LAB-11

SCOPE CONTROL TEST
MD-11-D6F-C

EP-D6F-C-DL

FICHE 1 OF 1

FEB 1978
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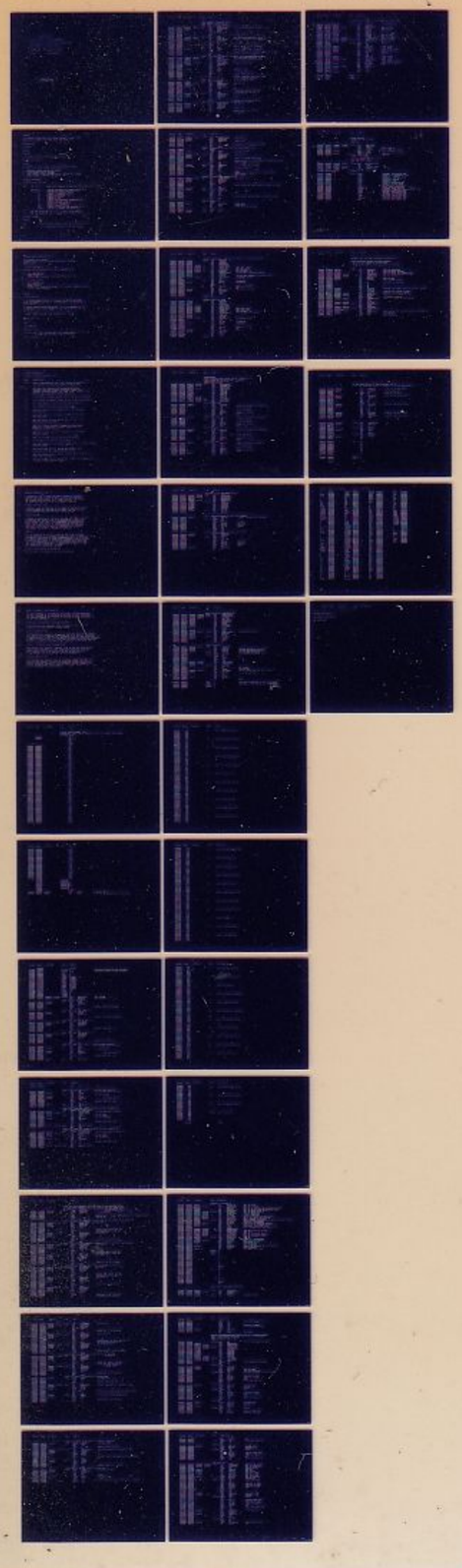
MADE IN USA



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        !DENTIFICATION

PRODUCT CODE:   MAINDEC-11-D6FC-D
PRODUCT NAME:   LAB-11 SCOPE CONTROL TEST
DATE CREATED:   MARCH 1, 1972
MAINTAINER:     DIAGNOSTIC GROUP
AUTHOR:         RAYMOND SHOOP
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1. ABSTRACT

THIS PROGRAM TESTS THE LAB-11 SCOPE CONTROL, X AND Y AXIS
DAC'S AND THE VR20 (TWO COLOR POINT PLOT DISPLAY).

2. REQUIREMENTS

2.1 EQUIPMENT

LAB-11

2.2 STORAGE

THE PROGRAM OCCUPIES MEMORY FROM 0 TO 5700.

3. LOADING PROCEDURE

3.1 METHOD

PROCEDURE FOR NORMAL BINARY TAPES SHOULD BE FOLLOWED.

1. ABSOLUTE LOADER MUST BE IN MEMORY.
2. PLACE BINARY TAPE IN READER.
3. LOAD ADDRESS 07500 (*DETERMINED BY ADDRESS OF LOADER).
4. PRESS "START" (PROGRAM WILL LOAD).

4. STARTING PROCEDURE

4.1 CONTROL SWITCH SETTINGS

200 SWR 4 = 0 LOOP THRU COMMAND, STATUS REGISTER AND DISPLAY TESTS.

SWR 4 = 1 LOOP ON SELECTED <VIA SWR 0-3> PATTERN.
SWR 0-3=0 COMMAND AND STATUS REGISTER TEST.
=1 DISPLAY A HORIZONTAL LINE.
=2 DISPLAY A VERTICAL LINE.
=3 DISPLAY A SQUARE.
=4 DISPLAY A "X".
=5 DISPLAY ALPHA-NUMERIC CHARACTER SET.
=6 DISPLAY CHANNEL 1 AND CHANNEL 2.
=7 COLOR DELAY ADJUSTMENT.
=10 DISPLAY COLOR PATTERN.
=11 DISPLAY A VERTICAL AND DIAGONAL LINE.
=12-17 COMMAND AND STATUS REGISTER TEST

204 SWR 0-5 DETERMINE THE A TO D CHANNEL TO BE SAMPLED.
SWR 6-7 DETERMINE THE A TO D GAIN OF THE CHANNEL.

4.2 STARTING ADDRESS

ADDRESS	TEST
200	COMMAND,STATUS REGISTER AND DISPLAY SEQUENCE TEST
204	A TO D KNOB DISPLAY TEST = MUST HAVE AD01

4,3 PROGRAM AND/OR OPERATOR ACTION

LOAD PROGRAM INTO MEMORY,
SELECT TEST BY LOADING APPROPRIATE STARTING ADDRESS,
PRESS "START"

5, OPERATING PROCEDURE

5,1 COMMAND, STATUS REGISTER AND DISPLAY SEQUENCE TEST

1, LOAD ADDRESS 200,
2, PRESS "START",
PROGRAM WILL RING BELL AFTER EACH PASS THRU TEST,

5,2 A TO D DISPLAY TEST

1, LOAD ADDRESS 204,
2, PRESS "START",
PROGRAM WILL DISPLAY SELECTED A TO D CHANNEL NUMBER AND THE
A TO D VALUE ON SCOPE,

6, ERRORS

6,1 ERROR REPORTING

IF AN ERROR OCCURS DURING THE COMMAND AND STATUS REGISTER
TEST, THE PROGRAM WILL HALT, REGISTER 0 WILL CONTAIN EXPECTED
VALUE OF DAC,

TO RESUME TESTING PRESS "CONTINUE", IF IT IS DESIRED TO LOOP
ON THE TEST THAT FAILS REPLACE THE HALT INSTRUCTION WITH A
240 (NOP),

NO ERROR CONDITIONS ARE GIVEN DURING OTHER TESTS,

7, RESTRICTIONS

NONE

8, MISCELLANEOUS

8,1 EXECUTION TIME

SEQUENCE TEST - THE TELETYPE BELL WILL RING AFTER EVERY PASS
WHICH IS APPROXIMATELY EVERY 90 SECONDS,

ALL OTHER TESTS - N/A,

9. PATTERN DESCRIPTION

9.0 COMMAND AND STATUS REGISTER TEST

TEST	DESCRIPTION
T0-T7	THESE TESTS EXERCISES THE X AND Y DAC'S TO MAKE CERTAIN THAT ALL BITS MAY BE SET, CLEARED AND READ BACK.
T8	TEST THAT INIT CLEARED THE FOLLOWING CSR BITS; LIGHTPEN FLAG (15), DISPLAY INTERRUPT ENABLE (6), LIGHTPEN INTERRUPT ENABLE (5), MODE (4-3), INTENSITY (2) CHANNEL (10), COLOR (9) AND SET READY (7).
T9	TEST DISPLAY INTERRUPT ENABLE (6) MAY BE SET AND CLEARED.
T10	TEST LIGHTPEN INTERRUPT ENABLE (5) MAY BE SET AND CLEARED.
T11	TEST MODE CONTROL (4-3) MAY BE SET AND CLEARED.
T12	TEST INTENSITY (2) MAY BE SET AND CLEARED
T13	TEST THAT READY (7) IS CLEARED WHEN X DAC IS LOADED WITH MODE 01.
T14	TEST THAT READY (7) IS CLEARED WHEN Y DAC IS LOADED WITH MODE 10.
T15	TEST THAT READY (7) WILL RETURN (SET) AFTER IT HAD BEEN CLEARED BY INTENSIFY.
T16	TEST THAT DISPLAY INTERRUPT ENABLE (6) WILL ALLOW READY (7) TO INTERRUPT TO VECTOR ADDRESS 140 WITH PROCESSOR PRIORITY LEVEL 3.
T17	TEST THAT DISPLAY DOES NOT INTERRUPT WITH PROCESSOR PRIORITY LEVEL 4.
T18	TEST THAT CHANNEL (10) MAY BE SET AND CLEARED.
T19	TEST COLOR (9) MAY BE SET AND CLEARED.
T20	TEST THAT READY (7) WILL RETURN CLEARED AFTER A CHANGE IN COLOR (GREEN TO RED).
T21	TEST THAT READY (7) WILL RETURN SET AFTER A DELAY FOLLOWING A CHANGE IN COLOR (GREEN TO RED).
T22	TEST THAT READY (7) WILL RETURN CLEARED AFTER A CHANGE IN COLOR (RED TO GREEN).
T23	TEST THAT READY (7) WILL RETURN SET AFTER A DELAY FOLLOWING A CHANGE IN COLOR (RED TO GREEN).

9,1 DISPLAY HORIZONTAL LINE

A HORIZONTAL LINE IS DISPLAYED ON THE SCOPE BY INITIALLY SETTING THE X AND Y DAC'S TO ZERO AND THEN INCREMENTING THE X VALUE WHILE HOLDING THE Y VALUE AT ZERO, THE POINTS ARE DISPLAYED USING THE DISPLAY INTERRUPT ENABLED.

9,2 DISPLAY VERTICAL LINE

A VERTICAL LINE IS DISPLAYED ON THE SCOPE IN THE SAME MANNER AS FOR A HORIZONTAL LINE (REF 9,1) EXCEPT NOW THE Y VALUE IS INCREMENTED WHILE HOLDING THE X VALUE AT ZERO.

9,3 DISPLAY SQUARE

A SQUARE IS DISPLAYED BY INITIALLY SETTING THE X AND Y VALUES TO NEGATIVE FULL SCALE, THEN X IS INCREMENTED TO POSITIVE SCALE (BOTTOM LINE) THEY Y IS INCREMENTED TO POSITIVE FULL SCALE (RIGHT LINE) THEN X IS DECREMENTED TO NEGATIVE FULL SCALE (TOP LINE) AND FINALLY Y IS DECREMENTED TO NEGATIVE FULL SCALE (LEFT LINE). MODE 01 (INTENSIFY ON LOADING X) AND MODE 10 (INTENSIFY ON LOADING Y) ARE USED.

9,4 DISPLAY X

AN X IS DISPLAYED BY INITIALLY SETTING THE X AND Y VALUES TO NEGATIVE FULL SCALE AND THEN INCREMENTING BOTH TO POSITIVE FULL SCALE (LOWER LEFT TO UPPER RIGHT DIAGONAL) THEN X IS RESET TO NEGATIVE FULL SCALE, Y REMAINS AT POSITIVE FULL SCALE AND THEN X IS INCREMENTED WHILE Y IS DECREMENTED UNTIL BOTH REACH FULL SCALE AGAIN (UPPER LEFT TO LOWER RIGHT DIAGONAL), MODE 01 (INTENSIFY ON LOADING X) IS USED.

9,5 DISPLAY ALPHA-NUMERIC CHARACTER SET

THE ALPHABET AND NUMBERS 1 THRU 0 ARE DISPLAYED.

9,6 DISPLAY CHANNEL 1 AND CHANNEL 2

THE TEXT "CHANNEL 1" IS DISPLAYED ON CHANNEL 1 SWITCH POSITION,
THE TEXT "CHANNEL 2" IS DISPLAYED ON CHANNEL 2 SWITCH POSITION,
THE COMBINED MESSAGE WILL APPEAR IF THE CHANNEL SELECTOR SWITCH IS
IN THE 1 & 2 POSITION.

9,7 COLOR DELAY ADJUSTMENT (SHORT-LONG DELAYS)

NO PATTERN WILL BE DISPLAYED, THIS IS USED TO ADJUST THE TWO
DELAYS ON THE COLOR DISPLAY CONTROL MODULE.

9,10 DISPLAY COLOR PATTERN

THIS ROUTINE WILL DISPLAY A BOX AROUND THE OUTER DEGE OF THE SCREEN
AND A SMALL "X" IS DISPLAYED IN THE CENTER, THIS PATTERN IS PLOTTED
IN GREEN AND THEN IN RED, THE END RESULT IS THAT ALL DOTS (RED AND GREEN)
CONVERGE AND THE PATTERN WILL APPEAR TO BE ORANGE IN COLOR, THIS TEST
IS USED TO ADJUST THE GAIN OF THE RED AMPLIFIER IN THE VR20 DISPLAY.

9,11 DISPLAY A VERTICAL AND A DIAGONAL LINE

THIS ROUTINE WILL DISPLAY A VERTICAL LINE AT THE LEFT SEDE OF THE
SCREEN AND A DIAGONAL LINE FROM UPPER LEFT CORNOR TO THE LOWER
RIGHT CORNOR, THIS IS TO TEST THE INITIAL DEFLECTION DELAY
OF THE CONTROL AND THE SETTLING TIME OF THE SCOPE.

9,12 DISPLAY A TO D VALUE

THIS ROUTINE WILL DISPLAY THE A TO D CHANNEL NUMBER AND THE A TO D
VALUE OF THAT CHANNEL, SWR 0-5 DETERMINE THE CHANNEL SAMPLED AND
SWR 6-7 DETERMINE THE GAIN OF THAT CHANNEL, THE TOP NUMBER ON THE
DISPLAY IS THE CHANNEL BEING SAMPLED, THE BOTTOM NUMBER IS THE
A TO D CONVERSION FOR THAT CHANNEL.

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                                ;LAB-11 SCOPE CONTROL TEST
                                ;COPYRIGHT  1971 DIGITAL EQUIPMENT CORP., MAYNARD, MASS. 01754
                                ;RAYMOND SHOOP
        000000                          .=0
        000040                          .REPT 40
                                        .+2
                                        HALT
                                        .ENDR
000000  000002                         .+2
000002  000000                         HALT
000004  000006                         .+2
000006  000000                         HALT
000010  000012                         .+2
000012  000000                         HALT
000014  000016                         .+2
000016  000000                         HALT
000020  000022                         .+2
000022  000000                         HALT
000024  000026                         .+2
000026  000000                         HALT
000030  000032                         .+2
000032  000000                         HALT
000034  000036                         .+2
000036  000000                         HALT
000040  000042                         .+2
000042  000000                         HALT
000044  000046                         .+2
000046  000000                         HALT
000050  000052                         .+2
000052  000000                         HALT
000054  000056                         .+2
000056  000000                         HALT
000060  000062                         .+2
000062  000000                         HALT
000064  000066                         .+2
000066  000000                         HALT
000070  000072                         .+2
000072  000000                         HALT
000074  000076                         .+2
000076  000000                         HALT
000100  000102                         .+2
000102  000000                         HALT
000104  000106                         .+2
000106  000000                         HALT
000110  000112                         .+2
000112  000000                         HALT
000114  000116                         .+2
000116  000000                         HALT
000120  000122                         .+2
000122  000000                         HALT
000124  000126                         .+2
000126  000000                         HALT
000130  000132                         .+2
000132  000000                         HALT
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000134  000136                  .+2
000136  000000                  HALT
000140  000142                  .+2
000142  000000                  HALT
000144  000146                  .+2
000146  000000                  HALT
000150  000152                  .+2
000152  000000                  HALT
000154  000156                  .+2
000156  000000                  HALT
000160  000162                  .+2
000162  000000                  HALT
000164  000166                  .+2
000166  000000                  HALT
000170  000172                  .+2
000172  000000                  HALT
000174  000176                  .+2
000176  000000                  HALT
        000240          NOP=240
        177776          CC=177776
        000776          STACK=776
        177570          SREG=177570
        000011          SCALE1=11
        000022          SCALE2=22
                                .=200
000200  000167  000634          JMP     CSRTST          ;SEQUENCE TEST
000204  000167  005114          JMP     KNOB            ;A TO D KNOB DISPLAY MUST HAVE AD01
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```
001000  001000                          .=1000
001000  000000  LOWLMT: 0                       ;CONTAINS 174000 FOR 3RD QUADRANT
001002  003774  HILMT: 3774                     ;CONTAINS 177774 FOR 3RD QUADRANT
001004  000000  LOW:   0
001006  000000  HIGH:  0
001010  177564  TCSR:  177564
001012  177566  TDBR:  177566
001014  176756  SCSR:  176756
001016  176760  XREG:  176760
001020  176762  YREG:  176762
001022  176770  ADCS:  176770
001024  176772  ADDB:  176772
001026  177570  SWR:   177570
001030  000140  SVEC:  140
001032  000144  LPVEC: 144
001034  000000  TIMSV: 0
001036  000000  TICKS: 0
001040  012767  000040  177770  CSRTST: MOV     #40,TICKS       ;SET TIMER
001046  012767  000340  176722          MOV     #340,CC         ;SET PRIORITY 7
                        ;TEST XREG CAN BE SET = 0
001054  005077  177736          T0:     CLR     @XREG
001060  017700  177732                  MOV     @XREG,%0
001064  001402                          BEQ     T1
001066  000000                          HALT                    ;ERROR, XREG NOT CLEARED
001070  000771                          BR      T0
                        ;TEST THAT YREG CAN BE SET = 0
001072  005077  177722          T1:     CLR     @YREG
001076  017700  177716                  MOV     @YREG,%0
001102  001402                          BEQ     T2
001104  000000                          HALT                    ;ERROR, Y REG NOT CLEARED
001106  000771                          BR      T1
                        ;TEST THAT XREG CAN BE SET = -1
001110  012777  177777  177700  T2:     MOV     #-1,@XREG
001116  017700  177674                  MOV     @XREG,%0
001122  022700  177777                  CMP     #-1,%0
001126  001402                          BEQ     T3
001130  000000                          HALT                    ;ERROR, XREG NOT = -1
001132  000766                          BR      T2
                        ;TEST THAT YREG CAN BE SET = -1
001134  012777  177777  177650  T3:     MOV     #-1,@YREG
001142  017700  177652                  MOV     @YREG,%0
001146  022700  177777                  CMP     #-1,%0
001152  001402                          BEQ     T4
001154  000000                          HALT                    ;ERROR, YREG NOT = -1
001156  000766                          BR      T3
                        ;TEST THAT XREG WILL ACCEPT A COUNT PATTERN (0-3777)
001160  005000          T4:     CLR     %0                      ;INITIALIZE COUNT PATTERN
001162  005077  177630          T4A:    CLR     @XREG
001166  005200                  INC     %0                      ;+1 TO PATTERN
001170  005277  177622                  INC     @XREG
001174  020077  177616                  CMP     %0,@XREG                ;DID XREG COUNT?
001200  001402                          BEQ     T4B
001202  000000                          HALT                    ;ERROR, XREG NOT = %0
001204  000765                          BR      T4
001206  022700  003777          T4B:    CMP     #3777,%0
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001212  001365                          BNE     T4A

                                ;TEST THAT YREG WILL ACCEPT A COUNT PATTERN (0-3777)
001214  005000                  T5:     CLR     %0              ;INITIALIZE COUNT PATTERN
001216  005077  177576                  CLR     @YREG
001222  005200                  T5A:    INC     %0              ;+1 TO PATTERN
001224  005277  177570                  INC     @YREG
001230  020077  177564                  CMP     %0,@YREG                ;DID YREG COUNT
001234  001402                          BEQ     T5B
001236  000000                          HALT                    ;ERROR, YREG NOT = %0
001240  000765                          BR      T5
001242  022700  003777          T5B:    CMP     #3777,%0
001246  001365                          BNE     T5A
                                ;TEST THAT XREG WILL ACCEPT A COUNT PATTERN (4000-7777)
                                ;BIT 11 SHOULD SET BITS 12-15
001250  012700  173777          T6:     MOV     #173777,%0      ;INITIALIZE COUNT PATTERN
001254  012777  003777  177534          MOV     #3777,@XREG
001262  005277  177530          T6A:    INC     @XREG           ;+1 TO XREG
001266  005200                          INC     %0              ;+1 TO PATTERN
001270  020077  177522                  CMP     %0,@XREG
001274  001402                          BEQ     T6B
001276  000000                          HALT                    ;ERROR, XREG NOT = %0
001300  000763                          BR      T6
001302  022777  177777  177500  T6B:    CMP     #177777,@XREG
001310  001364                          BNE     T6A
                                ;TEST THAT YREG WILL ACCEPT A COUNT PATTERN (4000-7777)
                                ;BIT 11 SHOULD SET BITS 12-15
001312  012700  173777          T7:     MOV     #173777,%0      ;INITIALIZE COUNT PATTERN
001316  012777  003777  177474          MOV     #3777,@YREG
001324  005277  177470          T7A:    INC     @YREG           ;+1 TO YREG
001330  005200                          INC     %0              ;+1 TO PATTERN
001332  020077  177462                  CMP     %0,@YREG
001336  001402                          BEQ     T7B
001340  000000                          HALT                    ;ERROR, YREG NOT = %0
001342  000763                          BR      T7
001344  022777  177777  177440  T7B:    CMP     #177777,@YREG
001352  001364                          BNE     T7A
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                                ;TEST THAT INIT CLEARED THE FOLLOWING STATUS REGISTER BITS:
                                ;LP FLAG (15), DISPLAY INT EN (6), LP INT EN (5), MODE (4-3),
                                ;INTENSITY (2), CHANNEL (1:), COLOR (9), AND SET READY (7);
001354  017700  177434        T8:     MOV     @SCSR,%0                ;MOVE STATUS REGISTER TO %0
001360  022700  000200                CMP     #200,%0         ;;IS READY SET?
001364  001403                BEQ     T9
001366  000000                HALT                            ;ERROR, BIT 7 (READY) IS ONLY ONE THAT SHOULD BE SET',
001370  000005                RESET                           ;TRY AGAIN
001372  000770                BR      T8
                                ;TEST THAT DISPLAY INTERRUPT ENABLE (BIT 6) MAY BE SET AND CLEARED,
001374  052777  000100  177412  T9:      BIS     #100,@SCSR      ;SET BIT 6
001402  017700  177406                MOV     @SCSR,%0
001406  022700  000300                CMP     #300,%0
001412  001402                BEQ     T9A
001414  000000                HALT                            ;ERROR, BIT 6 OR 7 NOT SET
001416  000766                BR      T9                      ;OR OTHER BITS PICKED UP
001420  042777  000100  177366  T9A:     BIC     #100,@SCSR      ;CLEAR BIT 6
001426  017700  177362                MOV     @SCSR,%0
001432  022700  000200                CMP     #200,%0
001436  001402                BEQ     T10
001440  000000                HALT                            ;ERROR, BIT 6 NOT CLEARED
001442  000766                BR      T9A
                                ;TEST THAT LIGHT PEN INTERRUPT ENABLE (BIT 5) MAY BE SET AND CLEARED
001444  052777  000040  177342  T10:     BIS     #40,@SCSR       ;SET BIT 5
001452  017700  177336                MOV     @SCSR,%0
001456  022700  000240                CMP     #240,%0
001462  001402                BEQ     T10A
001464  000000                HALT                            ;ERROR BIT 5 OR 7 NOT SET
001466  000766                BR      T10                     ;OR OTHER BITS PICKED UP
001470  042777  000040  177316  T10A:    BIC     #40,@SCSR       ;CLEAR BIT 5
001476  017700  177312                MOV     @SCSR,%0
001502  022700  000200                CMP     #200,%0
001506  001402                BEQ     T11
001510  000000                HALT                            ;ERROR BIT 5 NOT CLEARED
001512  000766                BR      T10A
                                ;TEST THAT MODE CONTROL (BITS 4-3) CAN BE SET AND CLEARED
001514  052777  000010  177272  T11:     BIS     #10,@SCSR       ;SET BIT 3
001522  017700  177266                MOV     @SCSR,%0
001526  022700  000210                CMP     #210,%0
001532  001402                BEQ     T11A
001534  000000                HALT                            ;ERROR, BIT 3 OR 7 NOT SET
001536  000766                BR      T11                     ;OR OTHER BITS PICKED UP
001540  042777  000010  177246  T11A:    BIC     #10,@SCSR       ;CLEAR BIT 3
001546  017700  177242                MOV     @SCSR,%0
001552  022700  000200                CMP     #200,%0
001556  001402                BEQ     T11B
001560  000000                HALT                            ;ERROR BIT 3 NOT CLEARED
001562  000766                BR      T11A
001564  052777  000020  177222  T11B:    BIS     #20,@SCSR
001572  017700  177216                MOV     @SCSR,%0
001576  022700  000220                CMP     #220,%0
001602  001402                BEQ     T11C
001604  000000                HALT                            ;ERROR BIT 4 OR 7 NOT SET
001606  000766                BR      T11B                    ;OR OTHER BITS PICKED UP
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001610  042777  000020  177170  T11C:  BIC     #20,@SCSR       ;CLEAR BIT 4
001616  017700  177172                 MOV     @SCSR,R0
001622  022700  000200                 CMP     #200,R0
001626  001402                         BEQ     T11D
001630  000000                         HALT                    ;ERROR BIT 4 NOT CLEARED
001632  000766                         BR      T11C
001634  052777  000030  177152  T11D:  BIS     #30,@SCSR       ;SET BITS 4-3
001642  017700  177146                 MOV     @SCSR,R0
001646  022700  000230                 CMP     #230,R0
001652  001402                         BEQ     T11E
001654  000000                         HALT                    ;ERROR BITS 4,3, OR 7 NOT SET
001656  000766                         BR      T11D            ;OR OTHER BITS PICKED UP
001660  042777  000030  177126  T11E:  BIC     #30,@SCSR       ;CLEAR BITS 4,3,
001666  017700  177122                 MOV     @SCSR,R0
001672  022700  000200                 CMP     #200,R0
001676  001402                         BEQ     T12
001700  000000                         HALT                    ;ERROR BITS 4, 3 NOT CLEARED
001702  000766                         BR      T11E
                        ;TEST THAT INTENSITY (BIT 2) MAY BE SET OR CLEARED
001704  052777  000004  177102  T12:   BIS     #4,@SCSR                ;SET BIT 2
001712  017700  177076                 MOV     @SCSR,R0
001716  022700  000204                 CMP     #204,R0
001722  001402                         BEQ     T12A
001724  000000                         HALT                    ;ERROR BIT 2 OR 7 NOT SET
001726  000766                         BR      T12             ;OR OTHER BITS PICKED UP
001730  042777  000004  177056  T12A:  BIC     #4,@SCSR                ;CLEAR BIT 2
001736  017700  177052                 MOV     @SCSR,R0
001742  022700  000200                 CMP     #200,R0
001746  001402                         BEQ     T13
001750  000000                         HALT                    ;ERROR BIT 2 NOT CLEARED
001752  000766                         BR      T12A
                        ;TEST THAT READY IS CLEARED BY LOADING XREG
001754  105777  177034          T13:   TSTB    @SCSR           ;IS READY SET
001760  100402                         BMI     T13A
001762  000000                         HALT                    ;ERROR, READY NOT SET
001764  000773                         BR      T13
001766  012777  000010  177020  T13A:  MOV     #10,@SCSR       ;ENABLE INTENSIFY ON LOADING X REG,
001774  005077  177020                 CLR     @YREG
002000  105777  177010                 TSTB    @SCSR
002004  100402                         BMI     T13B
002006  000000                         HALT                    ;ERROR, LOAD YREG SHOULDN'T CLEAR READY
002010  000761                         BR      T13
002012  005077  177000          T13B:  CLR     @XREG           ;LOAD XREG, SHOULD CLEAR READY
002016  105777  176772                 TSTB    @SCSR
002022  100030                         BPL     T15
002024  000000                         HALT                    ;ERROR READY NOT CLEARED
002026  000752                         BR      T13
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                                ;TEST THAT READY IS CLEARED BY LOADING Y REGISTER,
002030  105777  176760          T14:  TSTB    @SCSR           ;IS READY SET
002034  100402                        BMI     T14A
002036  000000                        HALT                    ;ERROR, READY NOT SET
002040  000773                        BR      T14
002042  012777  000020  176744  T14A: MOV     #20,@SCSR       ;ENABLE INTENSITY ON LOADING Y REG,
002050  005077  176742                CLR     @XREG
002054  105777  176734                TSTB    @SCSR
002060  100402                        BMI     T14B
002062  000000                        HALT                    ;ERROR, LOAD X REG SHOULDN'T CLEAR READY
002064  000761                        BR      T14
002066  005077  176726          T14B: CLR     @YREG
002072  105777  176716                TSTB    @SCSR
002076  100002                        BPL     T15
002100  000000                        HALT                    ;ERROR, READY NOT CLEARED
002102  000752                        BR      T14
                                ;READY SHOULD RETURN AFTER INTENSIFY SET
002104  005277  176704          T15:  INC     @SCSR           ;ENABLE INTENSIFY
002110  012700  177600                MOV     #-200,%0
002114  005200                        INC     %0
002116  001376                        BNE     .-2             ;DELAY
002120  105777  176670                TSTB    @SCSR           ;IS READY SET
002124  100402                        BMI     T16
002126  000000                        HALT                    ;ERROR READY FAILED TO SET AFTER INTENSIFY
002130  000765                        BR      T15
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                                ;TEST DISPLAY INTERRUPT ENABLE
                                ;TEST PROPER VECTOR RETURN
                                ;TEST READY TO CAUSE INTERRUPT
002132  012777  002226  176678  T16:    MOV     #T16$,@#VEC     ;INITIALIZE INTERRUPT RETURN
002140  012706  002776                  MOV     #STACK,%6
002144  105777  176644                  TSTB    @#SCSR
002150  100402                          BMI     T16A
002152  000000                          HALT                    ;READY NOT SET
002154  000766                          BR      T16
002156  012767  002142  175612  T16A:   MOV     #140,CC         ;SET PROCESSOR PRIORITY LEVEL 3
002164  012777  002101  176622          MOV     #101,@#SCSR     ;ENABLE INTERRUPT AND INTENSIFY
002172  012700  177600                  MOV     #-200,%0
002176  005200                          INC     %0
002200  001376                          BNE     .-2
002202  000000                          HALT                    ;ERROR, DIDN'T FIND INTERRUPT
002204  000752                          BR      T16
002206  105777  176622          T16$:   TSTB    @#SCSR          ;RETURN HERE AFTER INTERRUPT
002212  100402                          BMI     T17
002214  000000                          HALT                    ;ERROR, RECEIVED INTERRUPT BIT READY NOT SET
002216  000745                          BR      T16
                                ;TEST THAT DISPLAY DOES NOT INTERRUPT WITH PROCESSOR PRIORITY 4
002220  012767  000200  175550  T17:    MOV     #200,CC         ;SET PROCESSOR PRIORITY LEVEL 4
002226  012777  002272  176574          MOV     #T17A,@#VEC     ;INITIALIZE INTERRUPT RETURN
002234  012706  002776                  MOV     #STACK,%6
002240  012777  002101  176540          MOV     #101,@#SCSR     ;INITIALIZE DISPLAY
002246  012700  177600                  MOV     #-200,%0
002252  005200                          INC     %0
002254  001376                          BNE     .-2
002256  105777  176532                  TSTB    @#SCSR          ;IS READY SET?
002262  100404                          BMI     T18
002264  000000                          HALT                    ;ERROR READY NOT SET
002266  000754                          BR      T17
002270  000000          T17A:   HALT                    ;ERROR INTERRUPT SHOULDN'T OCCUR
002272  000752                  BR      T17             ;WITH PROCESSOR PRIORITY 4.
                                ;TEST THAT CHANNEL (BIT 10) MAY BE SET AND CLEARED
002274  005077  176514          T18:    CLR     @#SCSR
002300  052777  002000  176520          BIS     #2000,@#SCSR    ;SET BIT 10
002306  017700  176502                  MOV     @#SCSR,%0
002312  022700  002200                  CMP     #2200,%0
002316  001402                          BEQ     T18A            ;
002320  000000                          HALT                    ;ERROR, BIT 10 OR 7 NOT SET
002322  000764                          BR      T18             ; OR OTHER BITS PICKED UP
002324  042777  002000  176462  T18A:   BIC     #2000,@#SCSR    ;CLEAR BIT 10
002332  017700  176456                  MOV     @#SCSR,%0
002336  022700  000200                  CMP     #200,%0         ;TEST
002342  001401                          BEQ     T19             ;
002344  000000                          HALT                    ;ERROR, BIT 10 NOT CLEARED
                                ;TEST THAT THE COLOR (BIT 9) MAY BE SET AND CLEARED
002346  052777  001000  176440  T19:    BIS     #1000,@#SCSR    ;SET BIT 9
002354  017700  176434                  MOV     @#SCSR,%0
002360  032700  001000                  BIT     #1000,%0        ;TEST BIT 9
002364  001002                          BNE     T19A            ;
002366  000000                          HALT                    ;ERROR BIT 9 DID NOT SET
002370  000766                          BR      T19             ;TRY AGAIN
```

```
002372  042777  001000  176414  T19A:  BIC     #1000,@SCSR     ;CLEAR BIT 9
002400  017700  176410                 MOV     @SCSR,R0
002404  032700  001000                 BIT     #1000,R0        ;TEST BIT 9
002410  001402                         BEQ     T20             ;
002412  000000                         HALT                    ;ERROR, BIT 9 FAILED TO CLEAR
002414  000764                         BR      T19A
                                ;RESET THE MACHINE AND NOW TEST THE COLOR DELAY LOGIC
002416  000005                 T20:    RESET
002420  105777  176370                 TSTB    @SCSR           ;WAIT FOR READY
002424  100376                         BPL     .-2
002426  052777  001000  176360 T20A:   BIS     #1000,@SCSR     ;SET BIT 9
002434  017700  176354                 MOV     @SCSR,R0
002440  032700  000200                 BIT     #200,R0         ;TEST THAT READY WENT DOWN
002444  001402                         BEQ     T21             ;
002446  000000                         HALT                    ;READY FAILED TO CLEAR DURING A CHANGE IN COLOR
002450  000762                         BR      T20             ;TRY AGAIN
002452  012701  001000         T21:    MOV     #1000,R1                ;SET UP A COUNTER
002456  105777  176332         T21A:   TSTB    @SCSR           ;
002462  100404                         BMI     T22             ;FLAG DID COME UP
002464  005301                         DEC     R1
002466  001373                         BNE     T21A            ;DELAY
002470  000000                         HALT                    ;DONE FAILED TO SET AFTER A COLOR CHANGE
002472  000751                         BR      T20             ;TRY AGAIN
                                ;CHANGE TO GREEN TEST COLOR DELAYS
002474  042777  001000  176312 T22:    BIC     #1000,@SCSR     ;CLEAR BIT 9
002502  017700  176306                 MOV     @SCSR,R0
002506  032700  000200                 BIT     #200,R0
002512  001402                         BEQ     T23
002514  000000                         HALT                    ;DONE FAILED TO CLEAR AFTER A CHANGE IN COLOR
002516  000760                         BR      T22
002520  012701  001000         T23:    MOV     #1000,R1
002524  105777  176264         T23A:   TSTB    @SCSR
002530  100404                         BMI     T24
002532  005301                         DEC     R1
002534  001373                         BNE     T23A
002536  000000                         HALT                    ;DONE FAILED TO SET AFTER A CHANGE IN COLOR
002540  000755                         BR      T22
                                ;END OF BASIC TEST
002542  000005                 T24:    RESET
002544  004767  002430                 JSR     R7,TIMER        ;TEST TIME
002550  000404                         BR      T24A            ;MORE TIME
002552  000405                         BR      PIC0            ;TIME UP, NEXT PATTERN
002554  000005                 T24B:   RESET
002556  000167  176256                 JMP     CSRTST
002562  000167  176266         T24A:   JMP     T0
```

```
                                        ;DISPLAY HORIZONTAL LINE USING INTERRUPT, NON STORE DISPLAY.
002566  016700  176224          PIC0:   MOV     XREG,%0
002572  016701  176222                  MOV     YREG,%1
002576  012706  000776                  MOV     #STACK,%6
002602  012767  000600  176226          MOV     #600,TICKS
002610  012767  003774  176170  PB:     MOV     #3774,HIGH      ;SET HIGH LIMIT
002616  012767  004000  176160          MOV     #4000,LOW       ;SET LOW LIMIT
002624  012767  000140  175144  PD:     MOV     #140,CC         ;SET PRIORITY 3
002632  012777  002710  176170          MOV     #P0RET,@SVEC    ;INITIALIZE INTERRUPT VECTOR
002640  016703  176142                  MOV     HIGH,%3
002644  012702  000014                  MOV     #14,%2          ;INITIALIZE INCREMENTS BETWEEN POINTS
002650  052777  000100  176130          BIS     #100,@SCSR      ;INTERRUPT ENABLE
002656  005011                          CLR     (1)
002660  060210          PE:     ADD     %2,(0)          ;INCREMENT
002662  005277  176126                  INC     @SCSR           ;INTENSIFY
002666  000001                          WAIT
002670  021003                          CMP     (0),%3          ;DONE ALL POINTS?
002672  001372                          BNE     PE              ;NO
002674  016710  176104                  MOV     LOW,(0)         ;YES RE-INITIALIZE
002700  004767  002274                  JSR     %7,TIMER
002704  000766                          BR      PE+2
002706  000401                          BR      PIC1
002710  000002          P0RET:  RTI

                                        ;DISPLAY VERTICAL LINE
002712  016700  176102          PIC1:   MOV     YREG,%0
002716  016701  176074                  MOV     XREG,%1
002722  012706  000776                  MOV     #STACK,%6
002726  012767  000600  176102          MOV     #600,TICKS
002734  012767  003774  176044          MOV     #3774,HIGH      ;SET HIGH LIMIT
002742  012767  004000  176034          MOV     #4000,LOW       ;SET LOW LIMIT
002750  012767  000140  175020          MOV     #140,CC         ;SET PRIORITY 3
002756  012777  003034  176044          MOV     #P1RET,@SVEC    ;INITIALIZE INT, VECTOR
002764  016703  176016                  MOV     HIGH,%3
002770  012702  000014                  MOV     #14,%2          ;
002774  052777  000100  176012          BIS     #100,@SCSR      ;INTERRUPT ENABLE
003002  005011                          CLR     (1)
003004  060210          PF:     ADD     %2,(0)          ;INCREMENT
003006  005277  176002                  INC     @SCSR           ;INTENSIFY
003012  000001                          WAIT
003014  021003                          CMP     (0),%3          ;DONE ALL POINTS
003016  001372                          BNE     PF              ;NO
003020  016710  175760                  MOV     LOW,(0)         ;YES
003024  004767  002150                  JSR     %7,TIMER
003030  000766                          BR      PF+2
003032  000401                          BR      PIC3
003034  000002          P1RET:  RTI
```

```
                                ;PINCUSHION
                                ;PLOT A SQUARE FROM LOWER LEFT TO LOWER RIGHT TO
                                ;UPPER RIGHT TO UPPER LEFT TO LOWER LEFT,
                                ;NON STORE DISPLAY
003036  012767  003774  175742  PIC3:   MOV     #3774,HIGH
003044  012767  174000  175732          MOV     #174000,LOW
003052  012706  000776                  MOV     #STACK,%6
003056  012767  000300  175752          MOV     #300,TICKS
003064  016701  175726                  MOV     XREG,%1
003070  016702  175724                  MOV     YREG,%2
003074  016703  175714                  MOV     SCSR,%3
003100  012704  000014                  MOV     #14,%4
003104  012767  000340  174664          MOV     #340,CC
003112  016777  175666  175676  P3:     MOV     LOW,@XREG
003120  016777  175660  175672          MOV     LOW,@YREG
                                ;DRAW BOTTOM LINE
003126  016700  175654                  MOV     HIGH,%0
003132  012713  000010                  MOV     #10,(3)         ;ENABLE INTENSIFY ON LOADING X
003136  105713                  P3A:    TSTB    (3)
003140  100376                          BPL     .-2             ;WAIT FOR READY
003142  060411                          ADD     %4,(1)
003144  020011                          CMP     %0,(1)          ;DONE ALL POINTS?
003146  001373                          BNE     P3A             ;NO
                                ;DRAW RIGHT LINE
003150  012713  000020                  MOV     #20,(3)         ;ENABLE INTENSIFY ON LOADING Y
003154  105713                  P3B:    TSTB    (3)
003156  100376                          BPL     .-2             ;WAIT FOR READY
003160  060412                          ADD     %4,(2)
003162  020012                          CMP     %0,(2)          ;DONE ALL POINTS?
003164  001373                          BNE     P3B             ;NO
                                ;DRAW TOP LINE
003166  012713  000010                  MOV     #10,(3)         ;ENABLE INTENSIFY ON LOADING X
003172  016700  175606                  MOV     LOW,%0
003176  105713                  P3C:    TSTB    (3)
003200  100376                          BPL     .-2             ;WAIT FOR READY
003202  160411                          SUB     %4,(1)
003204  020011                          CMP     %0,(1)          ;DONE ALL POINTS?
003206  001373                          BNE     P3C             ;NO
                                ;DRAW LEFT LINE
003210  012713  000020                  MOV     #20,(3)         ;ENABLE INTENSIFY LOADING Y
003214  105713                  P3D:    TSTB    (3)
003216  100376                          BPL     .-2             ;WAIT FOR READY
003220  160412                          SUB     %4,(2)
003222  020012                          CMP     %0,(2)          ;DONE ALL POINTS?
003224  001373                          BNE     P3D             ;NO
003226  004767  001746                  JSR     %7,TIMER
003232  000727                          BR      P3
```

```
                                        ;PLOT AN X WITH NON STORE DISPLAY
003234  012767  004000  175542  PIC4:   MOV     #4000,LOW
003242  012767  003774  175536          MOV     #3774,HIGH
003250  012706  000776                  MOV     #STACK,%6
003254  012767  000600  175554          MOV     #600,TICKS
003262  016701  175530          PIC4B:  MOV     XREG,%1
003266  016702  175526                  MOV     YREG,%2
003272  016703  175516                  MOV     SCSR,%3
003276  016700  175504                  MOV     HIGH,%0
003302  012704  000014                  MOV     #14,%4
003306  016712  175472          P4:     MOV     LOW,(2)
003312  011211                          MOV     (2),(1)

                                        ;PLOT LINE BEGINNING IN LOWER LEFT CORNER
003314  012713  000010                  MOV     #10,(3)         ;ENABLE INTENSIFY ON LOADING X
003320  105713          P4A:    TSTB    (3)
003322  100376                  BPL     .-2
003324  060412                  ADD     %4,(2)          ;+4 TO Y
003326  060411                  ADD     %4,(1)          ;+4 TO X
003330  021100                  CMP     (1),%0          ;DONE?
003332  001372                  BNE     P4A             ;NO
003334  105713                  TSTB    (3)
003336  100376                  BPL     .-2
                                        ;PLOT LINE BEGINNING IN UPPER LEFT CORNER
003340  016712  175442                  MOV     HIGH,(2)
003344  016711  175434                  MOV     LOW,(1)
003350  105713          P4B:    TSTB    (3)
003352  100376                  BPL     .-2
003354  160412                  SUB     %4,(2)          ;-4 TO Y
003356  060411                  ADD     %4,(1)          ;+4 TO X
003360  021100                  CMP     (1),%0          ;DONE?
003362  001372                  BNE     P4B             ;NO
003364  004767  001610          JSR     %7,TIMER
003370  000746                  BR      P4
```

```
                                ;PLOT NON STORE CHARACTER SET
003372  012767  000400  175430  PIC6:   MOV     #400,TICKS
003400  012767  174000  000200  PIC6A:  MOV     #174000,XPOS
003406  012767  000000  000170          MOV     #0,YPOS
003414  012704  000022                  MOV     #SCALE2,%4
003420  012706  000776                  MOV     #STACK,%6
003424  005077  175364                  CLR     @SCSR
003430  004767  000012                  JSR     %7,PIC6B
003434  004767  001540                  JSR     %7,TIMER
003440  000757                          BR      PIC6A
003442  000167  000440                  JMP     PIC7
003446  012767  177734  000134  PIC6B:  MOV     #-36.,CHRCOL    ;CHARACTERS PER ROW
003454  016705  175334                  MOV     SCSR,%5
003460  012702  003614                  MOV     #A,%2
003464  004767  000010          GEN1:   JSR     %7,CHAR
003470  005267  000114                  INC     CHRCOL          ;
003474  001373                          BNE     GEN1
003476  000207                          RTS     %7

                                ;PLOT CHARACTER
003500  016767  000100  000104  CHAR:   MOV     YPOS,YPT
003506  052715  000020                  BIS     #20,(5)         ;ENABLE INTENSIFY ON LOADING Y
003512  012708  177773                  MOV     #-5,%0          ;INITIALIZE COLUMN COUNT
003516  012701  177771          CHAR1:  MOV     #-7,%1          ;INITIALIZE ROW COUNT
003522  112203                          MOVB    (2)+,%3         ;PUT CHARACTER POINTS IN %3
003524  106103          CHAR2:  ROLB    %3
003526  100010                          BPL     CHAR3           ;NO
003530  105715                          TSTB    (5)
003532  100376                          BPL     .-2
003534  016777  000046  175254          MOV     XPOS,@XREG
003542  016777  000036  175250          MOV     YPOS,@YREG
003550  060467  000030          CHAR3:  ADD     %4,YPOS
003554  005201                          INC     %1              ;+1 TO ROW
003556  001362                          BNE     CHAR2           ;FINISH ROW
003560  016767  000026  000010          MOV     YPT,YPOS        ;REINITIALIZE ROW FOR NEXT COLUMN
003566  060467  000014                  ADD     %4,XPOS
003572  005200                          INC     %0              ;+1 TO COLUMN COUNT
003574  001350                          BNE     CHAR1
003576  060467  000004                  ADD     %4,XPOS
003602  000207                          RTS     %7              ;EXIT

003604  000000          YPOS:   0               ;CONTAINS Y POSITION AT ANY GIVEN TIME
003606  000000          XPOS:   0               ;CONTAINS X POSITION AT ANY GIVEN TIME
003610  000000          CHRCOL: 0
003612  000000          YPT:    0
```

```
003614      176                 A1      ,BYTE 176,21,21,21,176
003615      021
003616      021
003617      021
003620      176
003621      177                 B1      ,BYTE 177,111,111,111,66
003622      111
003623      111
003624      111
003625      066
003626      076                 C1      ,BYTE 76,101,101,101,42
003627      101
003630      101
003631      101
003632      042
003633      177                 D1      ,BYTE 177,101,101,101,76
003634      101
003635      101
003636      101
003637      076
003640      177                 E1      ,BYTE 177,111,111,111,101
003641      111
003642      111
003643      111
003644      101
003645      177                 F1      ,BYTE 177,11,11,11,1
003646      011
003647      011
003650      011
003651      001
003652      076                 G1      ,BYTE 76,101,121,121,62
003653      101
003654      121
003655      121
003656      062
003657      177                 H1      ,BYTE 177,10,10,10,177
003660      010
003661      010
003662      010
003663      177
003664      000                 I1      ,BYTE 0,101,177,101,0
003665      101
003666      177
003667      101
003670      000
003671      060                 J1      ,BYTE 60,100,100,100,77
003672      100
003673      100
003674      100
003675      077
003676      177                 K1      ,BYTE 177,10,24,42,101
003677      010
003700      024
003701      042
```

```
003702      101
003703      177                 L1      ,BYTE 177,100,100,100,100
003704      100
003705      100
003706      100
003707      100
003710      177                 M1      ,BYTE 177,4,10,4,177
003711      004
003712      010
003713      004
003714      177
003715      177                 N1      ,BYTE 177,4,10,20,177
003716      004
003717      010
003720      020
003721      177
003722      076                 O1      ,BYTE 76,101,101,101,76
003723      101
003724      101
003725      101
003726      076
003727      177                 P1      ,BYTE 177,11,11,11,6
003730      011
003731      011
003732      011
003733      006
003734      076                 Q1      ,BYTE 76,101,121,141,176
003735      101
003736      121
003737      141
003740      176
003741      177                 R1      ,BYTE 177,11,31,51,106
003742      011
003743      031
003744      051
003745      106
003746      046                 S1      ,BYTE 46,111,111,111,62
003747      111
003750      111
003751      111
003752      062
003753      001                 T1      ,BYTE 1,1,177,1,1
003754      001
003755      177
003756      001
003757      001
003760      077                 U1      ,BYTE 77,100,100,100,77
003761      100
003762      100
003763      100
003764      077
003765      037                 V1      ,BYTE 37,40,100,40,37
003766      040
003767      100
003770      040
```

```
003771     037
003772     177                  W1      ,BYTE 177,20,10,20,177
003773     020
003774     010
003775     020
003776     177
003777     143                  X1      ,BYTE 143,24,10,24,143
004000     024
004001     010
004002     024
004003     143
004004     003                  Y1      ,BYTE 3,4,170,4,3
004005     004
004006     170
004007     004
004010     003
004011     141                  Z1      ,BYTE 141,121,111,105,103
004012     121
004013     111
004014     105
004015     103
004016     000                  N11     ,BYTE 0,102,177,100,0
004017     102
004020     177
004021     100
004022     000
004023     142                  N21     ,BYTE 142,121,111,105,102
004024     121
004025     111
004026     105
004027     102
004030     042                  N31     ,BYTE 42,101,111,111,66
004031     101
004032     111
004033     111
004034     066
004035     030                  N41     ,BYTE 30,24,22,177,20
004036     024
004037     022
004040     177
004041     020
004042     047                  N51     ,BYTE 47,105,105,105,71
004043     105
004044     105
004045     105
004046     071
004047     076                  N61     ,BYTE 76,111,111,111,62
004050     111
004051     111
004052     111
004053     062
004054     101                  N71     ,BYTE 101,41,21,11,7
004055     041
004056     021
004057     011
```

```
004060      007
004061      066             N8:     .BYTE 66,111,111,111,66
004062      111
004063      111
004064      111
004065      066
004066      046             N9:     .BYTE 46,111,111,111,76
004067      111
004070      111
004071      111
004072      076
004073      076             N0:     .BYTE 76,121,111,105,76
004074      121
004075      111
004076      105
004077      076
004100      000             SPACE:  .BYTE 0,0,0,0,0
004101      000
004102      000
004103      000
004104      000

            004106                  .EVEN
```

```
                                        ;CHANNEL 1 CHANNEL 2
004106  012706  000776          PIC7:   MOV     #STACK,%6       ;SET UP STACK
004112  012767  000600  174710          MOV     #600.,TICKS     ;SET UP A TIMER
004120  016705  174670          MOV     SCSR,%5         ;SET UP R5 FOR STATUS REGISTER POINTER
004124  012704  000022          MOV     #SCALE2,%4      ;SET UP SCALE SIZE <CHARACTER SIZE>
004130  012777  000000  174650  PIC7AA: MOV     #0,@SCSR        ;SET UP SCOPE CONTROL
004136  012767  006400  177442          MOV     #6400.,XPOS     ;LOAD X POSITION
004144  012767  000000  177432          MOV     #0,YPOS         ;LOAD Y POSITION
004152  012767  000011  000126          MOV     #9.,,P7CNT      ;SAVE THE NUMBER OF CHARACTERS
004160  012767  004312  000122          MOV     #CH1,P7PNT      ;SAVE CHANNEL 1 POINTER
004166  017702  000116          PIC7A:  MOV     @P7PNT,%2       ;MOVE MESSAGE POINTER INTO R2 FOR DISPLAY ROUTINE
004172  004767  177302          JSR     %7,CHAR         ;DISPLAY A CHARACTER
004176  062767  000002  000104          ADD     #2,P7PNT        ;ADD 2 TO THE MESSAGE POINTER
004204  005367  000076          DEC     P7CNT           ;DECREMENT CHARACTER COUNT
004210  001366          BNE     PIC7A           ;NOT FINISHED WITH ALL CHARACTERS
004212  012777  002004  174574          MOV     #2004,@SCSR
004220  012767  006400  177360          MOV     #6400.,XPOS     ;SET UP X POS FOR CHANNEL 2
004226  012767  007000  177350          MOV     #7000.,YPOS     ;SET UP Y
004234  012767  000011  000044          MOV     #9.,,P7CNT      ;SET UP CHARACTER COUNT
004242  012767  004334  000040          MOV     #CH2,P7PNT      ;SET UP CHANNEL 2 POINTER
004250  017702  000034          PIC7B:  MOV     @P7PNT,%2       ;SET UP
004254  004767  177220          JSR     %7,CHAR         ;DISPLAY A CHARACTER
004260  062767  000002  000022          ADD     #2,P7PNT        ;ADD 2 TO THE POINTER
004266  005367  000014          DEC     P7CNT           ;DECREMENT COUNT
004272  001366          BNE     PIC7B           ;NOT FINISHED
004274  004767  000700          JSR     %7,TIMER        ;CHECK THE RUNTIME OF THIS ROUTINE
004300  000713          BR      PIC7AA          ;NOT FINISHED
004302  000167  000050          JMP     PIC8            ;FINISHED, NEXT TEST
004306  000000  P7CNT:  0
004310  000000  P7PNT:  0
004312  003626  CH1:    C
004314  003657          H
004316  003614          A
004320  003715          N
004322  003715          N
004324  003640          E
004326  003703          L
004330  004100          SPACE
004332  004016          N1
004334  003626  CH2:    C
004336  003657          H
004340  003614          A
004342  003715          N
004344  003715          N
004346  003640          E
004350  003703          L
004352  004100          SPACE
004354  004023          N2

                                        ;COLOR DELAY ADJUSTMENT ROUTINE

004356  012706  000776          PIC8:   MOV     #STACK,%6
004362  012767  012000  174446          MOV     #12000.,TICKS
004370  016703  174420          MOV     SCSR,%3
004374  012713  001000          LOP1:   MOV     #1000,(3)       ;CHANGE TO RED
```

```
004400  105713                  TSTB    (3)             ;WAIT FOR COLOR DONE
004402  100376                  BPL     .-2
004404  005013                  CLR     (3)             ;CHANGE TO GREEN
004406  105713                  TSTB    (3)             ;WAIT FOR COLOR DONE
004410  100376                  BPL     .-2
004412  004767  000562          JSR     %7,TIMER
004416  000760                  BR      LOP1            ;DO AGAIN

                        ;COLOR PINCUSHION-COLORS SHOULD OVERLAY TO BECOME ORANGE
                        ;DRAW A BOX AROUND THE SCREEN AND A "X" IN THE CENTER
                        ;DRAW IN GREEN THEN IN RED

004420  005005          PIC10B: CLR     %5              ;SET UP FOR COLOR PATTERN
004422  012706  000776          MOV     #STACK,%6
004426  012767  000500  174402  MOV     #500,TICKS
004434  012767  003700  174344  PIC10:  MOV     #3700,HIGH
004442  012767  174000  174334          MOV     #174000,LOW
004450  016701  174342                  MOV     XREG,%1
004454  016702  174340                  MOV     YREG,%2
004460  016703  174330                  MOV     SCSR,%3
004464  012704  000100                  MOV     #100,%4
004470  012767  000340  173300          MOV     #340,CC
004476  016777  174302  174312  PIC10A: MOV     LOW,@XREG
004504  016777  174274  174300          MOV     LOW,@YREG
004512  105713                  TSTB    (3)             ;TEST CONTROL FOR READY
004514  100376                  BPL     .-2
                        ;BOTTOM LINE
004516  016700  174264          MOV     HIGH,%0
004522  012713  000010          MOV     #10,(3)         ;SET UP MODE
004526  050513                  BIS     %5,(3)          ;SET UP COLOR BIT
004530  105713          PIC10B: TSTB    (3)             ;CHANGE IN COLOR, WAIT FOR DONE
004532  100376                  BPL     .-2
004534  060411                  ADD     %4,(1)          ;ADD R4 TO XPOS
004536  020011                  CMP     %0,(1)          ;TEST IT, DONE ?
004540  001373                  BNE     PIC10B          ;NO,
004542  105713                  TSTB    (3)             ;WAIT FOR LAST DOT
004544  100376                  BPL     .-2
                        ;RIGHT LINE
004546  112713  000020          MOVB    #20,(3)         ;CHANGE MODE
004552  050513                  BIS     %5,(3)          ;COLOR BIT
004554  105713          PIC10C: TSTB    (3)             ;WAIT
004556  100376                  BPL     .-2
004560  060412                  ADD     %4,(2)          ;ADD R4 TO YPOS
004562  020012                  CMP     %0,(2)          ;TEST IT, DONE ?
004564  001373                  BNE     PIC10C          ;NO
004566  105713                  TSTB    (3)             ;WAIT FOR LAST DOT
004570  100376                  BPL     .-2
                        ;TOP LINE
004572  112713  000010          MOVB    #10,(3)         ;CHANGE MODE
004576  050513                  BIS     %5,(3)          ;COLOR BIT
004600  016700  174200          MOV     LOW,%0          ;
004604  105713          PIC10D: TSTB    (3)             ;READY
004606  100376                  BPL     .-2
004610  160411                  SUB     %4,(1)          ;SUB R4 FROM XPOS
004612  020011                  CMP     %0,(1)          ;TEST IT, DONE ?
```

```
004614  001373                          BNE     PIC10D          ;NO
004616  105713                          TSTB    (3)             ;WAIT FOR LAST DOT
004620  100376                          BPL     .-2
                                ;LEFT LINE
004622  112713  000020                  MOVB    #20,(3)         ;CHANGE MODE
004626  050513                          BIS     %5,(3)          ;COLOR BIT
004630  105713                  PIC10E: TSTB    (3)             ;READY
004632  100376                          BPL     .-2
004634  160412                          SUB     %4,(2)          ;SUB R4 FROM YPOS
004636  020012                          CMP     %0,(2)          ;TEST IT, DONE ?
004640  001373                          BNE     PIC10E          ;NO
004642  105713                          TSTB    (3)             ;WAIT FOR LAST DOT
004644  100376                          BPL     .-2

                                ;NOW DRAW THE X
004646  012767  007000  174130  PIC11:  MOV     #7000,LOW       ;SET UP LOW LIMIT
004654  012767  000400  174124          MOV     #400,HIGH       ;SET UP HIGH LIMIT
004662  105013                          CLRB    (3)             ;CLEAR CONTROL
004664  016700  174116                  MOV     HIGH,%0         ;SET UP
004670  012704  000040                  MOV     #40,%4          ;SET UP R4
004674  016712  174104                  MOV     LOW,(2)         ;SET UP Y POS
004700  011211                          MOV     (2),(1)         ;SET UP X POS
004702  112713  000010                  MOVB    #10,(3)         ;SET UP CONTROL
004706  050513                          BIS     %5,(3)          ;COLOR BIT
004710  105713                  PIC11A: TSTB    (3)             ;WAIT FOR READY
004712  100376                          BPL     .-2
004714  060412                          ADD     %4,(2)          ;ADD R4 TO YPOS
004716  060411                          ADD     %4,(1)          ;ADD R4 TO XPOS
004720  021100                          CMP     (1),%0          ;TEST IT, DONE ?
004722  001372                          BNE     PIC11A          ;NO
004724  105713                          TSTB    (3)
004726  100376                          BPL     .-2
004730  016712  174052                  MOV     HIGH,(2)        ;CHANGE Y POS
004734  016711  174044                  MOV     LOW,(1)         ;CHANGE X POS
004740  105713                  PIC11B: TSTB    (3)             ;READY
004742  100376                          BPL     .-2
004744  160412                          SUB     %4,(2)          ;SUB R4 FROM YPOS
004746  060411                          ADD     %4,(1)          ;ADD R4 TO XPOS
004750  021100                          CMP     (1),%0          ;TEST IT, DONE ?
004752  001372                          BNE     PIC11B          ;NO
004754  105713                          TSTB    (3)             ;WAIT FOR LAST POINT
004756  100376                          BPL     .-2
004760  032705  001000                  BIT     #1000,%5        ;TEST COLOR BIT
004764  001004                          BNE     PIC11C
004766  052705  003000                  BIS     #3000,%5
004772  105013                          CLRB    (3)
004774  000617                          BR      PIC10
004776  005005                  PIC11C: CLR     %5
005000  105013                          CLRB    (3)
005002  004767  000172                  JSR     %7,TIMER        ;HAS TIME EXPIRED ?
005006  000612                          BR      PIC10           ;NE
```

```
                                        ;THIS ROUTINE DISPLAYS THE VERTICAL AND DIAG, LINE

025010  012700  174000          PIC12:  MOV     SCSR,%0         ;SET UP CONTROL
025014  012706  000776                  MOV     #STACK,%6
025020  012767  007000  174010          MOV     #7000,TICKS     ;SET UP TIMER
025026  012710  000010                  MOV     #10,(0)         ;SET BIT 3
025032  012701  000200                  MOV     #200,%1         ;SET UP R1
025036  012704  000300                  MOV     #300,%4
025042  016702  173750                  MOV     XREG,%2         ;SET UP XREG
025046  016703  173746                  MOV     YREG,%3         ;SET UP Y REG
025052  012767  174000  000114          MOV     #174000,POS1X   ;SET UP VERTICAL
025060  012767  003700  000124  PIC12A: MOV     #3700,POSY      ;SET UP Y POS
025066  012767  174000  000102          MOV     #174000,POS2X   ;SET UP DIAG,
025074  105710                  PIC12B: TSTB    (0)             ;READY ?
025076  100376                          BPL     .-2
025100  016713  000066                  MOV     POSY,(3)        ;LOAD Y POS
025104  016712  000064                  MOV     POS1X,(2)       ;LOAD XPOS
025110  160167  000056                  SUB     %1,POSY         ;SUB R1 FROM YPOS
025114  060167  000056                  ADD     %1,POS2X        ;ADD R1 TO XPOS
025120  105710                          TSTB    (0)             ;READY ?
025122  100376                          BPL     .-2
025124  016713  000042                  MOV     POSY,(3)        ;LOAD Y POS
025130  016712  000042                  MOV     POS2X,(2)       ;LOAD X POS
025134  022767  003600  000034          CMP     #3600,POS2X     ;TEST POSX
025142  001354                          BNE     PIC12B          ;MORE POINTS TO PLOT
025144  004767  000030                  JSR     %7,TIMER        ;WAS TIME EXPIRED ?
025150  000743                          BR      PIC12A          ;NO
025152  012777  000207  173632          MOV     #207,@TDBR
025160  105777  173624                  TSTB    @TCSR
025164  100375                          BPL     .-4
025166  000167  175362                  JMP     T24B

025172  000000          POSY:   0
025174  000000          POS1X:  0
025176  000000          POS2X:  0
```

```
                        ;TIMER ROUTINE
                        ; ENTER VIA JSR %7,TIMER
                        ; SWR 4=0

005200  017767  173622  173620  TIMER:  MOV     @SWR,TIMSV
005206  032767  000020  173620          BIT     #20,TIMSV
005214  001006                          BNE     TIMER2          ;BIT 4 SET ?
005216  005367  173614                  DEC     TICKS           ;NO, DECREMENT TICKS
005222  001002                          BNE     TIMER1
005224  062716  000002                  ADD     #2,(6)          ;ADD 2 TO STACK POINTER
005230  000207                  TIMER1: RTS     %7              ;RETURN

                        ; SWR 4=1 SELECT TEST TO LOCK ON
                        ; SWR 3-0= TEST NUMBER

005232  042767  177760  173574  TIMER2: BIC     #177760,TIMSV
005240  006367  173570                  ASL     TIMSV
005244  062767  005264  173562          ADD     #ROUTPT,TIMSV
005252  017767  173556  173554          MOV     @TIMSV,TIMSV
005260  000177  173550          TIMER4: JMP     @TIMSV

005264  002554                  ROUTPT: T24B                    ;CONTROL AND STATUS TEST
005266  002566                          PIC0                    ;DISPLAY A HORIZONTAL LINE
005270  002712                          PIC1                    ;DISPLAY A VERTICAL LINE
005272  003036                          PIC3                    ;DISPLAY A SQUARE
005274  003234                          PIC4                    ;DISPALY A "X"
005276  003372                          PIC6                    ;DISPLAY CHARACTER SET
005300  004106                          PIC7                    ;DISPLAY CHANNEL TEST
005302  004356                          PIC8                    ;COLOR DELAY ADJUSTMENT
005304  004420                          PIC100                  ;DISPLAY COLOR PATTERN
005306  005010                          PIC12                   ;DISPLAY A VERTICAL AND DIAGONAL LINE
005310  002554                          T24B                    ;CONTROL AND STATUS TEST
005312  002554                          T24B                    ;CONTROL AND STATUS TEST
005314  002554                          T24B                    ;CONTROL AND STATUS TEST
005316  002554                          T24B                    ;CONTROL AND STATUS TEST
005320  002554                          T24B                    ;CONTROL AND STATUS TEST
005322  002554                          T24B                    ;CONTROL AND STATUS TEST
```

```
                        ;KNOBS- MUST HAVE ADB1 TO EXECUTE THIS ROUTINE

                        ;READ SWITCHES- USE 0-5 AS OCTAL NUMBER
                        ; DO AN A TO D SAMPLE OF THAT CHANNEL
                        ; BITS 7-0 ARE USED AS THE "GAIN" OF THE CHANNEL

005324  012706  000776          KNOB:   MOV     #STACK,%6       ;SET UP THE STACK
005330  016705  173460                  MOV     @CSR,%5         ;SET UP SCOPE CONTROL
005334  012704  000022                  MOV     #SCALE2,%4      ;SET UP SCALE <CHARACTER SIZE>
005340  012767  006400  176240          MOV     #6400,XPOS      ;SET UP CHANNEL SCOPE POINTER
005346  012767  001000  176230          MOV     #1000,YPOS
005354  017701  173446                  MOV     @SWR,%1         ;SET UP SWR
005360  010167  000270                  MOV     %1,P12CT        ;SAVE SWITCH VALUE
005364  000257                          CCC
005366  006001                          ROR     %1              ;THE GAME OF ROTATION
005370  006001                          ROR     %1              ;
005372  006001                          ROR     %1              ;
005374  004767  000200                  JSR     %7,CONVT        ;CONVERT THE FIRST DIGIT OF CHANNEL NUMBER
005400  016701  000250                  MOV     P12CT,%1
005404  004767  000170                  JSR     %7,CONVT        ;CONVERT THE SECOND NUMBER
005410  012767  006400  176170          MOV     #6400,XPOS      ;SET UP A TO D VALUE POINTER
005416  012767  000000  176160          MOV     #0,YPOS
005424  000367  000224                  SWAB    P12CT           ; A SHUFFEL ROUTINE
005430  032767  100000  000210          BIT     #100000,P12CT   ;TEST THE "GAIN" OF THE CHANNEL
005436  001003                          BNE     LPTA1
005440  052767  000020  000200          BIS     #20,P12CT
005446  032767  040000  000200  LPTA1:  BIT     #40000,P12CT
005454  001003                          BNE     LPTA2
005456  052767  000010  000170          BIS     #10,P12CT
005464  042767  140347  000162  LPTA2:  BIC     #140347,P12CT
005472  005267  000156                  INC     P12CT
005476  016777  000152  173310          MOV     P12CT,@ADCS     ;THE CHANNEL NO, AND THE "GAIN" ARE COMPUTED
005504  105777  173312                  TSTB    @ADCS           ;GO A TO D
005510  100375                          BPL     .-4             ;WAIT FOR DONE
```

```
                                ;TO GET HERE THE A TO D DONE FLAG HAS COME UP
                                ; SAVE THE CONVERTED VALUE AND DISPLAY IT ON THE VR28 DISPLAY

005512  017701  173306                 MOV     @ADDB,%1        ;SAVE A TO D CONVERSION
005516  010167  000134                 MOV     %1,P12SV
005522  000301                         SWAB    %1              ;SHUFFEL THE DATA
005524  006001                         ROR     %1
005526  004767  000046                 JSR     %7,CONVT        ;DISPLAY THE FIRST DIGIT
005532  016701  000120                 MOV     P12SV,%1
005536  006101                         ROL     %1
005540  006101                         ROL     %1
005542  000301                         SWAB    %1
005544  004767  000030                 JSR     %7,CONVT        ;DISPLAY THE SECOND DIGIT
005550  016701  000102                 MOV     P12SV,%1
005554  006001                         ROR     %1
005556  006001                         ROR     %1
005560  006001                         ROR     %1
005562  004767  000012                 JSR     %7,CONVT        ;DISPLAY THE NEXT DIGIT
005566  016701  000064                 MOV     P12SV,%1
005572  004767  000002                 JSR     %7,CONVT        ;DISPLAY THE LAST DIGIT
005576  000652                         BR      KNOB


005600  042701  177770         CONVT1: BIC     #177770,%1
005604  012700  005634                 MOV     #TAB1,%0
005610  005701                         TST     %1
005612  001404                 CONVT11: BEQ     CONVT2
005614  062700  000002                 ADD     #2,%0
005620  005301                         DEC     %1
005622  000773                         BR      CONVT1
005624  011002                 CONVT2: MOV     @%0,%2
005626  004767  175646                 JSR     %7,CHAR
005632  000207                         RTS     7

005634  004073                 TAB1:   N0
005636  004016                         N1
005640  004023                         N2
005642  004030                         N3
005644  004035                         N4
005646  004042                         N5
005650  004047                         N6
005652  004054                         N7

005654  000000                 P12CT:  0
005656  000000                 P12SV:  0

        000001                         .END
```

```
A       003614          P12CT   005654          SCALE2  000022          T9A     001222
ADCS    001022          P12SV   005656          SCSR    001014          T9B     001242
ADDB    001024          P1RET   003034          SPACE   004100          T6      001250
B       003621          P3      003112          SREG    177570          T6A     001262
C       003626          P3A     003136          STACK   000776          T6B     001302
CC      177776          P3B     003154          SVEC    001030          T7      001312
CH1     004312          P3C     003176          SWR     001026          T7A     001324
CH2     004334          P3D     003214          T       003753          T7B     001344
CHAR    003500          P4      003306          T0      001054          T8      001354
CHAR1   003516          P4A     003320          T1      001072          T9      001374
CHAR2   003524          P4B     003350          T10     001444          T9A     001420
CHAR3   003550          P7CNT   004306          T10A    001470          TAB1    005634
CHRCOL  003610          P7PNT   004310          T11     001514          TCSR    001010
CONVT   005600          PB      002610          T11A    001540          TDBR    001012
CONVT1  005612          PD      002624          T11B    001564          TICKS   001036
CONVT2  005624          PE      002660          T11C    001610          TIMER   005200
CSRTST  001040          PF      003004          T11D    001634          TIMER1  005230
D       003633          PIC0    002566          T11E    001660          TIMER2  005232
E       003640          PIC1    002712          T12     001704          TIMER4  005260
F       003645          PIC10   004434          T12A    001730          TIMSV   001034
G       003652          PIC100  004420          T13     001754          U       003760
GEN1    003464          PIC10A  004476          T13A    001766          V       003765
H       003657          PIC10B  004530          T13B    002012          W       003772
HIGH    001006          PIC10C  004554          T14     002030          X       003777
HILMT   001002          PIC10D  004604          T14A    002042          XPOS    003606
I       003664          PIC10E  004630          T14B    002066          XREG    001016
J       003671          PIC11   004646          T15     002104          Y       004004
K       003676          PIC11A  004710          T16     002132          YPOS    003604
KNOB    005324          PIC11B  004742          T16A    002156          YPT     003612
L       003703          PIC11C  004776          T16B    002206          YREG    001020
LOP1    004374          PIC12   005010          T17     002220          Z       004011
LOW     001004          PIC12A  005060          T17A    002270
LOWLMT  001000          PIC12B  005074          T18     002274
LPTA1   005446          PIC3    003036          T18A    002324
LPTA2   005464          PIC4    003234          T19     002346
LPVEC   001032          PIC4B   003262          T19A    002372
M       003710          PIC6    003372          T2      001110
N       003715          PIC6A   003400          T20     002416
N0      004073          PIC6B   003446          T20A    002426
N1      004016          PIC7    004106          T21     002452
N2      004023          PIC7A   004166          T21A    002456
N3      004030          PIC7AA  004130          T22     002474
N4      004035          PIC7B   004250          T23     002520
N5      004042          PIC8    004356          T23A    002524
N6      004047          POS1X   005174          T24     002542
N7      004054          POS2X   005176          T24A    002562
N8      004061          POSY    005172          T24B    002554
N9      004066          Q       003734          T3      001134
NOP     000240          R       003741          T4      001160
O       003722          ROUTPT  005264          T4A     001166
P       003727          S       003746          T4B     001206
PRET    002710          SCALE1  000011          T5      001214
```

```
ERRORS DETECTED: 0
RUN-TIME:  10 SECONDS
5K CORE USED
```