0 IS NEGLECTED.
31              ;       A COMMAND IS A SINGLE TELETYPE CHARACTER
32              ;
33              ;11.3   ODT COMMANDS
34              ;       THE LOCATIONS THAT CAN BE EXAMINED AND MODIFIED BY THE
35              ;       USER ARE CALLED CELLS. THESE CELLS ARE OF TWO TYPES:
36              ;       INTERNAL CPU CELLS AND MEMORY LOCATIONS.
37              ;
38              ;11.3.1 OPENING INTERNAL CELLS
39              ;       THE COMMAND TO OPEN ONE OF THE INTERNAL REGISTERS IS OF
40              ;       THE FORM "NA" WHERE N IS ANY OCTAL EXPRESSION BETWEEN
41              ;       0 AND 7
42              ;       0-3     FOR ACCUMULATORS 0-3
43              ;       4       FOR PC OF THE NEXT INSTRUCTION TO BE EXECUTED IN
44              ;               THE EVENT OF A "P" COMMAND.
45              ;       5       CPU AND TTO STATUS
46              ;               BIT     INTERPRETATION
47              ;               15      STATUS OF TTO DONE FLAG
48              ;               14      STATUS OF INTERRUPTS (ION FLAG)
49              ;               13      STATUS OF CARRY BIT
50              ;       6       ADDRESS OF THE LOCATION HAVING THE BREAK POINT
51              ;               (IF ANY)
52              ;       7       INSTRUCTION AT THE BREAK POINT LOCATION
53
```

```
!0017 MNDAE
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 POINTER
05                ;               AND PRINT ITS CONTENTS.
06                ;       .+"ADR"/        ADD "ADR" TO THE POINTER, OPEN THE CELL AND PRINT
07                ;               ITS CONTENTS.
08                ;       .-"ADR"/        SUBTRACT "ADR" FROM THE POINTER, OPEN
09                ;                THE CELL AND 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                ;
```

```
!0018 MNDAE
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 MOST
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 CELLS
07                ;               CONTENTS. THIS ALLOWS THE MODIFICATION OF THE CELL
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.
```

```
10019 MNDAE
01              ;11.4   INSTRUCTION SET:
02              ;       DOA:  OUTPUT STATUS BITS TO THE INTERFACE, CLEARS
03              ;       EXTERNAL INTERRUPT REQUEST AND LATE CONVERSION.
04              ;       SHOULD NOT BE GIVEN IF BUSY IS SET AND MUST APPEAR
05              ;       BEFORE DOB AND DOC IN DATA CHANNEL SETUP SEQUENCE.
06
07              ;       D0, D1, D2 ARE THE CLOCK SOURCE BITS FOR SENDING
08              ;       DIGITAL DATA TO THE D/A CONVERTERS:
09
10              ;       D0      D1      D2      CLOCK SOURCE TO SEND DAC DATA
11              ;       --      --      --      ------------------------------
12              ;       0       0       0       /STRT/, NO SYNC
13              ;       0       0       1       NO CONVERSIONS
14              ;       0       1       0       INTERNAL CLOCK SYNC *
15              ;       0       1       1       EXTERNAL CLOCK SYNC *
16              ;       1       0       0       /IOPLS/ (1 DATA CONVERSION
17              ;                               FOR EVERY /IOPLS/ FOLLOWING
18              ;                               /STRT/, NO SYNC) **
19              ;       1       0       1       /DATA READY/ (OCCURS 1
20              ;                               FSTROBE CYCLE AFTER /DCHO/
21              ;                               & IS MAXIMUM TRANSFER RATE)
22              ;       1       1       0       INTERNAL CLOCK SYNC
23              ;       1       1       1       EXTERNAL CLOCK SYNC
24
25              ;       * FIRST FALLING EDGE AFTER DOC COMMAND
26              ;       ** DATA SHOULD BE READY IN THE FIRST BUFFER BEFORE
27              ;          /IOPLS/ IS ISSUED
28
29              ;D3     ALTERNATE BIT       0       DO NOT ALTERNATE BETWEEN
30              ;                                   DAC X AND DAC Y.
31
32              ;                           1       ALTERNATE BETWEEN DAC X AND
33              ;                                   DAC Y, STARTING WITH DAC
34              ;                                   SELECTED BY D15
35
36              ;D4     /SCOPE MODE/ BIT    0       Z-AXIS PULSE GIVEN EVERY TIME
37              ;                                   DAC X OR DAC Y (JUMPER
38              ;                                   SELECTABLE) IS WRITTEN TO
39
40
41              ;                           1       NO Z-AXIS PULSES OUTPUTTED
42
43              ;D5     /NON-STORE/         1       FOR NON-STORE, OC TRUE-LOW
44              ;                                   OUTPUT (PINS A9 AND A10)
45
46              ;D6     /WRITE-THROUGH/     1       FOR WRITE-THROUGH, OC TRUE-LOW
47              ;                                   OUTPUT (PINS A11 AND A12)
48
49              ;D7     /ERASE/             1       FOR 2 MS PULSE TO SCOPE,
50              ;                                   OC TRUE-LOW OUTPUT
51              ;                                   (PINS A13 AND A14)
52
53              ;D15    DAC SELECT BIT      0       SELECTS DAC X
54              ;                           1       SELECTS DAC Y
55
56              ;       THE DEFAULT STATE OF ALL THESE STATUS BITS
57              ;       UPON POWER-UP OR IORST IS 0.
```

```
10020 MNDAE
01              ;DOB:   OUTPUTS TO ADDRESS REGISTER FOR DATA CHANNEL
02              ;       TRANSFERS.
03
04              ;DOC:   OUTPUTS TO WORD-COUNT REGISTER FOR DATA CHANNEL
05              ;       TRANSFERS. IN PROGRAMMED I/O MODE (D0=0 IN
06              ;       DOA INSTRUCTION) THIS INSTRUCTION CAUSES THE
07              ;       FIRST BUFFER TO BE LOADED WITH THE DATA IN
08              ;       THE ACCUMULATOR BITS 0-11, 14 AND 15.
09              ;       BITS 0-11 ARE THE D/A DATA, WITH BIT 0 THE MSB.
10              ;       BITS 14 AND 15 CONTAIN BRIGHTNESS INFORMATION
11              ;       FOR Z-AXIS PULSES. A CLOCK SIGNAL AS SELECTED BY
12              ;       THE DOA INSTRUCTION THEN OUTPUTS THE DATA TO THE
13              ;       SECOND BUFFER AND THE APPROPRIATE DAC.
14
15              ;DIA:   INPUTS STATUS BITS FROM THE INTERFACE
16
17              ;D0     1  IF EXTERNAL INTERRUPT REQUEST HAS OCCURRED,
18              ;       0  OTHERWISE
19              ;D1     1  IF DATA READY=1, 0 OTHERWISE.  THIS INDICATES
20              ;          THE PRESENCE OF DIGITAL DATA IN THE FIRST BUFFER.
21
22              ;D8     1  IF LATE CONVERSION=1, 0 OTHERWISE.  THIS INDICATES
23              ;          A LOSS OF SYCHRONIZATION WITH THE INTERNAL OR
24              ;          EXTERNAL CLOCK IN DATA CHANNEL MODE.
25
26              ;D15    1  IF /EXTERNAL ERASE INPUT/ LINE IS PULLED LOW,
27              ;       0  OTHERWISE.
28
29              ;DIB:   INPUTS CURRENT DATA CHANNEL ADDRESS REGISTER
30
31              ;DIC:   NOT USED
```

```
10021 MNDAE
01                ;
02                ;       5) MACROS USED (3)
03                ;               1) "OUTP" - DOES A CARRIAGE RETURN LINE FEED,
04                ;               OUTPUTS .TXT MESSAGE FROM LOCATION USED AS A
05                ;               MACRO CALL ARGUMENT (I.E. OUTP PROMT OUTPUTS
06                ;               THE TEXT FROM LOCATION "PROMT") THEN FOLLOWS
07                ;               UP W/2ND C.R. + L.F.
08                ;
09                ;               2) "OCTIN" INPUTS OCTAL DIGITS + ERROR RETURNS
10                ;               (KEY OTHER THAN 0-7 WAS HIT) TO THE MACRO CALL
11                ;               ARGUMENT. (I.E. OCTIN F13Z GETS OCTAL DIGITS
12                ;               UNTIL A C.R. OR IF AN ILLEGAL CHAR WAS HIT IT
13                ;               WILL GO TO F13Z)
14                ;
15                ;               3) "ADJS" SHIFTS A BINARY NO IN AC1 FOUR PLACES
16                ;               TO THE LEFT THEN STORES AC1 TO THE LOCATION
17                ;               SPECIFIED BY THE MACRO CALL ARGUMENT (I.E. ADJS
18                ;               X1 TAKES THE NO IN AC1, SHIFTS IT FOUR PLACES
19                ;               TO THE LEFT AND STORES IT IN LOC "X1")
20                ;
```

```
10022 MNDAE
01                ;       6. SUBROUTINES
02                ;               1) INPUT - CHECKS THE ASCII CLEAR TO DETERMINE
03                ;                  IF IT WAS A COMMAND - EXITS TO COMMAND IN-
04                ;                  TERPRETER OR WHERE IT CAME FROM
05                ;               2) TNUMB - A "T" COMMAND GETS YOU HERE - IT
06                ;                  THEN INPUTS THE TEST NO) - CHECK FOR <14
07                ;                  THEN GOES TO APPROPRIATE TEST OR TO THE
08                ;                  PROMPT IF TN >13.
09                ;               3) STR02 - GETS D-A COMMAND WORD (CALLED DOAWD)
10                ;                  AND SEND IT TO THE D-A, GETS THE DATA CHANNEL
11                ;                  STARTING ADDR) AND SENDS IT TO THE D-A, GETS
12                ;                  THE NEGATIVE WORD COUNT AND SENDS IT TO THE
13                ;                  D-A, STARTS THE D-A DCH CYCLE, TIMES IT, AND
14                ;                  LOOPS.
15                ;               4) NEWV1 - GETS OPERATOR VALUE TO USE AS X1.
16                ;                  (ALL SINGLE CHANNEL TESTS USE "X1" OTHERWISE
17                ;                  IT IS THE X CONVERTER VALUE)
18                ;               5) SLOOP - JUST HELPS TO BUILD THE DCH BUFFER
19                ;               6) NEW2V - USED IN TEST 9 + 10 TO GET THE TWO
20                ;                  VALUES FOR THE MULTI-LEVEL SQUARE WAVE.
21                ;                  USES "X2" + "X1".
22                ;               7) TOVAL - USED TO GET X1 + Y1 FOR THE TWO CHANNEL
23                ;                  SQUARE WAVE OF TEST 11
24                ;               8) GET4 - USED FOR GETTING X1+2 + Y1+2 FOR THE
25                ;                  DUAL TRACE, MULTI-LEVEL SQUARE WAVE OF TEST
26                ;                  12.
27                ;               9) S.TRCS - MAKES THE PATTERN IN THE DCH BUFFER
28                ;                  THAT FORMS THE 16 STEP BY 16 WORD STAIRCASE OF
29                ;                  TESTS 4,5,+6 (TEST 6 MAKES IT 16 STEPS X 32
30                ;                  WORDS PER STEP TO ALTERNATE X OR Y TO HAVE
31                ;                  16 X 16 EACH.
32                ;              10) S.QUAR - MAKES THE 64 DOT X 64 DOT SQUARE FOR
33                ;                  TESTS 1,2,+3.
34                ;              11) Z.MODE - USED BY TEST 3 TO SET EACH SIDE OF THE
35                ;                  SQUARE (DIVIDES BUFFER INTO QUARTERS) INCREMENTS
36                ;                  THE INTENSITY (WHICH PUTS OUT 1 OF 4 AT ANY ONE
37                ;                  TIME.
38                ;              12) T.IME - A PLACE TO WAIT FOR THE DCH TO FINISH-
39                ;                  SHOULD FINISH IN 10 MS BUT DELAY ALLOWS ABOUT
40                ;                  30 MS - ALSO CHECK FOR THE TTI.  AFTER DCH
41                ;                  FINISHES + SETS DONE THE STATUS IS CHECKED FOR A
42                ;                  LATE CONVERSION.
43                ;              13) P.OLET - CHECK THE CONVERSION MODE OF EACH OF THE
44                ;                  D-A'S AND DOCTORS THE DATA BUFFER ACCORDINGLY.
```

```
10023 MNDAE
01              ;12. SPECIAL NOTES/FEATURES
02              ;       1. CALIBRATION IS ACCOMPLISHED WITH THE USE OF TEST
03              ;          13 AND A FOUR AND A HALF (OR FULL SIX)
04              ;          DIGIT DMM (DVM).  TO CALIBRATE THE D-A DO THE
05              ;          FOLLOWING:
06              ;                1 - CONNECT THE DESIRED JUMPERS FOR POLARITY
07              ;                    AND RANGE (W1-W14)
08              ;                2 - LET THE D-A WARM-UP (ABOUT 30 MIN)
09              ;                3 - CONNECT THE DVM TO THE OUTPUT OF THE X
10              ;                    CONVERTER AND ITS RETURN
11              ;                4 - CALL TEST 13 AND ENTER 0000 FOR BOTH
12              ;                    CONVERTERS
13              ;                5 - ADJUST OFFSET POT R2 UNTIL THE OUTPUT
14              ;                    VOLTAGE IS EXACTLY -FSR/2* FOR BI-POLAR
15              ;                    OR 0 FOR UNI-POLAR.
16              ;                    *NOTE:  FSR=FULL SCALE RANGE
17              ;                    (I.E. + OR - 10V FSR=20V SO THAT
18              ;                    -FSR/2=-10V)
19              ;                6 - CONNECT TO THE OUTPUT OF THE Y CONVERTER
20              ;                    AND ITS RETURN AND ADJUST R8 AS IN STEP 5
21              ;                7 - WITH DVM STILL ON THE Y CONVERTER RE-CALL
22              ;                    TEST 13 AND ENTER 7777 FOR X AND Y VALUES.
23              ;                8 - ADJUST R7 FOR EXACTLY +FSR/2-1LSB IF BI-
24              ;                    POLAR OR FSR-1LSB FOR UNI-POLAR (SEE TABLE
25              ;                    TWO FOR EXACT VALUES)
26              ;                    CONNECT DVM TO THE X CONVERTER AND ITS
27              ;                    RETURN AND ADJUST R1 IN STEP 8
28              ;                9 - REPEAT ALL PROCEDURES TO COMPENSATE FOR
29              ;                    POSSIBILITY OF GAIN ADJUSTMENT UPSETTING
30              ;                    THE OFFSET ADJUSTMENT.
31              ;
32              ;13.    RUN TIME
33              ;       N/A
```

```
10024 MNDAE
01              ;                   TABLE 1 - JUMPER SELECTION
02              ;
03              ;W1-W10:
04              ;       VOLTAGE RANGE SELECT
05              ;       RANGE           DACX            DACY
06              ;       +-10V           W2,W4           W7,W9
07              ;       +-5V            W2,W5           W7,W10
08              ;       5V              W1,W3,W5        W6,W8,W10
09              ;       10V             W1,W5           W6,W10
10              ;
11              ;W11-W14:
12              ;       OFFSET BINARY OR 2'S COMPLIMENT (ONE OR THE OTHER
13              ;       MUST EXIST)
14              ;                               X-DAC           Y-DAC
15              ;       OFFSET BINARY           W11             W13
16              ;       TWO'S COMPLIMENT        W12             W14
17              ;
18              ;W15-W20:
19              ;       DEVICE CODE SELECT
20              ;
21              ;       A JUMPER IN IS EQUAL TO A "ONE" ON THE DATA (D) BUSS.
22              ;       THEY ARE READ AS FOLLOWS:
23              ;       D10 - W19
24              ;       D11 - W20
25              ;       D12 - W15
26              ;       D13 - W16
27              ;       D14 - W17
28              ;       D15 - W18
29              ;
30              ;W21-W22:
31              ;       SELECT Z AXIS FROM DACX OR DACY
32              ;
33              ;       W21 - DACY
34              ;       W22 - DACX
35              ;
```

```
10025 MNDAE
01                ;W23-W26:
02                ;       SELECTS INTENSITY LEVEL ORIGIN OF Z AXIS
03                ;
04                ;       W23 + W24       SELECT BITS 14 AND 15 OF DAC X WORD
05                ;       W25 + W26       SELECT BITS 14 AND 15 OF DAC Y WORD
06                ;
07                ;       NOTE:   NORMALLY W21 GOES W/W25+W26;
08                ;               W22 GOES W/W23+W24 IF W23-W26
09                ;               ARE NOT IN, THE Z AXIS WILL BE
10                ;               AT MAXIMUM INTENSITY.
11                ;W27:
12                ;       SELECTS POLARITY OF Z AXIS
13                ;       W27 IN - POSITIVE
14                ;       W27 OUT - NEGATIVE
15                ;
16                ;W28+W29:
17                ;       SELECT DATA VALID HIGH OR LOW TRUE
18                ;       W28 - HIGH TRUE
19                ;       W29 - LOW TRUE
20                ;
21                ;W30-W31:
22                ;       SELECTS DATA READY HIGH OR LOW TRUE
23                ;       W30 - HIGH TRUE
24                ;       W31 - LOW TRUE
25                ;
26                ;W32:
27                ;       (SELECT DONE ON A LATE CONVERSION)
28                ;       W32 IN - SET DONE ON LATE CONVERSION.
29                ;       W32 OUT - DO NOT SET DONE ON A LATE CONVERSION
```

```
10026 MNDAE
01                ;                       TABLE 2
02                ;
03                ;                 + AND - FSR RANGES (BI-P. = BI-POLAR)
04                ; (FOR DVM'S WITH LESS THAN SIX DIGITS - ROUND OFF THE FOLLOWING)
05                ;
06                ;       RANGE           MIN(0000)       MAX(7777)
07                ;                       (-FSR/2 BI-P.)  (+FSR/2-1LSB BI-P.)
08                ;       +-10V           -10.000V        +9.99512V
09                ;       +-5V            -5.00000V       +4.99756V
10                ;       5V              0.00000V        +4.99878V
11                ;       10V             0.00000V        +9.99756V
12                ;
13                ;       THE FOLLOWING ARE THE VOLTAGE GAINS FOR EACH
14                ;       BINARY COUNT TO THE D-A CONVERTERS
15                ;
16                ;       RANGE           VOLTAGE (IN MILLI-VOLTS) FOR 1 COUNT
17                ;       +-10V           4.8
18                ;       +-5V            2.44
19                ;       5V              1.22
20                ;       10V             2.44
21
22
23
24
                        .TITL   MNDAE
```

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**00000 TOTAL ERRORS, 00000 PASS 1 ERRORS