IDENTIFICATION

PRODUCT CODE: MAINDEC-11-D6CA-D

PRODUCT NAME: AA11-A,B,C SCOPE CONTROL TEST

DATE CREATED: DECEMBER 11, 1970

MAINTAINER: DIAGNOSTIC GROUP

AUTHOR: JOHN RODENHISER

DO NOT
REMOVE

1. ABSTRACT

THIS PROGRAM TESTS THE AA11-A,B,C SCOPE CONTROL, X AND Y AXIS DAC'S AND EACH OF THE THREE AVAILABLE SCOPES (TEKTRONIX 611 STORAGE DISPLAY UNIT, TEKTRONIX RM503 OSCILLOSCOPE, OR VR12 POINT PLOT DISPLAY).

2. REQUIREMENTS

2.1 EQUIPMENT

PDP-11/20
AA11-D DAC CONTROL WITH AN AA11-A,B, OR C SCOPE CONTROL.

2.2 STORAGE

THE PROGRAM OCCUPIES MEMORY FROM 0 TO 4222.

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 *7500 (*DETERMINED BY ADDRESS OF LOADER).
4. PRESS "START" (PROGRAM WILL LOAD).

4. STARTING PROCEDURE

4.1 CONTROL SWITCH SETTINGS

NONE

4.2 STARTING ADDRESS

NON-STORE DISPLAYS

	ADDRESS	TEST
4.2.1	200	COMMAND AND STATUS REGISTER TEST
4.2.2	204	DISPLAY HORIZONTAL LINE
4.2.3	210	DISPLAY VERTICAL LINE
4.2.4	214	DISPLAY SQUARE
4.2.5	220	DISPLAY X
4.2.6	224	DISPLAY LOW AND HIGH INTENSITY
4.2.7	230	DISPLAY ALPHA-NUMERIC CHARACTER SET

5.4 PHOSPHOR AND ERASE TEST

1. DETERMINE IF SCOPE IS SET UP FOR 1ST OR 3RD QUADRANT. LOAD APPROPRIATE STARTING ADDRESS (260 - 1ST QUADRANT, 264 - 3RD QUADRANT)
2. PRESS "START"
   PROGRAM WILL INTENSIFY PHOSPHOR
3. OPERATOR SHOULD INSPECT PHOSPHOR FOR DAMAGE.
4. PRESS "CONTINUE" TO TEST INTENSIFY AND READY WITH STORE MODE SET AND ERASE.
   PROGRAM WILL THEN REPEAT TEST.

6. ERRORS

6.1 ERROR REPORTING

IF AN ERROR OCCURS DURING THE COMMAND AND STATUS REGISTER TEST OR PHOSPHOR AND ERASE 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

CSR TEST - THE TELETYPE BELL WILL RING AFTER EVERY 100 PASSES WHICH IS APPROXIMATELY EVERY 30 SECONDS.

PHOSPHOR AND ERASE TEST - IT TAKES APPROXIMATELY 2 MINUTES 15 SECONDS TO COMPLETE ONE PASS THRU THIS TEST

ALL OTHER TESTS - N/A.

9. PROGRAM DESCRIPTION

9.1 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) 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.

(9.1 CONTD.)

TEST	DESCRIPTION
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 Ø1.
T14	TEST THAT READY (7) IS CLEARED WHEN Y DAC IS LOADED WITH MODE 1Ø.
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 14Ø WITH PROCESSOR PRIORITY LEVEL 3.
T17	TEST THAT DISPLAY DOES NOT INTERRUPT WITH PROCESSOR PRIORITY LEVEL 4.

9.2 DISPLAY HORIZONTAL LINE (STORAGE AND NON-STORAGE)

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.

9.3 DISPLAY VERTICAL LINE (STORAGE AND NON-STORAGE)

A VERTICAL LINE IS DISPLAYED ON THE SCOPE IN THE SAME MANNER AS FOR A HORIZONTAL LINE (REF 9.2) EXCEPT NOW THE Y VALUE IS INCREMENTED WHILE HOLDING THE X VALUE AT ZERO.

9.4 DISPLAY SQUARE (STORAGE AND NON-STORAGE)

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 Ø1 (INTENSIFY ON LOADING X) AND MODE 1Ø (INTENSIFY ON LOADING Y) ARE USED.

9.5 DISPLAY X (STORAGE AND NON-STORAGE)

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 Ø1 (INTENSIFY ON LOADING X) IS USED.

9,6 DISPLAY LOW AND HIGH INTENSITY (NON-STORAGE ONLY)

THE TEXT "LOW INTENSITY" IS DISPLAYED IN LOW INTENSITY.
THE TEXT "HI INTENSITY" IS DISPLAYED IN HIGH INTENSITY.

9,7 DISPLAY ALPHA-NUMERIC CHARACTER SET (STORAGE AND NON STORAGE)

THE ALPHABET AND NUMBERS 1 THRU Ø ARE DISPLAYED.

9,8 PHOSPHOR AND ERASE TEST (STORAGE ONLY)

EVERY SECOND POINT ON THE FACE OF THE SCOPE IS INTENSIFIED IN STORE MODE AND THEN THE PROGRAM WILL HALT. THIS WILL ALLOW THE OPERATOR TO INSPECT THE PHOSPHOR COATING ON THE CRT FOR DAMAGE. AFTER BEING SATISFIED WITH THE PHOSPHOR CONDITION THE OPERATOR MUST PRESS "CONTINUE". NOW THE FOLLOWING TESTS WILL BE MADE:

1. WILL INTENSIFY (Ø) CAUSE READY (7) TO CLEAR WITH STORE MODE SET (2)?
2. WILL READY RETURN AFTER BEING CLEARED?
3. DOES ERASE (1) CLEAR READY(7)?

AFTER COMPLETION OF THESE TEST THE SEQUENCE WILL REPEAT ITSELF. THE OPERATOR IS RESPONSIBLE FOR DETERMINING IF ERASE (1) ACTUALLY ERASED THE SCOPE.

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                                ;AA11-A, B, C SCOPE CONTROL TEST
                                ;COPYRIGHT 1970, DIGITAL EQUIPMENT CORP., MAYNARD, MASS. 01754
                                ;JOHN RODENHISER
        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
        000200                  .=200
000200  000167  000624          JMP     CSRTST          ;CSR TEST
000204  000167  002110          JMP     PIC0            ;HORIZONTAL LINE
000210  000167  002116          JMP     PIC0A           ;VERTICAL LINE
000214  000167  002256          JMP     PIC3            ;PINCUSHION SQUARE
000220  000167  002450          JMP     PIC4            ;X
000224  000167  002576          JMP     PIC5            ;LOW AND HIGH INTENSITY
000230  000167  003224          JMP     PIC6            ;CHARACTER SET
000234  000167  002120          JMP     PIC1            ;STORAGE DISPLAY HORIZONTAL LINE
000240  000167  002126          JMP     PIC1A           ;STORAGE DISPLAY VERTICAL LINE
000244  000167  002244          JMP     PIC3A           ;STORAGE DISPLAY SQUARE
000250  000167  002436          JMP     PIC4A           ;STORAGE DISPLAY X
000254  000167  003240          JMP     PIC6A           ;STORAGE CHARACTER SET
000260  000167  003010          JMP     ERASE           ;ERASE TEST (1ST QUADRANT)
000264  000167  003016          JMP     ERASE1          ;ERASE TEST (3RD QUADRANT)
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                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  000140                 SVEC:   140
001024  000144                 LPVEC:  144
001026  000000                 BELCNT: 0
001030  012767  177634  177770 CSRTST: MOV     #-100.,BELCNT
001036  012767  000340  176732         MOV     #340,CC          ;SET PRIORITY 7
                        ;TEST XREG CAN BE SET = 0
001044  005077  177746         T0:     CLR     @XREG
001050  017700  177742                 MOV     @XREG,%0
001054  001402                         BEQ     T1
001056  000000                         HALT                     ;ERROR, XREG NOT CLEARED
001060  000771                         BR      T0
                        ;TEST THAT YREG CAN BE SET = 0
001062  005077  177732         T1:     CLR     @YREG
001066  017700  177726                 MOV     @YREG,%0
001072  001402                         BEQ     T2
001074  000000                         HALT                     ;ERROR, Y REG NOT CLEARED
001076  000771                         BR      T1
                        ;TEST THAT XREG CAN BE SET = -1
001100  012777  177777  177710 T2:     MOV     #-1,@XREG
001106  017700  177704                 MOV     @XREG,%0
001112  022700  177777                 CMP     #-1,%0
001116  001402                         BEQ     T3
001120  000000                         HALT                     ;ERROR, XREG NOT = -1
001122  000766                         BR      T2
                        ;TEST THAT YREG CAN BE SET = -1
001124  012777  177777  177666 T3:     MOV     #-1,@YREG
001132  017700  177662                 MOV     @YREG,%0
001136  022700  177777                 CMP     #-1,%0
001142  001402                         BEQ     T4
001144  000000                         HALT                     ;ERROR, YREG NOT = -1
001146  000766                         BR      T3
                        ;TEST THAT XREG WILL ACCEPT A COUNT PATTERN (0-3777)
001150  005000         T4:     CLR     %0               ;INITIALIZE COUNT PATTERN
001152  005077  177640                 CLR     @XREG
001156  005200         T4A:    INC     %0               ;+1 TO PATTERN
001160  005277  177632                 INC     @XREG
001164  020077  177626                 CMP     %0,@XREG                 ;DID XREG COUNT?
001170  001402                         BEQ     T4B
001172  000000                         HALT                     ;ERROR, XREG NOT = %0
001174  000765                         BR      T4
001176  022700  003777         T4B:    CMP     #3777,%0
001202  001365                         BNE     T4A
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                                        ;TEST THAT YREG WILL ACCEPT A COUNT PATTERN (0-3777)
001204  005000                  T5:     CLR     %0              ;INITIALIZE COUNT PATTERN
001206  005077  177606                    CLR     @YREG
001212  005200                  T5A:    INC     %0              ;+1 TO PATTERN
001214  005277  177600                    INC     @YREG
001220  020077  177574                    CMP     %0,@YREG                ;DID YREG COUNT
001224  001402                          BEQ     T5B
001226  000000                          HALT                    ;ERROR, YREG NOT = %0
001230  000765                          BR      T5
001232  022700  003777          T5B:    CMP     #3777,%0
001236  001365                          BNE     T5A
                                        ;TEST THAT XREG WILL ACCEPT A COUNT PATTERN (4000-7777)
                                        ;BIT 11 SHOULD SET BITS 12-15
001240  012700  173777          T6:     MOV     #173777,%0      ;INITIALIZE COUNT PATTERN
001244  012777  003777  177544          MOV     #3777,@XREG
001252  005277  177540          T6A:    INC     @XREG           ;+1 TO XREG
001256  005200                          INC     %0              ;+1 TO PATTERM
001260  020077  177532                    CMP     %0,@XREG
001264  001402                          BEQ     T6B
001266  000000                          HALT                    ;ERROR, XREG NOT = %0
001270  000763                          BR      T6
001272  022777  177777  177516  T6B:    CMP     #177777,@XREG
001300  001364                          BNE     T6A
                                        ;TEST THAT YREG WILL ACCEPT A COUNT PATTERN (4000-7777)
                                        ;BIT 11 SHOULD SET BITS 12-15
001302  012700  173777          T7:     MOV     #173777,%0      ;INITIALIZE COUNT PATTERN
001306  012777  003777  177504          MOV     #3777,@YREG
001314  005277  177500          T7A:    INC     @YREG           ;+1 TO YREG
001320  005200                          INC     %0              ;+1 TO PATTERM
001322  020077  177472                    CMP     %0,@YREG
001326  001402                          BEQ     T7B
001330  000000                          HALT                    ;ERROR, YREG NOT = %0
001332  000763                          BR      T7
001334  022777  177777  177456  T7B:    CMP     #177777,@YREG
001342  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), AND SET READY (7).
001344  017700  177444        T8: MOV     @SCSR,%0            ;MOVE STATUS REGISTER TO %0
001350  022700  000200            CMP     #200,%0         ;IS READY SET?
001354  001403                    BEQ     T9
001356  000000                    HALT                    ;ERROR, BIT 7 (READY) IS ONLY ONE THAT SHOULD BE
001360  000005                    RESET                   ;TRY AGAIN
001362  000770                    BR      T8
                                ;TEST THAT DISPLAY INTERRUPT ENABLE (BIT 6) MAY BE SET AND CLEARED.
001364  052777  000100  177422  T9: BIS     #100,@SCSR      ;SET BIT 6
001372  017700  177416            MOV     @SCSR,%0
001376  022700  000300            CMP     #300,%0
001402  001402                    BEQ     T9A
001404  000000                    HALT                    ;ERROR, BIT 6 OR 7 NOT SET
001406  000766                    BR      T9              ;OR OTHER BITS PICKED UP
001410  042777  000100  177376  T9A: BIC     #100,@SCSR      ;CLEAR BIT 6
001416  017700  177372            MOV     @SCSR,%0
001422  022700  000200            CMP     #200,%0
001426  001402                    BEQ     T10
001430  000000                    HALT                    ;ERROR, BIT 6 NOT CLEARED
001432  000766                    BR      T9A
                                ;TEST THAT LIGHT PEN INTERRUPT ENABLE (BIT 5) MAY BE SET AND CLEARED
001434  052777  000040  177352  T10: BIS     #40,@SCSR       ;SET BIT 5
001442  017700  177346            MOV     @SCSR,%0
001446  022700  000240            CMP     #240,%0
001452  001402                    BEQ     T10A
001454  000000                    HALT                    ;ERROR BIT 5 OR 7 NOT SET
001456  000766                    BR      T10             ;OR OTHER BITS PICKED UP
001460  042777  000040  177326  T10A: BIC     #40,@SCSR       ;CLEAR BIT 5
001466  017700  177322            MOV     @SCSR,%0
001472  022700  000200            CMP     #200,%0
001476  001402                    BEQ     T11
001500  000000                    HALT                    ;ERROR BIT 5 NOT CLEARED
001502  000766                    BR      T10A
                                ;TEST THAT MODE CONTROL (BITS 4-3) CAN BE SET AND CLEARED
001504  052777  000010  177302  T11: BIS     #10,@SCSR       ;SET BIT 3
001512  017700  177276            MOV     @SCSR,%0
001516  022700  000210            CMP     #210,%0
001522  001402                    BEQ     T11A
001524  000000                    HALT                    ;ERROR, BIT 3 OR 7 NOT SET
001526  000766                    BR      T11             ;OR OTHER BITS PICKED UP
001530  042777  000010  177256  T11A: BIC     #10,@SCSR       ;CLEAR BIT 3
001536  017700  177252            MOV     @SCSR,%0
001542  022700  000200            CMP     #200,%0
001546  001402                    BEQ     T11B
001550  000000                    HALT                    ;ERROR BIT 3 NOT CLEARED
001552  000766                    BR      T11A
001554  052777  000020  177232  T11B: BIS     #20,@SCSR
001562  017700  177226            MOV     @SCSR,%0
001566  022700  000220            CMP     #220,%0
001572  001402                    BEQ     T11C
001574  000000                    HALT                    ;ERROR BIT 4 OR 7 NOT SET
001576  000766                    BR      T11B            ;OR OTHER BITS PICKED UP
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001600  042777  000020  177206  T11C:  BIC     #20,@SCSR       ;CCLEAR BIT 4
001606  017700  177202                 MOV     @SCSR,%0
001612  022700  000200                 CMP     #200,%0
001616  001402                         BEQ     T11D
001620  000000                         HALT                    ;ERROR BIT 4 NOT CLEARED
001622  000766                         BR      T11C
001624  052777  000030  177162  T11D:  BIS     #30,@SCSR       ;SET BITS 4-3
001632  017700  177156                 MOV     @SCSR,%0
001636  022700  000230                 CMP     #230,%0
001642  001402                         BEQ     T11E
001644  000000                         HALT                    ;ERROR BITS 4,3, OR 7 NOT SET
001646  000766                         BR      T11D            ;OR OTHER BITS PICKED UP
001650  042777  000030  177136  T11E:  BIC     #30,@SCSR       ;CLEAR BITS 4,3,
001656  017700  177132                 MOV     @SCSR,%0
001662  022700  000200                 CMP     #200,%0
001666  001402                         BEQ     T12
001670  000000                         HALT                    ;ERROR BITS 4, 3 NOT CLEARED
001672  000766                         BR      T11E
                        ;TEST THAT INTENSITY (BIT 2) MAY BE SET OR CLEARED
001674  052777  000004  177112  T12:   BIS     #4,@SCSR                ;SET BIT 2
001702  017700  177106                 MOV     @SCSR,%0
001706  022700  000204                 CMP     #204,%0
001712  001402                         BEQ     T12A
001714  000000                         HALT                    ;ERROR BIT 2 OR 7 NOT SET
001716  000766                         BR      T12             ;OR OTHER BITS PICKED UP
001720  042777  000004  177066  T12A:  BIC     #4,@SCSR                ;CLEAR BIT 2
001726  017700  177062                 MOV     @SCSR,%0
001732  022700  000200                 CMP     #200,%0
001736  001402                         BEQ     T13
001740  000000                         HALT                    ;ERROR BIT 2 NOT CLEARED
001742  000766                         BR      T12A
                        ;TEST THAT READY IS CLEARED BY LOADING XREG
001744  105777  177044          T13:   TSTB    @SCSR           ;IS READY SET
001750  100402                         BMI     T13A
001752  000000                         HALT                    ;ERROR, READY NOT SET
001754  000773                         BR      T13
001756  012777  000010  177030  T13A:  MOV     #10,@SCSR       ;ENABLE INTENSIFY ON LOADING X REG.
001764  005077  177030                 CLR     @YREG
001770  105777  177020                 TSTB    @SCSR
001774  100402                         BMI     T13B
001776  000000                         HALT                    ;ERROR, LOAD YREG SHOULDN'T CLEAR READY
002000  000761                         BR      T13
002002  005077  177010          T13B:  CLR     @XREG           ;LOAD XREG, SHOULD CLEAR READY
002006  105777  177002                 TSTB    @SCSR
002012  100030                         BPL     T15
002014  000000                         HALT                    ;ERROR READY NOT CLEARED
002016  000752                         BR      T13
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                                ;TEST THAT READY IS CLEARED BY LOADING Y REGISTER.
002020  105777  176770          T14:  TSTB    @SCSR           ;IS READY SET
002024  100402                       BMI     T14A
002026  000000                       HALT                    ;ERROR, READY NOT SET
002030  000773                       BR      T14
002032  012777  000020  176754  T14A: MOV     #20,@SCSR       ;ENABLE INTENSIFY ON LOADING Y REG.
002040  005077  176752               CLR     @XREG
002044  105777  176744               TSTB    @SCSR
002050  100402                       BMI     T14B
002052  000000                       HALT                    ;ERROR, LOAD XREG SHOULDN'T CLEAR READY
002054  000761                       BR      T14
002056  005077  176736          T14B: CLR     @YREG
002062  105777  176726               TSTB    @SCSR
002066  100002                       BPL     T15
002070  000000                       HALT                    ;ERROR, READY NOT CLEARED
002072  000752                       BR      T14
                                ;READY SHOULD RETURN AFTER INTENSIFY SET
002074  005277  176714          T15:  INC     @SCSR           ;ENABLE INTENSIFY
002100  012700  177600               MOV     #-200,%0
002104  005200                       INC     %0
002106  001376                       BNE     .-2             ;DELAY
002110  105777  176700               TSTB    @SCSR           ;IS READY SET
002114  100402                       BMI     T16
002116  000000                       HALT                    ;ERROR READY FAILED TO SET AFTER INTENSIFY
002120  000765                       BR      T15
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                                ;TEST DISPLAY INTERRUPT ENABLE
                                ;TEST PROPER VECTOR RETURN
                                ;TEST READY TO CAUSE INTERRUPT
002122  012777  002176  176672  T16:    MOV     #T16B,@SVEC     ;INITIALIZE INTERRUPT RETURN
002130  012706  000776          T16A:   MOV     #STACK,%6
002134  105777  176654                  TSTB    @SCSR
002140  100402                          BMI     T16A
002142  000000                          HALT                    ;READY NOT SET
002144  000766                          BR      T16
002146  012767  000140  175622  T16A:   MOV     #140,CC         ;SET PROCESSOR PRIORITY LEVEL 3
002154  012777  000101  176632          MOV     #101,@SCSR      ;ENABLE INTERRUPT AND INTENSIFY
002162  012700  177600                  MOV     #-200,%0
002166  005200                          INC     %0
002170  001376                          BNE     .-2
002172  000000                          HALT                    ;ERROR, DIDN'T FIND INTERRUPT
002174  000752                          BR      T16
002176  105777  176612          T16B:   TSTB    @SCSR           ;RETURN HERE AFTER INTERRUPT
002202  100402                          BMI     T17
002204  000000                          HALT                    ;ERROR, RECEIVED INTERRUPT BIT READY NOT SET
002206  000745                          BR      T16
                                ;TEST THAT DISPLAY DOES NOT INTERRUPT WITH PROCESSOR PRIORITY 4
002210  012767  000200  175560  T17:    MOV     #200,CC         ;SET PROCESSOR PRIORITY LEVEL 4
002216  012777  002260  176576          MOV     #T17A,@SVEC     ;INITIALIZE INTERRUPT RETURN
002224  012706  000776                  MOV     #STACK,%6
002230  012777  000101  176556          MOV     #101,@SCSR      ;INITIALIZE DISPLAY
002236  012700  177600                  MOV     #-200,%0
002242  005200                          INC     %0
002244  001376                          BNE     .-2
002246  105777  176542                  TSTB    @SCSR           ;IS READY SET?
002252  100404                          BMI     T18
002254  000000                          HALT                    ;ERROR READY NOT SET
002256  000754                          BR      T17
002260  000000          T17A:   HALT                    ;ERROR INTERRUPT SHOULDN'T OCCUR
002262  000752                  BR      T17             ;WITH PROCESSOR PRIORITY 4.
                                ;END OF BASIC TEST
002264  000005          T18:    RESET
002266  005267  176534                  INC     BELCNT
002272  001402                          BEQ     BELL
002274  000167  176544                  JMP     T0
002300  105777  176504          BELL:   TSTB    @TCSR           ;RING BELL EVERY 100 PASSES
002304  100375                          BPL     .-4
002306  012777  000207  176476          MOV     #207,@TDBR
002314  000167  176510                  JMP     CSRTST
```

```
                                ;DISPLAY HORIZONTAL LINE USING INTERRUPT, NON STORE DISPLAY.
002320  016700  176472          PIC0:   MOV     XREG,%0
002324  016701  176470                  MOV     YREG,%1
002330  000404                          BR      PB
                                ;DISPLAY VERTICAL LINE
002332  016700  176462          PIC0A:  MOV     YREG,%0
002336  016701  176454                  MOV     XREG,%1
002342  012767  003774  176436  PB:     MOV     #3774,HIGH      ;SET HIGH LIMIT
002350  012767  004000  176426          MOV     #4000,LOW       ;SET LOW LIMIT
002356  000417                          BR      PD
                                ;DISPLAY HORIZONTAL LINE USING INTERRUPT, STORAGE DISPLAY
002360  016700  176432          PIC1:   MOV     XREG,%0
002364  016701  176430                  MOV     YREG,%1
002370  000404                          BR      PC
                                ;DISPLAY VERTICAL LINE
002372  016700  176422          PIC1A:  MOV     YREG,%0
002376  016701  176414                  MOV     XREG,%1
002402  016767  176372  176374  PC:     MOV     LOWLMT,LOW      ;SET LOW LIMIT
002410  016767  176366  176370          MOV     HILMT,HIGH      ;SET HIGH LIMIT
                                ;COMMON SECTION FOR ALL LINES
002416  012767  000140  175352  PD:     MOV     #140,CC         ;SET PRIORITY 3
002424  012777  002474  176370          MOV     #P0RET,@SVEC    ;INITIALIZE INTERRUPT VECTOR
002432  016703  176350                  MOV     HIGH,%3
002436  012702  000004                  MOV     #4,%2           ;INITIALIZE INCREMENTS BETWEEN POINTS
002442  052777  000100  176344          BIS     #100,@SCSR      ;INTERRUPT ENABLE
002450  005011                          CLR     (1)
002452  060210                  PE:     ADD     %2,(0)          ;INCREMENT
002454  005277  176334                  INC     @SCSR           ;INTENSIFY
002460  000001                          WAIT
002462  021003                          CMP     (0),%3          ;DONE ALL POINTS?
002464  001372                          BNE     PE              ;NO
002466  016710  176312                  MOV     LOW,(0)         ;YES RE-INITIALIZE
002472  000770                          BR      PE+2
002474  000002                  P0RET:  RTI
```

```
                                ;PINCUSHION
                                ;PLOT A SQUARE FROM LOWER LEFT TO LOWER RIGHT TO
                                ;UPPER RIGHT TO UPPER LEFT TO LOWER LEFT.
                                ;NON STORE DISPLAY
002476  012767  003774  176302  PIC3:   MOV     #3774,HIGH
002504  012767  174000  176272          MOV     #174000,LOW
002512  000406                         BR      PIC3B
                                ;STORAGE DISPLAY
002514  016767  176260  176262  PIC3A:  MOV     LOWLMT,LOW
002522  016767  176254  176256          MOV     HILMT,HIGH
002530  016701  176262          PIC3B:  MOV     XREG,%1
002534  016702  176260                  MOV     YREG,%2
002540  016703  176250                  MOV     SCSR,%3
002544  012704  000004                  MOV     #4,%4
002550  012767  000340  175220          MOV     #340,CC
002556  016777  176222  176232  P3:     MOV     LOW,@XREG
002564  016777  176214  176226          MOV     LOW,@YREG
                                ;DRAW BOTTOM LINE
002572  016700  176210                  MOV     HIGH,%0
002576  012713  000010                  MOV     #10,(3)         ;ENABLE INTENSIFY ON LOADING X
002602  105713                  P3A:    TSTB    (3)
002604  100376                          BPL     .-2             ;WAIT FOR READY
002606  060411                          ADD     %4,(1)
002610  020011                          CMP     %0,(1)          ;DONE ALL POINTS?
002612  001373                          BNE     P3A             ;NO
                                ;DRAW RIGHT LINE
002614  012713  000020                  MOV     #20,(3)         ;ENABLE INTENSIFY ON LOADING Y
002620  105713                  P3B:    TSTB    (3)
002622  100376                          BPL     .-2             ;WAIT FOR READY
002624  060412                          ADD     %4,(2)
002626  020012                          CMP     %0,(2)          ;DONE ALL POINTS?
002630  001373                          BNE     P3B             ;NO
                                ;DRAW TOP LINE
002632  012713  000010                  MOV     #10,(3)         ;ENABLE INTENSIFY ON LOADING X
002636  016700  176142                  MOV     LOW,%0
002642  105713                  P3C:    TSTB    (3)
002644  100376                          BPL     .-2             ;WAIT FOR READY
002646  160411                          SUB     %4,(1)
002650  020011                          CMP     %0,(1)          ;DONE ALL POINTS?
002652  001373                          BNE     P3C             ;NO
                                ;DRAW LEFT LINE
002654  012713  000020                  MOV     #20,(3)         ;ENABLE INTENSIFY LOADING Y
002660  105713                  P3D:    TSTB    (3)
002662  100376                          BPL     .-2             ;WAIT FOR READY
002664  160412                          SUB     %4,(2)
002666  020012                          CMP     %0,(2)          ;DONE ALL POINTS?
002670  001373                          BNE     P3D             ;NO
002672  000731                          BR      P3
```

```
                                        ;PLOT AN X WITH NON STORE DISPLAY
002674  012767  004000  176102  PIC4:   MOV     #4000,LOW
002702  012767  003774  176076          MOV     #3774,HIGH
002710  000406                          BR      PIC4B
                                        ;PLOT AN X WITH STORAGE DISPLAY
002712  016767  176062  176064  PIC4A:  MOV     LOWLMT,LOW
002720  016767  176056  176060          MOV     HILMT,HIGH
002726  016701  176064          PIC4B:  MOV     XREG,%1
002732  016702  176062                  MOV     YREG,%2
002736  016703  176052                  MOV     SCSR,%3
002742  016700  176040                  MOV     HIGH,%0
002746  012704  000004                  MOV     #4,%4
002752  016712  176026          P4:     MOV     LOW,(2)
002756  011211                          MOV     (2),(1)

                                        ;PLOT LINE BEGINNING IN LOWER LEFT CORNER
002760  012713  000010                  MOV     #10,(3)         ;ENABLE INTENSIFY ON LOADING X
002764  105713          P4A:    TSTB    (3)
002766  100376                  BPL     .-2
002770  060412                  ADD     %4,(2)          ;+4 TO Y
002772  060411                  ADD     %4,(1)          ;+4 TO X
002774  021100                  CMP     (1),%0          ;DONE?
002776  001372                  BNE     P4A             ;NO
                                        ;PLOT LINE BEGINNING IN UPPER LEFT CORNER
003000  016712  176002                  MOV     HIGH,(2)
003004  016711  175774                  MOV     LOW,(1)
003010  105713          P4B:    TSTB    (3)
003012  100376                  BPL     .-2
003014  160412                  SUB     %4,(2)          ;-4 TO Y
003016  060411                  ADD     %4,(1)          ;+4 TO X
003020  021100                  CMP     (1),%0          ;DONE?
003022  001372                  BNE     P4B             ;NO
003024  000752                  BR      P4
```

STORAGE DISPLAY

	ADDRESS	TEST
4,2,8	234	DISPLAY HORIZONTAL LINE
4,2,9	240	DISPLAY VERTICAL LINE
4,2,10	244	DISPLAY SQUARE
4,2,11	250	DISPLAY X
4,2,12	254	DISPLAY ALPHA-NUMERIC CHARACTER SET
4,2,13	260	PHOSPHOR AND ERASE TEST (1ST QUADRANT)
4,2,14	264	PHOSPHOR AND ERASE TEST (3RD QUADRANT)

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 AND STATUS REGISTER TEST

1. LOAD ADDRESS 200.
2. PRESS "START",
   PROGRAM WILL RING BELL AFTER EACH 100 PASSES THRU TEST.

5,2 NON-STORE DISPLAY TESTS

1. LOAD APPROPRIATE STARTING ADDRESS (204,210,214,220,224 OR 230).
2. PRESS "START",
   PROGRAM WILL DISPLAY SELECTED TEST ON SCOPE.

5,3 STORAGE DISPLAY TESTS

1. DETERMINE IF SCOPE IS SET UP FOR + DAC VALUES (1ST QUADRANT)
   OR - DAC VALUES (3RD QUADRANT). IF IT IS SET FOR + VALUES
   NO PROGRAM MODIFICATIONS ARE NECESSARY; GO TO STEP 3.
2. IF THE SCOPE IS SET FOR - DAC VALUES TWO ADDRESSES IN
   MEMORY MUST BE MODIFIED:

ADDRESS	CHANGED FROM	NEW VALUE
1000	000000	174000
1002	003774	177774

3. LOAD APPROPRIATE STARTING ADDRESS (234,240,244,250 OR 254)
4. PRESS "START",
   PROGRAM WILL DISPLAY SELECTED TEST ON SCOPE.

```
                                ;TEST STORAGE SCOPE ERASE (BIT 1)
                                ;PLOT EVERY 2ND POINT ON FACE OF SCOPE IN STORE MODE
                                ;THEN HALT.
                                ;PRESS CONTINUE TO TEST ERASE.
003274  012704  003776          ERASE:  MOV     #3776,%4        ;1ST QUAD
003300  012703  000002                  MOV     #2,%3
003304  000404                          BR      E0
003306  012704  004000          ERASE1: MOV     #4000,%4        ;3RD QUAD
003312  012703  177776                  MOV     #-2,%3
                                ;TEST READY AND INTENSIFY WITH STORE MODE
003316  012777  000004  175470  E0:     MOV     #4,@SCSR        ;SET STORE MODE
003324  005277  175464                  INC     @SCSR           ;INTENSIFY
003330  105777  175460                  TSTB    @SCSR           ;DID READY CLEAR
003334  100002                          BPL     E0A             ;YES
003336  000000                          HALT                    ;ERROR, READY DIDN'T CLEAR
003340  000766                          BR      E0
003342  012700  177600          E0A:    MOV     #-200,%0
003346  005200                          INC     %0
003350  001376                          BNE     .-2             ;DELAY
003352  105777  175436                  TSTB    @SCSR           ;IS READY SET
003356  100402                          BMI     E0B
003360  000000                          HALT                    ;ERROR, READY FAILED TO SET
003362  000767                          BR      E0A
003364  052777  000002  175422  E0B:    BIS     #2,@SCSR        ;TEST ERASE
003372  105777  175416                  TSTB    @SCSR
003376  100002                          BPL     E0C             ;DID READY CLEAR?
003400  000000                          HALT                    ;ERROR, READY NOT CLEARED BY ERASE
003402  000745                          BR      E0
003404  105777  175404          E0C:    TSTB    @SCSR
003410  100375                          BPL     .-4             ;WAIT FOR READY
003412  016700  175400          ERASE2: MOV     XREG,%0         ;MOVE ALL PRINCIPAL VALUES TO REGISTERS FOR SPEED
003416  016701  175376                  MOV     YREG,%1
003422  016702  175366                  MOV     SCSR,%2
003426  012712  000004                  MOV     #4,(2)          ;ENABLE STORE
003432  010411                          MOV     %4,(1)          ;3776 TO YREG
003434  010410                  E1:     MOV     %4,(0)          ;3776 TO XREG
003436  005212                  E2:     INC     (2)             ;INTENSIFY
003440  105712                          TSTB    (2)
003442  100376                          BPL     .-2             ;WAIT FOR READY
003444  160310                          SUB     %3,(0)          ;-2 FROM XREG
003446  001373                          BNE     E2              ;DO AGAIN IF XREG NOT EQUAL TO 0
003450  160311                          SUB     %3,(1)          ;-2 FROM YREG
003452  001370                          BNE     E1              ;DO AGAIN IF YREG NOT EQUAL TO 0.
003454  000000                          HALT                    ;STOP SO THAT OPERATOR MAY INSPECT PHOSPHOR
003456  000717                          BR      E0              ;DO AGAIN
```

```
                                        ;DRAW LOW AND HIGH INTENSITY
003026  012706  000776          PIC5:   MOV     #STACK,%6
003032  016705  175756                  MOV     SCSR,%5
003036  012704  000022                  MOV     #SCALE2,%4
003042  005077  175746                  CLR     @SCSR
003046  012767  176400  000650          MOV     #176400,XPOS
003054  012767  000000  000640          MOV     #0,YPOS
003062  012767  000015  000116          MOV     #13.,P5CNT
003070  012767  003212  000112          MOV     #LOWINT,P5PNT
003076  017702  000106          PIC5A:  MOV     @P5PNT,%2
003102  004767  000510                  JSR     %7,CHAR
003106  062767  000002  000074          ADD     #2,P5PNT
003114  005367  000066                  DEC     P5CNT
003120  001366                          BNE     PIC5A
003122  012777  000004  175664          MOV     #4,@SCSR
003130  012767  176400  000566          MOV     #176400,XPOS
003136  012767  177000  000556          MOV     #177000,YPOS
003144  012767  000014  000034          MOV     #12.,P5CNT
003152  012767  003244  000030          MOV     #HINT,P5PNT
003160  017702  000024          PIC5B:  MOV     @P5PNT,%2
003164  004767  000426                  JSR     %7,CHAR
003170  062767  000002  000012          ADD     #2,P5PNT
003176  005367  000004                  DEC     P5CNT
003202  001366                          BNE     PIC5B
003204  000710                          BR      PIC5
003206  000000          P5CNT:  0
003210  000000          P5PNT:  0
003212  004021          LOWINT: L
003214  004040                  O
003216  004110                  W
003220  004216                  SPACE
003222  004002                  I
003224  004033                  N
003226  004071                  T
003230  003756                  E
003232  004033                  N
003234  004064                  S
003236  004002                  I
003240  004071                  T
003242  004122                  Y

003244  003775          HINT:   H
003246  004002                  I
003250  004216                  SPACE
003252  004002                  I
003254  004033                  N
003256  004071                  T
003260  003756                  E
003262  004033                  N
003264  004064                  S
003266  004002                  I
003270  004071                  T
003272  004122                  Y
```

```
                                ;PLOT NON STORE CHARACTER SET
003460  012767  174000  000236  PIC6:   MOV     #174000,XPOS
003466  012767  000000  000226          MOV     #0,YPOS
003474  012704  000022                  MOV     #SCALE2,%4
003500  012706  000776                  MOV     #STACK,%6
003504  052777  000004  175302          BIS     #4,@SCSR        ;INTENSITY HIC
003512  004767  000046                  JSR     %7,PIC6B
003516  000760                          BR      PIC6
                                ;PLOT STORAGE DISPLAY CHARACTER SET
003520  016767  175254  000176  PIC6A:  MOV     LOWLMT,XPOS
003526  016767  175246  000166          MOV     LOWLMT,YPOS
003534  062767  002000  000160          ADD     #2000,YPOS
003542  012704  000011                  MOV     #SCALE1,%4
003546  012706  000776                  MOV     #STACK,%6
003552  005077  175236                  CLR     @SCSR
003556  004767  000002                  JSR     %7,PIC6B
003562  000756                          BR      PIC6A
003564  012767  177734  000134  PIC6B:  MOV     #-36.,CHRCOL    ;CHARACTERS PER ROW
003572  016705  175216                  MOV     SCSR,%5
003576  012702  003732                  MOV     #A,%2
003602  004767  000010          GEN1:   JSR     %7,CHAR
003606  005267  000114                  INC     CHRCOL          ;
003612  001373                          BNE     GEN1
003614  000207                          RTS     %7

                                ;PLOT CHARACTER
003616  016767  000100  000104  CHAR:   MOV     YPOS,YPT
003624  052715  000020                  BIS     #20,(5)         ;ENABLE INTENSIFY ON LOADING Y
003630  012700  177773                  MOV     #-5,%0          ;INITIALIZE COLUMN COUNT
003634  012701  177771          CHAR1:  MOV     #-7,%1          ;INITIALIZE ROW COUNT
003640  112203                          MOVB    (2)+,%3         ;PUT CHARACTER POINTS IN %3
003642  106103                  CHAR2:  ROLB    %3
003644  100010                          BPL     CHAR3           ;NO
003646  105715                          TSTB    (5)
003650  100376                          BPL     .-2
003652  016777  000046  175136          MOV     XPOS,@XREG
003660  016777  000036  175132          MOV     YPOS,@YREG
003666  060467  000030          CHAR3:  ADD     %4,YPOS
003672  005201                          INC     %1              ;+1 TO ROW
003674  001362                          BNE     CHAR2           ;FINISH ROW
003676  016767  000026  000016          MOV     YPT,YPOS        ;REINITIALIZE ROW FOR NEXT COLUMN
003704  060467  000014                  ADD     %4,XPOS
003710  005200                          INC     %0              ;+1 TO COLUMN COUNT
003712  001350                          BNE     CHAR1
003714  060467  000004                  ADD     %4,XPOS
003720  000207                          RTS     %7              ;EXIT

003722  000000          YPOS:   0               ;CONTAINS Y POSITION AT ANY GIVEN TIME
003724  000000          XPOS:   0               ;CONTAINS X POSITION AT ANY GIVEN TIME
003726  000000          CHRCOL: 0
003730  000000          YPT:    0
```

```
003732  176             A:      .BYTE 176,21,21,21,176
003733  021
003734  021
003735  021
003736  176
003737  177             B:      .BYTE 177,111,111,111,66
003740  111
003741  111
003742  111
003743  066
003744  076             C:      .BYTE 76,101,101,101,42
003745  101
003746  101
003747  101
003750  042
003751  177             D:      .BYTE 177,101,101,101,76
003752  101
003753  101
003754  101
003755  076
003756  177             E:      .BYTE 177,111,111,111,101
003757  111
003760  111
003761  111
003762  101
003763  177             F:      .BYTE 177,11,11,11,1
003764  011
003765  011
003766  011
003767  001
003770  076             G:      .BYTE 76,101,121,121,62
003771  101
003772  121
003773  121
003774  062
003775  177             H:      .BYTE 177,10,10,10,177
003776  010
003777  010
004000  010
004001  177
004002  000             I:      .BYTE 0,101,177,101,0
004003  101
004004  177
004005  101
004006  000
004007  060             J:      .BYTE 60,100,100,100,77
004010  100
004011  100
004012  100
004013  077
004014  177             K:      .BYTE 177,10,24,42,101
004015  010
004016  024
004017  042
```

```
004020      101
004021      177                 L:      .BYTE 177,100,100,100,100
004022      100
004023      100
004024      100
004025      100
004026      177                 M:      .BYTE 177,4,10,4,177
004027      004
004030      010
004031      004
004032      177
004033      177                 N:      .BYTE 177,4,10,20,177
004034      004
004035      010
004036      020
004037      177
004040      076                 O:      .BYTE 76,101,101,101,76
004041      101
004042      101
004043      101
004044      076
004045      177                 P:      .BYTE 177,11,11,11,6
004046      011
004047      011
004050      011
004051      006
004052      076                 Q:      .BYTE 76,101,121,141,176
004053      101
004054      121
004055      141
004056      176
004057      177                 R:      .BYTE 177,11,31,51,106
004060      011
004061      031
004062      051
004063      106
004064      046                 S:      .BYTE 46,111,111,111,62
004065      111
004066      111
004067      111
004070      062
004071      001                 T:      .BYTE 1,1,177,1,1
004072      001
004073      177
004074      001
004075      001
004076      077                 U:      .BYTE 77,100,100,100,77
004077      100
004100      100
004101      100
004102      077
004103      037                 V:      .BYTE 37,40,100,40,37
004104      040
004105      100
004106      040
```

```
004107      037
004110      177                 W:      ,BYTE 177,20,10,20,177
004111      020
004112      010
004113      020
004114      177
004115      143                 X:      ,BYTE 143,24,10,24,143
004116      024
004117      010
004120      024
004121      143
004122      003                 Y:      ,BYTE 3,4,170,4,3
004123      004
004124      170
004125      004
004126      003
004127      141                 Z:      ,BYTE 141,121,111,105,103
004130      121
004131      111
004132      105
004133      103
004134      000                 N1:     ,BYTE 0,102,177,100,0
004135      102
004136      177
004137      100
004140      000
004141      142                 N2:     ,BYTE 142,121,111,105,102
004142      121
004143      111
004144      105
004145      102
004146      042                 N3:     ,BYTE 42,101,111,111,66
004147      101
004150      111
004151      111
004152      066
004153      030                 N4:     ,BYTE 30,24,22,177,20
004154      024
004155      022
004156      177
004157      020
004160      047                 N5:     ,BYTE 47,105,105,105,71
004161      105
004162      105
004163      105
004164      071
004165      076                 N6:     ,BYTE 76,111,111,111,62
004166      111
004167      111
004170      111
004171      062
004172      101                 N7:     ,BYTE 101,41,21,11,7
004173      041
004174      021
004175      011
```

```
004176      007
004177      066                 N8:     .BYTE 66,111,111,111,66
004200      111
004201      111
004202      111
004203      066
004204      046                 N9:     .BYTE 46,111,111,111,76
004205      111
004206      111
004207      111
004210      076
004211      070                 N0:     .BYTE 76,121,111,105,76
004212      121
004213      111
004214      105
004215      076
004216      000                 SPACE:  .BYTE 0,0,0,0,0
004217      000
004220      000
004221      000
004222      000

            004224                      .EVEN
            000001                      .END
```

A	003732	P	004045	T11E	001650
B	003737	P0RET	002474	T12	001674
BELCNT	001026	P3	002556	T12A	001720
BELL	002300	P3A	002602	T13	001744
C	003744	P3B	002620	T13A	001756
CC	177776	P3C	002642	T13B	002002
CHAR	003616	P3D	002660	T14	002020
CHAR1	003634	P4	002752	T14A	002032
CHAR2	003642	P4A	002764	T14B	002056
CHAR3	003666	P4B	003010	T15	002074
CHRCOL	003726	P5CNT	003206	T16	002122
CSRTST	001030	P5PNT	003210	T16A	002146
D	003751	PB	002342	T16B	002176
E	003756	PC	002402	T17	002210
E0	003316	PD	002416	T17A	002260
E0A	003342	PE	002452	T18	002264
E0B	003364	PIC0	002320	T2	001100
E0C	003404	PIC0A	002332	T3	001124
E1	003434	PIC1	002360	T4	001150
E2	003436	PIC1A	002372	T4A	001156
ERASE	003274	PIC3	002476	T4B	001176
ERASE1	003306	PIC3A	002514	T5	001204
ERASE2	003412	PIC3B	002530	T5A	001212
F	003763	PIC4	002674	T5B	001232
G	003770	PIC4A	002712	T6	001240
GEN1	003602	PIC4B	002726	T6A	001252
H	003775	PIC5	003026	T6B	001272
HIGH	001006	PIC5A	003076	T7	001302
HILMT	001002	PIC5B	003160	T7A	001314
HINT	003244	PIC6	003460	T7B	001334
I	004002	PIC6A	003520	T8	001344
J	004007	PIC6B	003564	T9	001364
K	004014	Q	004052	T9A	001410
L	004021	R	004057	TCSR	001010
LOW	001004	S	004064	TDBR	001012
LOWINT	003212	SCALE1	000011	U	004076
LOWLMT	001000	SCALE2	000022	V	004103
LPVEC	001024	SCSR	001014	W	004110
M	004026	SPACE	004216	X	004115
N	004033	SREG	177570	XPOS	003724
N0	004211	STACK	000776	XREG	001016
N1	004134	SVEC	001022	Y	004122
N2	004141	T	004071	YPOS	003722
N3	004146	T0	001044	YPT	003730
N4	004153	T1	001062	YREG	001020
N5	004160	T10	001434	Z	004127
N6	004165	T10A	001460		
N7	004172	T11	001504		
N8	004177	T11A	001530		
N9	004204	T11B	001554		
NOP	000240	T11C	001600		
O	004040	T11D	001624		