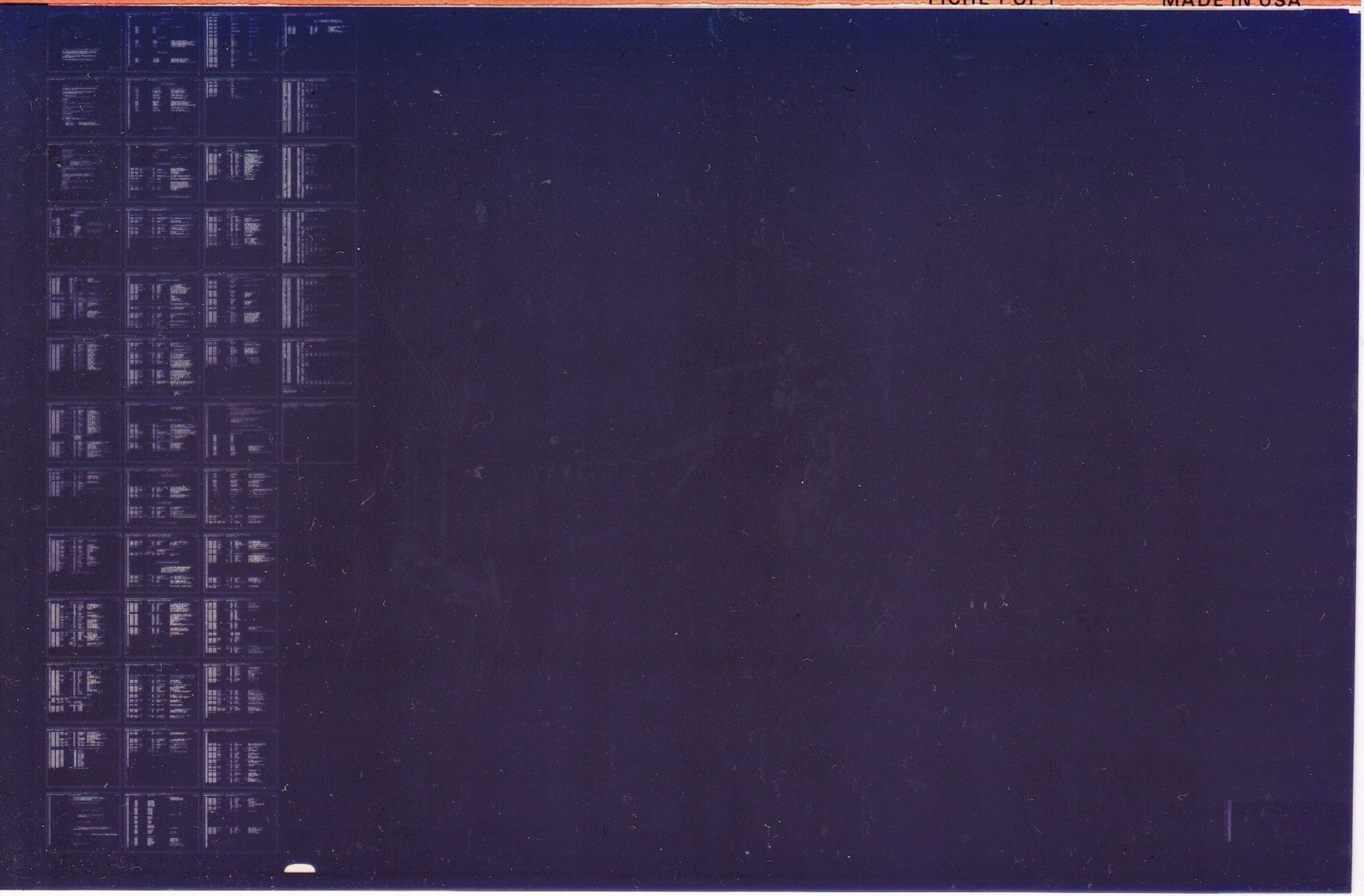
GT40,VT11

GT40 ROM VERIFY
CDGTDD0

AH-7926D-MC

FICHE 1 OF 1

JAN 1980
digital
MADE IN USA



.TITLE GT40 ROM BOOTSTRAP TEST MAINDEC-11-DGTD-C

.REM

IDENTIFICATION

PRODUCT CODE: AC-7924D-MC

PRODUCT NAME: CDGTDDO GT40 ROM VERIFY

DATE: AUG. 1979

MAINTAINER: DIAGNOSTIC GROUP

1. ABSTRACT

THIS VERSION OF THE PROGRAM SUPPORTS NON-SWITCH REGISTER CPU'S.
FOR THESE CPU'S, THE SWITCH REGISTER CAN BE CHANGED BY CHANGING
THE CONTENTS OF SWREG (170).

THE CDGTD DIAGNOSTIC PROGRAM IS WRITTEN TO BE USED AS AN AID
TO HARDWARE DEBUGGING AND MAINTENANCE OF THE GT40 ROM
BOOTSTRAP LOADER VERSION 1, 2 OR 3.

THE AVAILABLE TESTS ARE
PRG0 - LOGIC TESTS
PRG1 - ROM DATA DUMP TO THE CONSOLE TELETYPE

2. REQUIREMENTS

2.1 EQUIPMENT

GT40 DISPLAY PROCESSOR WITH ROM BOOTSTRAP VERSION 1, 2 OR 3.

2.2 STORAGE

THIS PROGRAM USES MEMORY LOCATIONS 0-7776 + 16000-16776(8).

3. LOADING PROCEDURE

PROCEDURE FOR A NORMAL BINARY TAPE SHOULD BE FOLLOWED.

4. STARTING PROCEDURE

4.1 STARTING ADDRESSES

0200 PROGRAM 0, ROM LOGIC TEST.
0204 PROGRAM 1, ROM DATA DUMP ON CONSOLE TTY.

4.2 SWITCH SETTINGS

CONSOLE SW 11-0	NORMAL RUN (64. INTERATIONS/TEST)
CONSOLE SW 11 1	SUPPRES SUBPROGRAM INTERATIONS
CONSOLE SW 08 0	TEST AS VERSION 2 OR 3 ROM (512. WORDS)
CONSOLE SW 08 1	TEST AS VERSION 1 ROM (256. WORDS)

5. PROGRAM DESCRIPTIONS

5.1 PRG0 - LOGIC TESTS

THE LOGIC TESTS CONSIST OF 4 ROUTINES TO TEST THE GT40 ROM BOOTSTRAP LOGIC

5.1.1 ROUTINE DESCRIPTIONS

ROUTINE	TESTS
T1	ADDRESSABILITY OF GT40 ROM BOOTSTRAP
T2	DATA RELIABILITY
T3	THAT GT40 ROM BOOTSTRAP TIMES OUT WHEN REFERENCED BY A DATIP BUS CYCLE
T4	THAT DATA READ FROM THE ROM IS CORRECT

5.2 PRG1 - ROM DATA DUMP

THIS PROGRAM TYPES OUT THE 512./256. WORDS OF ROM DATA ON THE CONSOLE TELETYPE AND HALTS.

6. ERRORS

THE PROGRAM WILL ONLY HALT ON ERROR. THE PROGRAM DOES NOT CONTAIN FACILITIES FOR REPORTING ERROR CONDITIONS.
TO PLACE THE PROGRAM INTO A SCOPE LOOP, REPLACE THE ERROR HALT WITH A NOP.

7. EXECUTION TIME

PRG0 TAKES APPROX. 5 SECONDS PER PASS.
PROG1 N/A
PROG2 N/A

8. XXDP/ACT/APT

THE PROGRAM IS CHAINABLE UNDER XXDP OR ACT BUT WILL NOT SCRIPT UNDER APT.

```
                                        .LIST ME,BIN,SEQ,LD
                                        .ENABL  ABS,AMA

                                ;LOAD ADDRESS=0200
                                ;DEPRESS START
                                ;STACK POINTER IS AT 500

        000000                          .LIST
        000034                          .-34
000034  002140                          SCOPEC
000036  000000                          0
        000046                          .-46
000046  001600                          LOGICAL                 ;END ADDRESS FOR ACT/XXDP
        000052                          .=52
000052  000000                          0                       ;NO MANUAL INTERVENTION REQUIRED
                                ;EQUATE STATEMENTS
        104400                          SCOPE=TRAP
        177564                          TPCSR=177564
        177566                          TPDBR=177566
        177776                          PSW=177776
        177570                          DSWR=177570             ;ADDRESS OF SWITCH REGISTER
        000004                          ERRVEC=4
        000500                          STKPTR=500              ;INITIAL STACK SETTING
        000170                          .=170
000170  000000                  SWREG:  .WORD 0
000172  177570                  SWR:    DSWR
        000200                          .=200
000200  000137  001040                  JMP     PRMTRS
000204  000137  001614                  JMP     PRG1
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```
                        001000                          .=1000
001000  166000                    ROMADD: 166000                  ;ROM ADDRESS
001002  001000                    WORDS:  512.    ;256.           ;ROM LENGTH
001004  006000                    IMAGE:  START   ;STARTA         ;ROM IMAGE
001006  172002                    DSR:    172002                  ;DISPLAY STATUS REGISTER
001010  000000                    R0SAV:  0                       ;CONTENTS OF REGISTERS
001012  000000                    R1SAV:  0
001014  000000                    R2SAV:  0
001016  000000                    R3SAV:  0
001020  000000                    R4SAV:  0
001022  000000                    R5SAV:  0
001024  000010                    FILLER: 10                      ;# OF FILLER CHAR
001026  000010                    FILCNT: 10
001030  000000                    ICNT:   0
001032  000000                    DUMP:   0
001034  000000                    CHARA:  0
001036  000000                    TERM:   0
001040  012706  000500            PRMTRS: MOV     #STKPTR,%6      ;SET STACK PTR
001044  004737  002424                    JSR     PC,SWITCH       ;CHECK ROM VERSION

                                ;PROGRAM 0 LOGIC TESTS

001050  005037  001030            PRG0:   CLR     ICNT            ;CLEAR PASS COUNT
001054  012706  000500            PRG0R:  MOV     #STKPTR,%6
001060  012737  001054  002214            MOV     #PRG0R,RETURN   ;SET RETURN ADDRESS FOR SCOPE

                                ;TEST1 TEST ABILITY TO REFERENCE ROM WITHOUT TIMING OUT

001066  013700  001000            T1:     MOV     ROMADD,%0       ;GET ROM ADDRESS
001072  013701  001002                    MOV     WORDS,%1        ;GET ADDRESS COUNTER
001076  012737  001136  000004            MOV     #ERROR1,4       ;SET UP TIME OUT VECTOR
001104  011003                    T1A:    MOV     (0),%3          ;REFERENCE
001106  005720                            TST     (0)+            ;ROM
001110  064037  001032                    ADD     -(0),DUMP       ;
001114  021010                            CMP     (0),(0)         ;
001116  132020                            BITB    (0)+,(0)+       ;
001120  164037  001032                    SUB     -(0),DUMP
001124  062700  000002                    ADD     #2,%0           ;INCREMENT POINTER
001130  005301                            DEC     %1              ;DECREMENT ADDRESS COUNTER
001132  001364                            BNE     T1A             ;BRANCH IF NOT FINISHED
001134  000405                            BR      T1B             ;GO TO SCOPE LOOP
001136  022626                    ERROR1: CMP     (6)+,(6)+       ;REPOSITION STACK
001140  004737  002372                    JSR     PC,SAVE05       ;SAVE R0-R5
001144  000000                            HALT                    ;ERROR, TIME-OUT  ON ROM ADDRESS
001146  000756                            BR      T1A             ;LOOP ON ERROR
001150  104400                    T1B:    SCOPE
```

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241
242                                     ;TEST2  TEST THAT ROM DATA CAN BE READ RELIABLY.
243
244  001152  013700  001000          T2:     MOV     ROMADD,%0       ;GET ROM ADDRESS
245  001156  013701  001002                  MOV     WORDS,%1        ;GET ADDRESS COUNTER
246  001162  012737  000006  000004          MOV     #6,4            ;INITIALIZE TIME OUT VECTOR
247  001170  005037  001032          T2A:    CLR     DUMP            ;INITIALIZE DUMP
248  001174  011003                          MOV     (0),%3          ;GET DATA
249  001176  062037  001032                  ADD     (0)+,DUMP       ;ADD DATA TO DUMP
250  001202  163703  001032                  SUB     DUMP,%3         ;SUBTRACT DATA FROM DATA
251  001206  001404                          BEQ     T2B             ;BRANCH IF EQUAL
252  001210  004737  002372          ERROR2: JSR     PC,SAVE05       ;SAVE R0-R5
253  001214  000000                          HALT                    ;DATA ERROR
254  001216  000764                          BR      T2A             ;LOOP ON ERROR
255  001220  044037  001032          T2B:    BIC     -(0),DUMP       ;CLEAR DUMP BITS
256  001224  001404                          BEQ     T2C             ;BRANCH IF EQUAL TO 0
257  001226  004737  002372                  JSR     PC,SAVE05       ;SAVE R0-R5
258  001232  000000                          HALT                    ;DATA ERROR
259  001234  000771                          BR      T2B             ;LOOP ON ERROR
260  001236  021010          T2C:    CMP     (0),(0)         ;COMPARE DATA
261  001240  001404                          BEQ     T2D             ;BRANCH IF EQUAL
262  001242  004737  002372                  JSR     PC,SAVE05       ;SAVE R0-R5
263  001246  000000                          HALT                    ;DATA ERROR
264  001250  000772                          BR      T2C             ;LOOP ON ERROR
265  001252  122040          T2D:    CMPB    (0)+,-(0)       ;COMPARE DATA (BYTE OPERATION)
266  001254  001404                          BEQ     T2E             ;BRANCH IF EQUAL
267  001256  004737  002372                  JSR     PC,SAVE05       ;SAVE R0-R5
268  001262  000000                          HALT                    ;DATA ERROR
269  001264  000772                          BR      T2D             ;LOOP ON ERROR
270  001266  005720          T2E:    TST     (0)+            ;INCREMENT ADDRESS POINTER
271  001270  005301                          DEC     %1              ;DECREMENT ADDRESS COUNTER
272  001272  001336                          BNE     T2A             ;RETURN IF NOT DONE
273  001274  104400                          SCOPE
274
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                                        ;TEST3 TEST THAT ROM TIMES OUT IF REFERENCED BY OTHER
                                        ;THAN DATI BUS CYCLE

001276  012706  000500          T3:     MOV     #STKPTR,%6      ;SET STACK PTR
001302  013700  001000                  MOV     ROMADD,%0       ;GET ROM ADDRESS
001306  013701  001002                  MOV     WORDS,%1        ;GET ADDRESS COUNTER
001312  012737  001332  000004  T3AA:   MOV     #T3B,4          ;SET UP TIME OUT VECTOR
001320  010010              T3A:    MOV     %0,(0)          ;ATTEMPT TO ALTER DATA
001322  004737  002372              JSR     PC,SAVE05       ;SAVE R0-R5
001326  000000                      HALT                    ;HERE IF DID NOT TIME OUT
001330  000773                      BR      T3A             ;LOOP ON ERROR
001332  012737  001354  000004  T3B:    MOV     #T3D,4          ;SET UP TIME OUT VECTOR
001340  022626                      CMP     (6)+,(6)+       ;REPOSITION STACK
001342  005210              T3C:    INC     (0)             ;ATTEMPT TO ALTER DATA
001344  004737  002372              JSR     PC,SAVE05       ;SAVE R0-R5
001350  000000                      HALT                    ;HERE IF DID NOT TIME OUT
001352  000773                      BR      T3C             ;LOOP ON ERROR
001354  012737  001400  000004  T3D:    MOV     #T3F,4          ;SET UP TIME OUT VECTOR
001362  022626                      CMP     (6)+,(6)+       ;REPOSITION STACK
001364  005077  177410          T3E:    CLR     @ROMADD         ;ATTEMPT TO ALTER DATA
001370  004737  002372              JSR     PC,SAVE05       ;SAVE R0-R5
001374  000000                      HALT                    ;HERE IF DID NOT TIME OUT
001376  000772                      BR      T3E             ;LOOP ON ERROR
001400  005720              T3F:    TST     (0)+            ;INCREMENT ADDRESS POINTER
001402  022626                      CMP     (6)+,(6)+       ;REPOSITION STACK
001404  005301                      DEC     %1              ;DECREMENT ADDRESS COUNTER
001406  001341                      BNE     T3AA            ;RETURN IF NOT DONE
001410  012737  000006  000004      MOV     #6,@#4          ;RESTORE TIME OUT TRAP
001416  104400                      SCOPE                   ;SCOPE LOOP

                                        ;COMPARE THE ROM DATA TO THE IMAGE DATA
                                        ;       R0-WORD NUMBER
                                        ;       R1-GOOD ADDRESS
                                        ;       R2-GOOD DATA
                                        ;       R3=BAD ADDRESS
                                        ;       R4=BAD  DATA

001420  012700  000000          T4:     MOV     #0,%0           ;SET UP INITIAL WORD COUNT
001424  013701  001004                  MOV     IMAGE,%1        ;SET UP STARTING ADDRESS OF ROM IMAGE
001430  013703  001000                  MOV     ROMADD,%3       ;SET UP STARTING ROM ADDRESS
001434  011102              T4A:    MOV     (%1),%2         ;READ EXPECTED VALUE
001436  011304                      MOV     (%3),%4         ;READ ROM VALUE
001440  020204                      CMP     %2,%4           ;COMPARE EXPECTED TO THE VALUE READ
001442  001422                      BEQ     T4E             ;BRANCH IF CORRECT
001444  012705  002536              MOV     #TABLE0,%5      ;LOAD PATCH POINTER
001450  020015              T4B:    CMP     %0,(%5)         ;TEST IF PATCHED LOCATION
001452  001406                      BEQ     T4C             ;BR IF IT IS
001454  020527  002652              CMP     %5,#TABLEX      ;TEST IF END OF PATCH TABLE
001460  001407                      BEQ     T4D             ;BR IF END OF TABLE * MUST BE A BAD ROM  WORD
001462  062705  000004              ADD     #4,%5           ;ADJUST PATCH POINTER
001466  000770                      BR      T4B             ;TRY AGAIN
001470  005725              T4C:    TST     (%5)+           ;POINT TO PATCH WORD VALUE
001472  011502                      MOV     (%5),%2         ;GET PATCHED WORD VALUE
001474  020204                      CMP     %2,%4           ;COMPARE EXPECTED TO VALUE READ
001476  001404                      BEQ     T4E             ;BR IF CORRECT
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                                                ;SAVE CONTENTS OF R0 - R5
                                                ;ERROR, ROM VALUE FAILED TO EQUAL EXPECTED
                                                ;INCREMENT ADDRESSES POINTERS
                                                ;INCREMENT WORD COUNT
                                                ;COMPARE IF END WORD
                                                ;BRANCH IF NOT LAST WORD

                                                ;INCREMENT PASS COUNT
                                                ;RING THE GT40 BELL
                                                ;RING THE TELETYPE BELL

                                                ;RETURN TO XXDP/ACT MONITOR?

                                                ;RETURN.
```

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                                ;THIS PROGRAM TYPES OUT ROM DATA
                                
001614  012706  000500          PRG1:   MOV     #STKPTR,%6      ;INITIALIZE STACK
001620  012737  000006  000004          MOV     #6,@#4          ;SET UP BUSS ERROR
001626  004737  002424                  JSR     PC,SWITCH
001632  004537  001776                  JSR     5,TYPEM
001636  002361                          M8
001640  004537  001776                  JSR     5,TYPEM         ;TYPE MESSAGE
001644  002336                          M7                      ;'ROM DATA'
001646  013701  001002                  MOV     WORDS,%1        ;GET # OF WORDS
001652  013700  001000          PRG1A:  MOV     ROMADD,%0       ;GET STARTING ADDRESS
001656  012702  000010                  MOV     #10,%2          ;GET ADDRESS INDICATOR
001662  105737  177564                  TSTB    TPCSR           ;WAIT FOR
001666  100375                          BPL     .-4             ;TELEPRINTER FLAG
001670  010037  002230          PRG1B:  MOV     %0,D2BTYP       ;GET ADDRESS
001674  004737  002232                  JSR     7,02A           ;AND TYPE IT
001700  004537  001776                  JSR     5,TYPEM         ;TYPE
001704  002365                          M9                      ;CR/LF
001706  012037  002230          PRG1C:  MOV     (0)+,D2BTYP     ;TYPE
001712  004737  002232                  JSR     7,02A           ;DATA
001716  105737  177564                  TSTB    TPCSR           ;WAIT FOR
001722  100375                          BPL     .-4             ;TELEPRINTER FLAG
001724  012737  000040  177566          MOV     #' ,TPDBR       ;TYPE SPACE
001732  005301                          DEC     %1              ;ALL DATA TYPED
001734  001410                          BEQ     PRG1D           ;GO TO FINISH
001736  005302                          DEC     %2
001740  001362                          BNE     PRG1C           ;RETURN TO PRG1B
001742  012702  000010                  MOV     #10,%2          ;GET ADDRESS INDICATOR
001746  004537  001776                  JSR     5,TYPEM         ;TYPE
001752  002361                          M8                      ;CR/LF
001754  000745                          BR      PRG1B           ;RETURN TO PRG1B
001756  004537  001776          PRG1D:  JSR     5,TYPEM
001762  002361                          M8
001764  004537  001776                  JSR     5,TYPEM
001770  002361                          M8
001772  000000                          HALT
001774  000707                          BR      PRG1
                                
                                ;ROUTINE TO LOOP ON A SINGLE ADDRESS
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                                        ;ROUTINE TO TYPE A MESSAGE
                                        
001776  010026                  TYPEM:  MOV     %0,(6)+         ;SAVE REGISTER 0
002000  012500                          MOV     (5)+,%0         ;PLACE MESSAGE ADDRESS IN R0
002002  112037  001036                  MOVB    (0)+,TERM       ;GET TERMINATOR CHARACTER
002006  112037  001034          TYPEMA: MOVB    (0)+,CHARA      ;GET NEXT CHARACTER
002012  123737  001034  001036          CMPB    CHARA,TERM      ;WAS NEXT CHARACTER THE TERM
002020  001005                          BNE     TYPEMB          ;CHARACTER
002022  014600                          MOV     -(6),%0         ;RESTORE R0
002024  105737  177564                  TSTB    TPCSR
002030  100375                          BPL     .-4
002032  000205                          RTS     5               ;AND EXIT
002034  123727  001034  000045  TYPEMB: CMPB    CHARA,#'%       ;WAS CHARACTER %
002042  001027                          BNE     TYPEMC
002044  105737  177564                  TSTB    TPCSR           ;TEST TELEPRINTER FLAG
002050  100375                          BPL     .-4             ;AND WAIT FOR DONE
002052  012737  000215  177566          MOV     #215,TPDBR      ;LOAD TELEPRINTER WITH CAR. RET
002060  013737  001024  001026          MOV     FILLER,FILCNT           ;LOAD FILLER COUNT
002066  000403                          BR      1$
002070  012737  000006  177566  2$:     MOV     #6,TPDBR        ;PRINT FILLER CHAR
002076  105737  177564          1$:     TSTB    TPCSR           ;TEST TELEPRINTER FLAG
002102  100375                          BPL     .-4             ;AND WAIT FOR DONE
002104  005337  001026                  DEC     FILCNT          ;FINISHED FILLERS ?
002110  001367                          BNE     2$              ;BR IF NOT
002112  012737  000212  177566          MOV     #212,TPDBR      ;LOAD TELEPRINTER WITH LINE FEED
002120  000732                          BR      TYPEMA          ;GET NEXT CHARACTER
002122  105737  177564          TYPEMC: TSTB    TPCSR           ;TEST TELEPRINTER FLAG
002126  100375                          BPL     .-4             ;AND WAIT FOR DONE
002130  013737  001034  177566          MOV     CHARA,TPDBR     ;LOAD TELEPRINTER BUFFER
002136  000723                          BR      TYPEMA          ;AND GET NEXT CHARACTER
                                        
                                        ;SCOPE ROUTINE. THIS ROUTINE IS ENTERED AT THE END OF EACH SUBTEST.
                                        
002140  032777  040000  176024  SCOPEC: BIT     #40000,@SWR     ;TEST SR FOR SCOPE
002146  001023                          BNE     SCOPEB          ;YES SCOPE
002150  032777  004000  176014          BIT     #4000,@SWR      ;TEST FOR ITERATION
002156  001007                          BNE     SCOPEG          ;INHIBIT ITERATION
002160  023737  002212  002210          CMP     SCOPEF,ICOUNT   ;ITERATION COMPLETE
002166  001403                          BEQ     SCOPEG          ;ITERATION COMPLETE GO TO SCOPEG
002170  005237  002212                  INC     SCOPEF          ;INCREMENT ITERATION COUNT
002174  000410                          BR      SCOPEB          ;GO TO SCOPEB
002176  005037  002212          SCOPEG: CLR     SCOPEF          ;CLEAR ITERATION COUNT
002202  011637  002214                  MOV     @%6,RETURN      ;GET ADDRESS OF NEXT TEST
002206  000002                          RTI                     ;EXIT
002210  000100                  ICOUNT: 100
002212  000000                  SCOPEF: 0                       ;CONTAINS SUBTEST ITERATION COUNT
002214  000000                  RETURN: .WORD   0               ;CONTAINS RETURN PC FOR SCOPE
002216  005726                  SCOPEB: TST     (6)+            ;POP PC
002220  012637  177776                  MOV     (6)+,PSW        ;RESTORE CONDITION CODES
002224  000177  177764                  JMP     @RETURN
```

```
                                ;THIS ROUTINE CONVERTS AN OCTAL NUMBER TO ASCII AND TYPES IT ON THE TTY.

002230  000000                  D2BTYP: 0
002232  013746  177564          O2A:    MOV     TPCSR,-(6)      ;SAVE TPCSR
002236  010246                          MOV     %2,-(6)         ;SAVE R2
002240  010146                          MOV     %1,-(6)         ;SAVE R1
002242  010046                          MOV     %0,-(6)         ;SAVE R0
002244  013700  002230                  MOV     D2BTYP,%0       ;GET DATA TO BE TYPED
002250  012701  000006                  MOV     #6,%1           ;GET COUNTER
002254  005002                          CLR     %2              ;CLEAR WORKING REGISTER
002256  006100                          ROL     %0              ;MOV FIRST BIT (MSB) INTO
002260  006102                          ROL     %2              ;R2
002262  062702  000260          O2AA:   ADD     #260,%2         ;FORM ASCII CODE
002266  105737  177564                  TSTB    TPCSR           ;TEST TELEPRINTER
002272  100375                          BPL     .-4             ;FLAG AND WAIT UNTIL DONE
002274  010237  177566                  MOV     %2,TPDBR        ;LOAD TELEPRINTER BUFFER
002300  005002                          CLR     %2              ;CLEAR WORKING REGISTER
002302  006100                          ROL     %0              ;ROTATE THE
002304  006102                          ROL     %2              ;NEXT
002306  006100                          ROL     %0              ;OCTAL CHARACTER
002310  006102                          ROL     %2              ;INTO
002312  006100                          ROL     %0              ;REGISTER
002314  006102                          ROL     %2              ;TWO
002316  005301                          DEC     %1              ;DECREMENT COUNTER
002320  001360                          BNE     O2AA            ;GO TO O2AA IF NOT 0
002322  012600                          MOV     (6)+,%0         ;FINISHED.  RESTORE REGISTERS
002324  012601                          MOV     (6)+,%1         ;
002326  012602                          MOV     (6)+,%2         ;
002330  012637  177564                  MOV     (6)+,TPCSR      ;AND TPCSR
002334  000207                          RTS     7               ;AND EXIT

                                ;ASCII MESSAGES
002336  022500  052107  032055  M7:     .ASCII  '@%GT-40 ROM DATA%%@'
002344  020060  047522  020115
002352  040504  040524  022445
002360     100
002361     100  022445     100  M8:     .ASCII  '@%%@'
002365     100  020040     100  M9:     .ASCII  '@ @'
        002372                          .EVEN

                                ;SUBROUTINE TO SAVE R0-R5 NEAR LOC. 1000
002372  010037  001010          SAVE05: MOV     R0,R0SAV
002376  010137  001012                  MOV     R1,R1SAV
002402  010237  001014                  MOV     R2,R2SAV
002406  010337  001016                  MOV     R3,R3SAV
002412  010437  001020                  MOV     R4,R4SAV
002416  010537  001022                  MOV     R5,R5SAV
002422  000207                          RTS     PC              ;EXIT
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 503  002424  013746  000004          SWITCH: MOV     @#ERRVEC,-(SP)  ;SAVE VECTORS CONTENTS
 504  002430  012737  002456  000004          MOV     #1$,@#ERRVEC    ;SET UP FOR TRAP
 505  002436  012737  177570  000172          MOV     #DSWR,@#SWR     ;SET UP TO TEST FOR SWITCH REGISTER
 506  002444  022777  177777  175520          CMP     #-1,@SWR        ;TEST FOR SWITCH REGISTER
 507  002452  001005                          BNE     3$              ;SWITCH REGISTER IS PRESENT
 508  002454  000401                          BR      2$              ;NO SWITCH REGISTER
 509  002456  022626                  1$:     CMP     (SP)+,(SP)+     ;POP 2 WORDS OFF STACK
 510  002460  012737  000170  000172  2$:     MOV     #SWREG,@#SWR    ;SET UP FOR SOFTWARE SWITCH REGISTER
 511  002466  012637  000004          3$:     MOV     (SP)+,@#ERRVEC  ;RESTORE VECTORS CONTENTS
 512  002472  032777  000400  175472          BIT     #400,@SWR       ;TEST BIT 8
 513  002500  001007                          BNE     4$              ;BR IF VERSION 1
 514  002502  012737  001000  001002          MOV     #512.,WORDS     ;SET UP VERSION 2 LENGTH
 515  002510  012737  006000  001004          MOV     #START,IMAGE    ;SET UP VERSION 2 STARTING ADD.
 516  002516  000406                          BR      5$
 517  002520  012737  000400  001002  4$:     MOV     #256.,WORDS     ;SET UP VERSION 1 LENGTH
 518  002526  012737  016000  001004          MOV     #STARTA,IMAGE   ;SET UP VERSION 1 STARTING ADD.
 519  002534  000207                  5$:     RTS     PC
 520
 521                                          .SBTTL  ROM VERSION 3 PATCH VALUE FOR VERSION 2
 522
 523  002536  000001  000137          TABLEO: .WORD   1,137
 524  002542  000002  167636                  .WORD   2,167636
 525  002546  000003  000000                  .WORD   3,0
 526  002552  000327  000137                  .WORD   215.,137
 527  002556  000330  167620                  .WORD   216.,167620
 528  002562  000710  105737                  .WORD   456.,105737
 529  002566  000711  175614                  .WORD   457.,175614
 530  002572  000712  100375                  .WORD   458.,100375
 531  002576  000713  112337                  .WORD   459.,112337
 532  002602  000714  175616                  .WORD   460.,175616
 533  002606  000715  000203                  .WORD   461.,203
 534  002612  000716  000000                  .WORD   462.,0
 535  002616  000717  005037                  .WORD   463.,5037
 536  002622  000720  177776                  .WORD   464.,177776
 537  002626  000721  012737                  .WORD   465.,12737
 538  002632  000722  010007                  .WORD   466.,10007
 539  002636  000723  175610                  .WORD   467.,175610
 540  002642  000724  000137                  .WORD   468.,137
 541  002646  000725  166010                  .WORD   469.,166010
 542  002652  000000              TABLEX: 0
 543                                          .SBTTL  ROM VERSION 2 VALUES
```

```
                        ;*************************************************************
                        ;       EXCEPT FOR THE NEW ORGIN ADDRESS AND SEVERAL ''!160000''
                        ;       FOR ADDRESS FUDGING THIS IS AN EXACT COPY OF THE CONTENTS
                        ;       OF THE GT-40 BOOTSTRAP VERSION #2
                        ;*************************************************************


                                .TITLE  SCROLLING ROM BOOTSTRAP FOR THE GT40




                        ;                       BOOTGT.T16      OCT 10, 1973



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                        ;               146 MAIN STREET
                        ;               MAYNARD, MASSACHUSETTS
                        ;                                       01754



                        ;               WRITTEN BY JACK BURNESS.



                        ;               THIS PROGRAM IS THE SECOND VERSION THE THE ROM BOOTSTRAP FOR
                        ;       THE GT40 DISPLAY TERMINAL. IT INCLUDES SCROLLING AND AN END OF
                        ;       MEMORY SEARCH FOR THE LOADER.



                                .ENABL  ABS,AMA                 ;ASSEMBLER DIRECTIVES FOR ABSOLUTE BINARY OUTPUT
                                                                ;  NOTE: USE 'MACDLX'' TO ASSEMBLE THIS PROGRAM.



                                .SBTTL  DEFINITION SECTION
                                .PAGE
```

```
                        ;
                        ;                    REGISTER DEFINITIONS
                        ;                    -------- -----------
                        ;
                        ;
                        ;
                        ;            BASIC DEFINTIONS
                        ;            ----- ----------
                        ;
000000                      R0=%0                       ;DEFINE STANDARD VALUES.
000001                      R1=%1
000002                      R2=%2
000003                      R3=%3
000004                      R4=%4
000005                      R5=%5
000006                      SP=%6
000007                      PC=%7
                        ;
                        ;            GT40 DEFINTIONS
                        ;            ---- ----------
                        ;
000000                      CHAR=R0                     ;CONTAINS THE INPUT CHARACTER.
000001                      POINTR=R1                   ;POINTS TO NEXT INSERTION BYTE IN DISPLAY BUFFER
000002                      TABCNT=R2                   ;CHARACTER COUNTER FOR THE "TAB" FEATURE.
000003                      SCAN=R3                     ;GENERALLY CONTAINS A POINTER WHICH
                                                        ;IS USED WHEN SCANNING MEMORY FOR SOMETHING.
000004                      HOLD=R4                     ;TYPICALLY A TEMPORARY WHICH IS USED TO RETAIN
                                                        ;A VALUE FOR A SHORT TIME
000005                      COUNTR R5                   ;TYPICALLY USED AS A COUNTER.
                        ;
                        ;
                        ;
                        ;
                        ;            LOADER DEFINITIONS
                        ;            ------ ----------
                        ;
                        ;
                        ;
                        ;
000000                      L.BYT=CHAR                  ;CHARACTER INPUT FOR THE LOADER.
000001                      L.ADR=POINTR                ;CURRENT MEMORY ADDRESS TO BE LOADED.
000002                      L.BC=TABCNT                 ;NUMBER OF DATA ITEMS TO LOAD.
000005                      L.CKSM=COUNTR               ;CHECKSUM ON THE INPUT DATA.
000003                      INDEX=SCAN                  ;INDICATES HOW TO ASSEMBLE THE 8 BIT CHARACTER.

                            .PAGE
```

```
                        ;                   MAJOR SYSTEM DEFINITIONS
                        ;                   ----- ------ -----------



        166000                  ORIGIN=166000           ;ORIGIN OF THE BOOTSTRAP.

        175610                  DL11IS=175610           ;INPUT STATUS REGISTER OF DL11
        175612                  DL11IB=DL11IS+2         ;INPUT CHARACTER FROM DL11
        175614                  DL11OS=DL11IB+2         ;OUTPUT STATUS OF THE DL11
        175616                  DL11OB=DL11OS+2         ;OUTPUT CHARACTER TO THE DL11

        177560                  KBDIS=177560            ;KEYBOARD INPUT STATUS
        177562                  KBDIB=KBDIS+2           ;CURRENT CHARACTER FROM KEYBOARD.

        172000                  GT40PC=172000           ;GT40 PROGRAM COUNTER.
        172002                  GT40SR=GT40PC+2         ;GT40 STATUS REGISTER ADDRESS.


        001000                  BSTART=1000             ;START OF THE DISPLAY BUFFER
        007000                  BLIMIT=7000             ;APPROXIMATE END OF THE DISPLAY BUFFER.
        007776                  TMPEND=7776             ;LOCATION OF INITIALIZATION STACK.
        000004                  CORSTR=4                ;LOCATION OF PDP-11 TRAP VECTOR.
        007012                  JMPADD=BLIMIT+10.       ;WHERE THE POINTER IS TO FIRST CHAR ON SCREEN
        000040                  NUMLIN=32.              ;NUMBER OF LINES ON TEXT TO SHOW ON THE SCREEN

        005015                  CRLF=5015               ;CARRIAGE RETURN - LINE FEED
        000175                  ALTMOD=175              ;THE 'KEY'' CHARACTER [I.E. ALTMODE].

        160000                  DISJMP=160000           ;THE GT40 JMP INSTRUCTION
        173000                  DISTOP=173000           ;THE GT40 STOP DISPLAY INSTRUCTION.



                                .SBTTL  INITIALIZATION AND RESTART CODE
                                .PAGE
```

```
                                        ;               GT40 BOOTSTRAP CODE
                                        ;               ---- --------- ----

                006000                          .=6000

                                        ;       .=ORIGIN                        ;DEFINE ORIGIN OF THE BOOTSTRAP.

                                        ;               COLD INITIALIZATION CODE
                                        ;               ---- -------------- ----

006000  000005                  START:  RESET                                   ;RESET ALL HARDWARE NOW.
006002  012737  000007  175610          MOV     #7,DL11IS                       ;INITIALIZE DL-11 INPUT NOW.
006010  012706  007776                  MOV     #TMPEND,SP                      ;ESTABLISH A GOOD TEMPORARY STACK
                                                                                ;POINTER FOR CORE SEARCH.
006014  005237  175614                  INC     DL11OS                          ;SET BREAK BIT
006020  004337  166652                  JSR     SCAN,OUTLIT!160000              ;FOR 2 CHARACTER TIMES
006024  000000                          .WORD 0                                 ;SEND TWO ZERO'S

006026  012703  000004                  MOV     #CORSTR,SCAN                    ;GET ADDRESS OF BAD CORE TRAP VECTOR.
006032  012723  166042                  MOV     #NOTHERE!160000,(SCAN)+         ;AND INSERT A POINTER TO US THERE.

006036  005023          ENDCOR: CLR     (SCAN)+                                 ;NOW CLEAR ALL OF MEMORY BEYOND THE POINTER,
006040  000776                  BR      ENDCOR                                  ;UNTIL WE RUN OUT OF MEMORY AND TRAP.

006042  005743          NOTHER: TST     -(SCAN)                                 ;WHEN WE TRAP OUT, WE COME HERE.
                                                                                ;WE BACK UP POINTER TO GOOD CORE.
                                                                                ;NOTE THAT IF WE TRAP OUT AGAIN, IT
                                                                                ;IS STILL OK, BECAUSE WE WILL LOOP
                                                                                ;UNTIL WE GET A GOOD CORE ADDRESS.
006044  010306                  MOV     SCAN,SP                                 ;WHEN WE GET ONE, THAT IS LAST LOCATION
                                                                                ;IN THE MACHINE, AND HENCE OUR SP.
006046  105737  175614  1$:     TSTB    DL11OS                                  ;SEE IF BREAK IS DONE
006052  100375                  BPL     1$                                      ;NO GO BACK
006054  005037  175614          CLR     DL11OS                                  ;CLEAR BREAK BIT

                                        ;               RESTART INITIALIZATION CODE WHEN COMMUNICATIONS IS WORKING.
                                        ;               ------- -------------- ---- ---- ------------- -- --------
```

```
                                ;FORCE THE SP TO LIMIT OF EXISTING CORE.
006060  052706  007776  RESTRT: BIS     #TMPEND,SP
                        MOV     #BLIMIT-NUMLIN-NUMLIN,SCAN      ;NOW WE WILL FILL THE KEY AREAS OF THE
006064  012703  006700
006070  012702  000040  MOV     #NUMLIN,TABCNT          ;DISPLAY BUFFER WITH INITIAL CR-LF'S.
006074  012723  005015  SETLP1: MOV     #CRLF,(SCAN)+           ;INSERT A CRLF NOW.
006100  005302          DEC     TABCNT                  ;AND LOOP UNTIL DONE.
006102  003374          BGT     SETLP1                  ;THUS DISPLAY CORE IS ALMOST CORRECT.

006104  012703  166432  MOV     #SETUP!160000,SCAN              ;NOW WE WILL INITALIZE CORE FOR THE
                                                        ;DISPLAY. PICK UP POINTER TO LIST.
006110  012302  SETLP2: MOV     (SCAN)+,TABCNT          ;GET NUMBER OF ITEMS TO INSERT.
006112  001405          BEQ     SETDUN                  ;IF ZERO, WE ARE DONE.
006114  012301          MOV     (SCAN)+,POINTR          ;PICK UP FIRST CORE ADDRESS POINTER.

006116  012321  SETLP3: MOV     (SCAN)+,(POINTR)+       ;MOVE OVER A DATA ITEM NOW.
006120  005302          DEC     TABCNT                  ;ALL DONE?
006122  003375          BGT     SETLP3                  ;NOPE. MOVE OVER THE NEXT.
006124  000771          BR      SETLP2                  ;YES. GET NEXT MAJOR LIST TO INSERT.

006126  012701  006776  SETDUN: MOV     #BLIMIT-2,POINTR        ;ESTABLISH THE BUFFER POINTER NOW.


                        .SBTTL  VT05 SIMULATOR
                        .PAGE
```

```
803
804
805
806                                     ;               VT05 (SCROLLING) PORTION OF THE BOOTSTRAP
807                                     ;               ---- ---------  ------- -- --- ---------
808
809
810
811  006132  004737  166564   NXTCHR: JSR     PC,GETCHR!160000                ;GET A CHARACTER NOW.
812  006136  020027  000177           CMP     CHAR,#177               ;IS IT OUT OF RANGE?
813  006142  002373                   BGE     NXTCHR                  ;YEP. GET ANOTHER ONE.
814  006144  020027  000040           CMP     CHAR,#40                ;IS IT A PRINTING CHARACTER?
815  006150  002020                   BGE     NORMAL                  ;YES. IT'S A NORMAL PRINTING CHARACTER.
816  006152  010003                   MOV     CHAR,SCAN               ;MOVE IT OVER SO WE CAN PLAY WITH IT.
817  006154  162703  000007           SUB     #7,SCAN                 ;BIAS SO THAT BELL [7] IS ZERO.
818  006160  020327  000007           CMP     SCAN,#7                 ;IF CHARACTER IS LESS THEN BELL OR
819  006164  103362                   BHIS    NXTCHR                  ;GREATER THEN CR, THEN IGNORE.
820  006166  006303                   ASL     SCAN                    ;IF GOOD, MAKE IT WORD INDEX.
821  006170  060307                   ADD     SCAN,PC                 ;AND GO TO THE CORRECT ROUTINE.
822
823  006172  000426                   BR      BELL                    ;7=BELL
824  006174  000406                   BR      NORMAL                  ;10=BACKSPACE
825  006176  000411                   BR      TAB                     ;11=TAB
826  006200  000437                   BR      LF                      ;12=LINE FEED [LF]
827  006202  000420                   BR      VT                      ;13=VERTICAL TAB [VT]
828  006204  000424                   BR      FF                      ;14=FORM FEED [FF]
829                                                                   ;15=CARRIAGE RETURN [CR]
830
831
832  006206  012702  177777   CR:     MOV     #-1,TABCNT              ;RESET TAB POSITION ON A CR, AND
833                                                                   ;FALL THROUGH TO INSERT THE CHARACTER.
834
835
836  006212  004737  166350   NORMAL: JSR     PC,INSERT!160000                ;INSERT THE CHARACTER IN THE BUFFER.
837  006216  005202                   INC     TABCNT                  ;UPDATE TAB POSITION NOW.
838  006220  000744                   BR      NXTCHR                  ;AND GET NEXT CHARACTER.
839
840
841
842
843  006222  012700  000040   TAB:    MOV     #40,CHAR                ;ON A TAB, INSERT BLANKS UNTIL THE
844  006226  004737  166350           JSR     PC,INSERT!160000                ;NEXT CHARACTER POSITION IS A MULTIPLE
845  006232  005202                   INC     TABCNT                  ;OF 8.
846  006234  032702  000007           BIT     #7,TABCNT               ;ARE WE DONE YET?
847  006240  001370                   BNE     TAB                     ;NOPE.
848  006242  000733                   BR      NXTCHR                  ;YES.
849
850
851  006244  111705           VT:     MOVB    (PC),COUNTR             ;THIS PUTS THE LOW BYTE OF THE
852                                                                   ;BRANCH CODE IN COUNTR-SAVE A WORD
853  006246  000405                   BR      FFLOOP
854                                                                   ;
855  006250  005037  172002   BELL:   CLR     GT40SR                  ;RING BELL -WRITE IN GT40SR
856  006254  000726                   BR      NXTCHR                  ;AND LOOP BACK
857
858  006256  012705  000040   FF:     MOV     #NUMLIN,COUNTR          ;FORM FEED IS DONE BY INSERTING LF'S.
```

```
006262  012700  000012          FFLOOP: MOV     #12,CHAR                ;MAKE THE CHARACTER A LINEFEED.
006266  004737  166304                  JSR     PC,LFSUB.160000         ;DO A LINEFEED.
006272  005305                          DEC     COUNTR                  ;DONE?
006274  003372                          BGT     FFLOOP                  ;NOPE. KEEP SENDING THEM.
006276  000715                          BR      NXTCHR                  ;YES. NOW RETURN. DO NOT FALL THROUGH.


006300  012746  166132          LF:     MOV     #NXTCHR.160000,-(SP)            ;RETURN TO NXTCHR AFTER PROCESSING
                                                                        ;THE LF BY FAKING A JSR.

006304  013703  007012          LFSUB:  MOV     JMPADD,SCAN             ;GET POINTER TO FIRST CHAR ON SCREEN

006310  122300                  LFLOOP: CMPB    (SCAN)+,CHAR            ;AND LOOK FOR A LINEFEED.
006312  001406                          BEQ     LFOUND                  ;GOT IT. SEARCH HAS ENDED.
006314  020327  007000                  CMP     SCAN,#BLIMIT            ;ARE WE AT END OF BUFFER?
006320  103773                          BLO     LFLOOP                  ;NOPE. KEEP ON LOOKING.
006322  012703  001000                  MOV     #BSTART,SCAN            ;IF AT TOP, RESET TO BOTTOM OF BUFFER
006326  000770                          BR      LFLOOP                  ;AND KEEP ON LOOKING.

006330  005203                  LFOUND: INC     SCAN                    ;WE'VE GOT THE LINE FEED. STOP SHOWING
006332  042703  000001                  BIC     #1,SCAN                 ;FIRST LINE BY CHANGING THE 'DISJMP''
006336  010337  007012                  MOV     SCAN,JMPADD             ;INSTRUCTION TO FIRST CHAR BEYOND LF.
006342  004737  166350                  JSR     PC,INSERT!160000                ;INSERT THE LF IN THE BUFFER.
006346  005000                          CLR     CHAR                    ;AND THEN INSERT ONE NULL CHARACTER BECAUSE
                                                                        ;THE 'DISJMP'' ADDRESS MUST BE EVEN, AND
                                                                        ;THIS GUARANTEES WE WILL NOT LOSE A
                                                                        ;A GOOD DATA CHARACTER. WE FALL THROUGH
                                                                        ;TO INSERT THE NULL IN THE BUFFER.


006350  110021                  INSERT: MOVB    CHAR,(POINTR)+          ;STICK IN THE CHARACTER NOW.
006352  032701  000001                  BIT     #1,POINTR               ;IS NEXT POSITION EVEN OR ODD?
006356  001021                          BNE     INSRTX                  ;ODD. NO PROBLEMS. SPACE IS ALLOCATED.
006360  020127  007000                  CMP     POINTR,#BLIMIT          ;EVEN. ARE WE AT THE END OF THE BUFFER?
006364  103410                          BLO     INSRTL                  ;NO. JUST MAKE ROOM FOR ANOTHER WORD.
006366  010103                          MOV     POINTR,SCAN             ;AT THE END. MOVE THE STUFF TO THE
006370  012701  001000                  MOV     #BSTART,POINTR          ;BEGINNING OF THE BUFFER.
006374  004737  166406                  JSR     PC,INSRTL!160000                ;CALL THE ROUTINE TO SAVE SPACE.
006400  005023                          CLR     (SCAN)+                 ;AND CLEAR UP THE INSTRUCTIONS AT THE
006402  005013                          CLR     (SCAN)                  ;END OF THE BUFFER.
006404  000207                          RTS     PC                      ;AND THEN RETURN.

006406  022121                  INSRTL: CMP     (POINTR)+,(POINTR)+     ;BYPASS THE 'DISJMP'' BY ADDING 4 TO POINTR.
006410  012711  166474                  MOV     #HEADER.160000,(POINTR) ;NOW INSERT THE DISJMP INSTRUCTION TO OUR HEADER
006414  012741  160000                  MOV     #DISJMP,-(POINTR)       ;AND IT'S ADDRESS (PUT THEM IN BACKWARDS).
006420  005041                          CLR     -(POINTR)               ;MAKE AVAILABLE A NEW CHARACTER SPOT.

006422  000207                  INSRTX: RTS     PC                      ;FINALLY RETURN TO THE CALLER.





006424  012737  001000  172000  GTBUSE: MOV     #BSTART,GT40PC          ;ON A BUS ERROR, WE MERELY RESTART THE GT40 AT
```

```
                                                        ;THE RTI FOR THIS ROUTINE
                                                        ;IS THE FIRST WORD OF THE TABLE
                                                        ;BELOW-IT SAVES A WORD.
;
;                               INITIALIZATION TABLE FOR THE SCROLLER
;                               -------------- ----- --- --- --------

006432  000002          SETUP:  .WORD   2               ;INITIALIZE 2 WORDS.--ALSO RTI FROM ABOVE
006434  000330                  .WORD   330             ;STARTING AT LOCATION 330
006436  166424                  .WORD   GTBUSE!160000           ;FIRST WORD IS POINTER TO BUS ERROR ROUT
006440  000200                  .WORD   200             ;SECOND WORD IS NEW STATUS WORD ON INTERRUPT.

006442  000007                  .WORD   7               ;INITIALIZE THE END OF THE BUFFER TO
006444  006776                  .WORD   BLIMIT-2        ;A CLEAR SPACE TO INSERT THE CHARACTER.
006446  000000                  .WORD   0               ;THIS IS THE 'RUNNING' START. THIS IS
006450  160000  166474          .WORD   DISJMP,HEADER!160000    ;FOLLOWED BY A DISJMP TO OUR HEADER BLOC
006454  160000  001000          .WORD   DISJMP,BSTART   ;AND THEN A DISJMP TO THE START OF THE BUFFER
006460  160000  006700          .WORD   DISJMP,BLIMIT-NUMLIN-NUMLIN     ;AND A DISJMP TO THE FIRST CHAR ON SCREE

006464  000001                  .WORD   1               ;FINALLY START THE GT40 GOING AT
006466  172000                  .WORD   GT40PC          ;THE POSITION INSTRUCTION IN THE
006470  166474                  .WORD   HEADER!160000           ;HEADER BLOCK.

006472  000000                  .WORD   0               ;END OF INIT CODE
;
;               HEADER BLOCK FOR THE SCROLLER

006474  103334          HEADER: .WORD   103334          ;ENABL CHAR MODE,BLINKING
006476  000177                  .WORD   177             ;A BLINKING BOX-RUB OUT.
006500  116124                  .WORD   116124          ;GO TO POINT MODE
006502  171340                  .WORD   171340          ;LOAD STATUS REGISTER
006504  000000  001352          .WORD   0,1352          ;POINT TO UPPER LEFT
006510  103324                  .WORD   103324          ;BACK TO CHAR MODE
006512  160000  007010          .WORD   DISJMP,JMPADD-2 ;AND TO THE CHANGING JMP INST.

                                .SBTTL  COMMUNICATIONS AND MISC. SUPPORT ROUTINES
                                .PAGE
```

```
                                ;                       COMMUNICATIONS HANDLING ROUTINES
                                ;                       -------------- -------- --------
                                ;                               THE DL-11 HANDLER
                                ;                               --- ----- -------
006516  105737  175610        GETDL:  TSTB    DL11IS          ;CHECK THE HOST INPUT STATUS.
006522  100011                        BPL     GETDL1          ;HOST DID NOT SEND ANYTHING, YET.
006524  113700  175612                MOVB    DL11IB,CHAR     ;HOST SENT US A CHARACTER. PROCESS IT.
006530  012737  000007  175610        MOV     #7,DL11IS       ;REENABLE THE HOST TELECOMMUNICATIONS.
006536  042700  177600                BIC     #-200,CHAR      ;MAKE CHARACTER JUST SEVEN BITS.
006542  001765                        BEQ     GETDL           ;IF NULL, IGNORE IT.
006544  000207                        RTS     PC              ;ELSE RETURN NOW.

006546  105737  177560        GETDL1: TSTB    KBDIS           ;DID USER TYPE A CHARACTER?
006552  100361                        BPL     GETDL           ;NO. GO BACK AND CHECK HOST MACHINE.
006554  113737  177562  175616        MOVB    KBDIB,DL110B    ;MOVE THE CHARACTER TO THE HOST.
006562  000755                        BR      GETDL           ;AND CHECK AGAIN FOR INPUT.


                                ;                       THE ''GET CHARACTER'' ROUTINE
                                ;                       --- --- ---------  -------


006564  004737  166516        GETCHR: JSR     PC,GETDL!160000 ;GET A CHARACTER FROM THE HOST NOW.
006570  020027  000175                CMP     CHAR,#ALTMOD    ;IS IT AN ''ALTMODE''
006574  001025                        BNE     GETEXT          ;NO. EXIT NOW.

006576  004737  166516                JSR     PC,GETDL!160000 ;YES. GET ANOTHER ONE NOW.
006602  020027  000114                CMP     CHAR,#'L        ;IS IT AN 'L''
006606  001501                        BEQ     LOADER          ;YES. START LOADING NOW.
006610  020027  000122                CMP     CHAR,#'R        ;IS IT AN 'R''
006614  001015                        BNE     GETEXT          ;NO. IGNORE THE ALTMODE AND JUST RETURN THE CHAR

006616  012737  173000  007010        MOV     #DISTOP,JMPADD-2 ;YES. RESET. STOP DISPLAY BY INSERTING A 'DISTOP
006624  000137  166060        PRESTR: JMP     RESTRT!160000           ;INSTRUCTION IN THE BUFFER, AND RESTART.


                                ;                       THE ''GET A SIX BIT CHARACTER'' ROUTINE
```

```
1020                                    ;               --- --- - --- --- ---------  -------
1021
1022
1023
1024  006630  004737  166564    GETSIX: JSR     PC,GETCHR!160000                ;GET A CHARACTER NOW.
1025  006634  020027  000040            CMP     CHAR,#40                ;IS IT A LEGAL PRINTING CHARACTER?
1026  006640  002517                    BLT     L.BAD                   ;NOPE. ABORT
1027  006642  020027  000137            CMP     CHAR,#137               ;IT'S BIG ENOUGH. IS IT TOO BIG?
1028  006646  003114                    BGT     L.BAD                   ;YEP. ABORT.
1029
1030  006650  000207    GETEXT: RTS     PC                              ;RETURN TO THE CALLER.
1031
1032
1033                                    ;               THIS OUTPUTS TWO CHARACTERS VIA A
1034                                    ;               JSR SCAN,OUTLIT
1035                                    ;               'TWO CHARACTERS'
1036
1037  006652  112337  175616    OUTLIT: MOVB    (SCAN)+,DL110B
1038  006656  112337  175616            MOVB    (SCAN)+,DL110B          ;DOUBLE BUFFERED
1039  006662  000203                    RTS     SCAN                    ;RETURN
1040
1041
1042
1043
1044
1045
1046
1047                                    ;               THE ''GET AN EIGHT BIT CHARACTER'' ROUTINE
1048                                    ;               --- --- -- ----- --- ---------  -------
1049
1050
1051
1052                                    ;                       THIS ROUTINE DIFFERS FROM THE PREVIOUS ROUTINES
1053                                    ;               IN THAT IT WILL TAKE SIX BIT CHARACTERS AND ASSEMBLE
1054                                    ;               THEM FOR THE LOADER TO USE. NOTE THAT FROM THIS POINT
1055                                    ;               ON WE WILL SWITCH TO THE LOADER DEFINITIONS OF THE
1056                                    ;               REGISTERS. THUS THE CHARACTER IS RETURNED IN
1057                                    ;               REGISTER 'L.BYT'' RATHER THAN CHAR (THOUGH THEY ARE
1058                                    ;               PHYSICALLY THE SAME).
1059
1060
1061
1062  006664  004737  166630    GET8:   JSR     PC,GETSIX!160000                ;GET A SIXBIT CHARACTER.
1063  006670  010046                    MOV     L.BYT,-(SP)             ;SAVE IT ON THE STACK.
1064  006672  005723                    TST     (INDEX)+                ;UPDATE INDEX TO NEXT ITEM (ALL ARE *2)
1065  006674  000163  166676            JMP     GET8TB-2!160000(INDEX)          ;AND DISPATCH ACCORDING TO THE INDEX.
1066
1067  006700  000404    GET8TB: BR      GET81                   ;INDEX=2: ASSEMBLE FIRST CHAR
1068  006702  000416            BR      GET82                   ;INDEX=4: ASSEMBLE SECOND CHAR
1069  006704  000432            BR      GET83                   ;INDEX=6: ASSEMBLE THIRD AND LAST CHAR
1070                                                            ;INDEX=8: RESET INDEX TO 0 [2] AND RETRY.
1071
1072
1073  006706  012703  000002    GET84:  MOV     #2,INDEX                ;THE FOURTH INDEX IS THE SAME AS THE FIRST
1074                                                            ;INDEX. JUST RESET IT AND FALL THROUGH.
1075
```

```
1076
1077  006712  004737  166630  GET81:  JSR     PC,GETSIX!160000        ;GET ANOTHER CHARACTER NOW.
1078  006716  010004                  MOV     L.BYT,HOLD              ;AND PRESERVE IT FOR NEXT TIME THROUGH.
1079  006720  006300                  ASL     L.BYT                   ;NOW THROW AWAY LEFT MOST BITS OF
1080  006722  006300                  ASL     L.BYT                   ;THE 8 BIT CHARACTER. NOW MERGE IN
1081  006724  106300                  ASLB    L.BYT                   ;THE LEFT TWO BITS OF THE
1082  006726  106116                  ROLB    (SP)                    ;NEW SIX BIT CHARACTER WITH THE SIX
1083  006730  106300                  ASLB    L.BYT                   ;BITS FROM THE CHARACTER ON THE
1084  006732  106116                  ROLB    (SP)                    ;STACK. 1ST CHARACTER IS NOW ASSEMBLED,
1085  006734  012600                  MOV     (SP)+,L.BYT             ;SO WE'LL RETURN IT TO THE USER.
1086  006736  000207                  RTS     PC                      ;AND THEN WE SHALL RETURN TO HIM.
1087
1088
1089  006740  006300          GET82:  ASL     L.BYT                   ;THE SECOND CHARACTER IS CREATED FROM
1090  006742  006300                  ASL     L.BYT                   ;THE 4 RIGHT BITS OF THE PREVIOUS CHARACTER
1091  006744  106300                  ASLB    L.BYT                   ;AND THE FOUR MIDDLE BITS OF THE PRESENT
1092  006746  106104                  ROLB    HOLD                    ;8 BIT CHARACTER.
1093  006750  106300                  ASLB    L.BYT                   ;WE WILL CREATE THE NEW 8 BIT
1094  006752  106104                  ROLB    HOLD                    ;IN THIS REGISTER, SINCE IT
1095  006754  106300                  ASLB    L.BYT                   ;MORE CONVIENT. WE WILL MOVE OVER THE
1096  006756  106104                  ROLB    HOLD                    ;ANSWER AT THE END.
1097  006760  106300                  ASLB    L.BYT                   ;ONE MORE TO GO
1098  006762  106104                  ROLB    HOLD                    ;DONE.
1099  006764  010400                  MOV     HOLD,L.BYT              ;BRING OVER THE VALUE.
1100  006766  012604                  MOV     (SP)+,HOLD              ;AND REMEMBER THE LAST CHARACTER WE RECEIVED.
1101  006770  000207                  RTS     PC                      ;AND RETURN TO THE CALLER.
1102
1103
1104  006772  006100          GET83:  ROL     L.BYT                   ;FINAL CHARACTER IS EASY. JUST A
1105  006774  106100                  ROLB    L.BYT                   ;SIMPLE MERGER OF LEFT TWO BITS OF
1106  006776  006004                  ROR     HOLD                    ;PREVIOUS VALUE WITH RIGHT SIX BITS
1107  007000  106000                  RORB    L.BYT                   ;OF LAST (4TH) CHARACTER RECEIVED.
1108  007002  006004                  ROR     HOLD
1109  007004  106000                  RORB    L.BYT                   ;AND WE ARE DONE.
1110  007006  005726                  TST     (SP)+                   ;FINALLY THROW AWAY STACK.
1111  007010  000207                  RTS     PC                      ;AND RETURN TO THE CALLER.
1112
1113
1114
1115
1116
1117
1118
1119
1120
1121
1122
1123
1124                            .SBTTL  THE LOADER
1125                            .PAGE
```

```
1126
1127
1128
1129                                    ;               THE LOADER
1130                                    ;               --- ------
1131
1132
1133
1134
1135  007012  012737  173000  007010  LOADER: MOV     #DISTOP,JMPADD-2        ;STOP THE GT40 BY INSERTING A 'DISTOP'' IN THE LI
1136
1137  007020  005003                          CLR     INDEX                   ;RESET THE 8 BIT ASSEMBLER TO THE FIRST CHAR
1138
1139
1140  007022  005005                  L.LD2:  CLR     L.CKSM                  ;CLEAR THE CHECKSUM
1141  007024  004737  167114                  JSR     PC,L.PTR!160000         ;GET A BYTE NOW.
1142  007030  105300                          DECB    L.BYT                   ;IS IT A ONE (HEADER)?
1143  007032  001373                          BNE     L.LD2                   ;NO. WAIT FOR THE ONE.
1144
1145  007034  004737  167114                  JSR     PC,L.PTR!160000         ;YES. SKIP OVER THE NEXT CHARACTER NOW.
1146
1147  007040  004737  167126                  JSR     PC,L.GWRD!160000                ;ASSEMBLE A WORD NOW.
1148  007044  010002                          MOV     L.BYT,L.BC              ;MOVE OVER TO THE COUNTER.
1149  007046  162702  000004                  SUB     #4,L.BC                 ;REDUCE TO ACTUAL DATA COUNT.
1150  007052  022702  000002                  CMP     #2,L.BC                 ;ANY DATA AT ALL?
1151  007056  001433                          BEQ     L.JMP                   ;NO. MUST BE END
1152  007060  004737  167126                  JSR     PC,L.GWRD!160000                ;YES. ASSEMBLE A DATA WORD NOW.
1153  007064  010001                          MOV     L.BYT,L.ADR             ;AND THIS MUST BE THE FIRST ADDRESS.
1154
1155
1156  007066  004737  167114          L.LD3:  JSR     PC,L.PTR!160000         ;GET A BYTE OF DATA NOW.
1157  007072  002006                          BGE     L.LD4                   ;ALL DONE?
1158  007074  105705                          TSTB    L.CKSM                  ;YEP. COUNTER IS MINUS. CHECK CHECKSUM.
1159  007076  001751                          BEQ     L.LD2                   ;CHECKSUM GOOD. GET NEXT COMMAND.
1160
1161
1162  007100  004337  166652          L.BAD:  JSR     SCAN,OUTLIT!160000      ;BAD LOAD INFORM HOST
1163  007104     175     102                  .BYTE   ALTMOD,'B               ;SEND ALTMODE B
1164  007106  000646                          BR      PRESTRT                 ;AND RESTART THE DISPLAY.
1165
1166
1167  007110  110021          L.LD4:  MOVB    L.BYT,(L.ADR)+          ;INSERT BYTE INTO MEMORY.
1168  007112  000765                  BR      L.LD3                   ;AND GET THE NEXT BYTE.
1169
1170
1171
1172  007114  004737  166664          L.PTR:  JSR     PC,GET8!160000                  ;ASSEMBLE AN 8 BIT CHARACTER NOW.
1173  007120  060005                          ADD     L.BYT,L.CKSM            ;UPDATE THE CHECKSUM NOW.
1174  007122  005302                          DEC     L.BC                    ;DECREMENT THE CHARACTER COUNTER.
1175  007124  000207                          RTS     PC                      ;AND RETURN TO THE CALLER NOW.
1176
1177
1178
1179  007126  004737  167114          L.GWRD: JSR     PC,L.PTR!160000         ;ASSEMBLE A WORD. FIRST GET A CHARACTER
1180  007132  010046                          MOV     L.BYT,-(SP)             ;AND SAVE IT.
1181  007134  004737  167114                  JSR     PC,L.PTR!160000         ;AND THEN GET ANOTHER ONE.
```

```
1182  007140  000300                  SWAB    L.BYT                   ;AND THEN REASSEMBLE THE MESS.
1183  007142  052600                  BIS     (SP)+,L.BYT             ;WITH THE FEARSOME POWER OF THE 11.
1184  007144  000207                  RTS     PC                      ;AND RETURN TO THE CALLER.
1185
1186
1187
1188
1189  007146  004737  167126  L.JMP:  JSR     PC,L.GWRD!160000                ;ALL DONE WITH THE LOAD. ASSEMBLE
1190  007152  010046                  MOV     L.BYT,-(SP)             ;THE STARTING ADDRESS NOW.
1191  007154  004737  167114          JSR     PC,L.PTR!160000         ;AND DON'T FORGET TO CHECKSUM IT.
1192  007160  105705                  TSTB    L.CKSM
1193  007162  001346                  BNE     L.BAD                   ;A BAD CHECKSUM. ALL IS EVIL.
1194
1195  007164  004337  166652          JSR     SCAN,OUTLIT!160000              ;GOOD CHKSUM,INFORM HOST
1196  007170     175     107          .BYTE   ALTMOD,'G               ;WITH ALTMOD G
1197
1198  007172  032716  000001          BIT     #1,(SP)                 ;DO WE WANT TO START EXECUTION?
1199  007176  001401                  BEQ     L.JMP1                  ;YES. AWAY WE GO.
1200
1201  007200  000000          L.HALT: HALT                            ;IF NOT, HALT.
1202
1203  007202  000136          L.JMP1: JMP     @(SP)+                  ;IF GO, THEN GO ALREADY. WHEEEE.
1204
1205
1206
1207                                  .SBTTL  THE SELF TEST
1208
1209
1210
1211
1212
1213
1214
1215
1216
1217
1218
1219
1220                                  .PAGE
```

```
                                                        ;THIS IS GT40 QUICK TEST
                                                        ;GIVES QUICK VISUAL TEST
                                                        ;OF CONDITION OF MACHINE
                                                        ;WITHOUT READING IN DIAG.
100000                  CHAR=100000
104000                  SHORTV=104000
110000                  LONGV=110000
114000                  POINT=114000
120000                  GRAPHX=120000
124000                  GRAPHY=124000
130000                  RELATV=130000

002000                  INT0=2000
002200                  INT1=2200
002400                  INT2=2400
002600                  INT3=2600
003000                  INT4=3000
003200                  INT5=3200
003400                  INT6=3400
003600                  INT7=3600                       ;BRIGHTEST

000100                  LPOFF=100
000140                  LPON=140
000020                  BLKOFF=20
000030                  BLKON=30

000004                  LINE0=4
000005                  LINE1=5
000006                  LINE2=6
000007                  LINE3=7

160000                  DJMP=160000
164000                  DNOP=164000
170000                  STATSA=170000
173400                  DSTOP=173400                    ;STOP INTERRUPT

000300                  LPLITE=300
000200                  LPDARK=200
000040                  ITAL0=40                        ;ITALICS OFF
000060                  ITAL1=60                        ;''       ON
000004                  SYNON=4                         ;SYNC ON


174000                  STATSB=174000

000100                  INCR=100                        ;LOAD GRAPH INCR
040000                  INTX=40000                      ;INTENSIFY BIT
001777                  MAXX=1777                       ;BIGGEST X VECTOR
001377                  MAXY=1377                       ;BIGGEST Y VECTOR
020000                  MINUSX=20000                    ;THE MINUS BIT
020000                  MINUSY=MINUSX
017600                  MAXSX=17600                     ;BIGGEST X IN SHORTVEC
000077                  MAXSY=77                        ;''      Y IN  ''
000100                  MINSUY=100                      ;MINUS BIT FOR Y IN SHORTVEC
```

```
1277  007204  012737  167214  172000          MOV     #FILE0,167214           ;START THE GT40
1278  007212  000001                          WAIT                            ;AND WAIT
1279
1280  007214  114020                  FILE0:  POINT!BLKOFF                    ;POINT--INVISIBLE
1281  007216  00000C                          0
1282  007220  001377                          MAXY
1283
1284  007222  112004                          LONGV!INT0.LINE0                ;DRAW TOP LINE
1285  007224  041777                          INTX.MAXX
1286  007226  000000                          0
1287
1288  007230  112405                          LONGV!INT2!LINE
1289  007232  040000                          INTX                            ;DRAW LINE TO RIGHT
1290  007234  021377                          MINUSX!MAXY
1291
1292  007236  113006                          LONGV.INT4 LINE2
1293  007240  061777                          INTX.MINUSX!MAXX                ;DRAW BOTTOM LINE
1294  007242  000000                          0
1295
1296  007244  113407                          LONGV!INT6!LINE3
1297  007246  040000                          INTX
1298  007250  001377                          MAXY                            ;DRAW LINE TO LEFT
1299
1300  007252  114000                          POINT
1301  007254  000400                          400
1302  007256  000500                          500
1303  007260  106200                          SHORTV!INT1
1304  007262  057677                          57677                           ;+X+Y
1305  007264  106600                          SHORTV!INT3
1306  007266  077677                          77677                           ;+X-Y
1307  007270  107200                          SHORTV!INT5
1308  007272  077777                          77777                           ;-X-Y
1309  007274  107600                          SHORTV!INT7
1310  007276  057777                          57777                           ;-X+Y
1311
1312  007300  114000                          POINT
1313  007302  001400                          1400
1314  007304  000500                          500
1315  007306  133030                          RELATV!INT4!BLKON
1316  007310  057677                          57677                           ;+X+Y
1317  007312  077677                          77677                           ;+X-Y
1318  007314  077777                          77777                           ;-X-Y
1319  007316  057777                          57777                           ;-X+Y
1320
1321  007320  114000                          POINT
1322  007322  000400                          400
1323  007324  000100                          100
1324  007326  174120                          STATSB!INCR+20                  ;TRY GRAPH MODES
1325  007330  114000                          POINT
1326  007332  001000                          1000
1327  007334  000200                          200
1328
1329  007336  120000                          GRAPHX
1330  007340  001010                          1010
1331  007342  001020                          1020
1332  007344  001030                          1030
```

```
 1333  007346  001040                    1040
 1334  007350  001050                    1050
 1335
 1336  007352  114000                    POINT
 1337  007354  001000                    1000
 1338  007356  001200                    1200
 1339
 1340  007360  124000                    GRAPHY
 1341  007362  001020                    1020
 1342  007364  001030                    1030
 1343  007366  001040                    1040
 1344  007370  001050                    1050
 1345  007372  001060                    1060
 1346
 1347  007374  160000                    DJMP
 1348  007376  167214                    FILE0:160000
 1349
 1350                                    .SBTTL  PAPER TAPE BOOT
```

```
                                        ;
                                        ; PAPER TAPE BOOT
                                        ;
            177550                      HSR=177550                      ;HIGH SPEED READER ADDRESS
            177560                      LSR=177560                      ;LOW SPEED READER ADDRESS
                                        ;       .=ORIGIN+1400
                                        ;
007400  012701  160000          PTBOOT: MOV     #160000,R1              ;SET MEMORY CHECK LIMITS
007404  012702  000004                  MOV     #4,R2                   ;TRAP ADDRESS IS LOC. 4
007410  012703  167500                  MOV     #DEV+4!160000,R3        ;POINTER TO DEVICE ADDRESSES
007414  010712                          MOV     PC,@R2                  ;PRESET TRAP ADDRESS IN LOC. 4
007416  012706  000024                  MOV     #24,SP                  ;STACK SET UP AT SPECIAL ADDRESS
007422  014304                  DEV1:   MOV     -(R3),R4                ;GET DEVICE ADDRESS
007424  005714                          TST     @R4                     ;CHECK AVAILABILITY OF DEVICE
007426  100775                          BMI     DEV1                    ;CHECK DEVICE FOR ERRORS
007430  010712                          MOV     PC,@R2                  ;RESET TRAP ADDRESS AT LOC. 4
007432  012706  000024                  MOV     #24,SP                  ;SPECIAL ADDRESS USED AS MASK LATER
007436  010441                          MOV     R4,-(R1)                ;DO MEM CHK:READER STATUS ADDRESS
                                                                        ;IS MOVED
007440  040601                          BIC     SP,R1                   ;SET R1=X7752,MASK IN SP=24
007442  010111                          MOV     R1,@R1                  ;STORE OWN ADDRESS IN POINTER
007444  011102                  LOOP:   MOV     @R1,R2                  ;GET BYTE POINTER
007446  005214                          INC     @R4                     ;ENABLE READER
007450  105714                          TSTB    @R4                     ;TEST DONE BIT
007452  100376                          BPL     .-2                     ;WAIT UNTIL READY
007454  116412  000002                  MOVB    2(R4),@R2               ;THEN PICK IT UP AND STORE IT
007460  005211                          INC     @R1                     ;BUMP POINTER
007462  120227  000375                  CMPB    R2,#375                 ;STORED JUMP OFFSET?
007466  001366                          BNE     LOOP                    ;NOT YET
007470  105222                          INCB    (R2)+                   ;YES,ALL DONE
007472  000142                          JMP     -(R2)                   ;GO EXECUTE AS BRANCH
                                        ;
                                        ; DEVICE ADDRESSES FOLLOW - DO NOT CHANGE THE ORDER
                                        ;
007474  177560                  DEV:    LSR                             ;LOW SPEED READER
007476  177550                          HSR                             ;HIGH SPEED READER

                                        .SBTTL  CASSETTE BOOT
```

```
1392                                    ;
1393                                    ; CASSETTE BOOT
1394                                    ;
1395            177500                  TACS=177500                     ;TA-11 CONTROL AND STATUS REGISTER
1396                                    ;       .=ORIGIN+1500
1397  007500   012700  177500           TABOOT: MOV     #TACS,R0
1398  007504   005010                           CLR     (R0)            ;SELECT UNIT #0
1399  007506   010701                   RES:    MOV     PC,R1           ;USE FOR PIC
1400  007510   062701  000052                   ADD     #TABLE-.,R1     ;R1 HOLDS ADDR. OF COMMAND TABLE
1401  007514   012702  000375                   MOV     #375,R2         ;MEMORY PTR. AND DATA FLAG
1402  007520   112103                           MOVB    (R1)+,R3        ;TEST BITS
1403                                    ;
1404  007522   112110                   LOOP1:  MOVB    (R1)+,(R0)      ;COMMAND FROM TABLE TO TACS
1405  007524   100413                           BMI     DONE            ;WHEN COMMAND CODE NEG., QUIT
1406  007526   130310                    LOOP2: BITB    R3,(R0)         ;TEST READY AND T-REQ BITS IN TACS
1407  007530   001776                           BEQ     LOOP2           ;LOOP 'TIL SOMETHING COMES UP
1408  007532   105202                           INCB    R2              ;ADVANCE MEMORY POINTER
1409  007534   100772                           BMI     LOOP1           ;IF MINUS, TRY NEXT COMMAND
1410  007536   116012  000002                   MOVB    2(R0),(R2)      ;READ DATA INTO MEMORY
1411  007542   120337  000000                   CMPB    R3,@#0          ;FIRST BYTE READ SHOULD BE '240'
1412  007546   001767                           BEQ     LOOP2           ;IF O.K., GO READ ANOTHER BYTE
1413  007550   000000                   STOP:   HALT                    ;HALT ON ERROR
1414  007552   000755                           BR      RES             ;RESTART ON CONTINUE
1415                                    ;
1416  007554   005710                   DONE:   TST     (R0)            ;CHECK FOR ERROR
1417  007556   100774                           BMI     STOP            ;HALT ON ERROR
1418  007560   005007                           CLR     PC              ;= 'JMP @#0'
1419                                    ;
1420  007562   017640                   TABLE:  .WORD   17640           ;.BYTE 240: READY+T-REQ.
1421                                                                    ;.BYTE 37:  ILBS+READY+GO
1422  007564   002415                           .WORD   2415            ;.BYTE  15: SFB+GO
1423                                                                    ;.BYTE   5: READ+GO
1424  007566   112024                           .WORD   112024          ;.BYTE  24: READ+ILBS
1425                                                                    ;.BYTE 224: READ+ILBS+E.O.TABLE
1426  007570   000000  000000                   .WORD   0,0             ;THESE ARE FILLER WORDS
1427  007574   167500                           .WORD   TABOOT.160000           ;POWER UP VECTOR AND PRIORITY
1428  007576   000340                           .WORD   340             ;
1429
1430
1431                                            .SBTTL  MR11-DB BOOT
```

```
1433                                    ;MR11-DB BULK STORAGE PROGRAM LOADER LISTING
1434
1435                                    ;       .=ORIGIN+1600                   ;KEEP TRACK OF ORIGIN
1436
1437  007600  010702                    RF11:   MOV PC,R2               ;FIXED HEAD DISK (256 KW)
1438  007602  000451                            BR OTHER
1439  007604  177462                            177462
1440  007606  000005                            5
1441
1442  007610  010702                    RK11:   MOV PC,R2               ;MOVING HEAD DISK (CARTRIDGE)
1443  007612  000445                            BR OTHER
1444  007614  177406                            177406
1445  007616  000005                            5
1446
1447
1448  007620  010702                    TC11:   MOV PC,R2
1449  007622  000417                            BR TAPES
1450  007624  177344                            177344              ;ADDRESS OF WORD COUNT
1451  007626  000005                            5                   ;LAST COMMAND
1452  007630  004003                            4003                ;FIRST COMMAND
1453  007632  100000                            100000              ;DONE MASK
1454  007634  024000                            24000               ;ERROR MASK
1455
1456
1457  007636  010702                    TM11:   MOV PC,R2
1458  007640  000410                            BR TAPES
1459  007642  172524                            172524              ;ADDRESS OF BYTE COUNT
1460  007644  060003                            60003               ;LAST COMMAND
1461  007646  060011                            60011               ;FIRST COMMAND
1462  007650  000200                            200                 ;DONE MASK
1463  007652  100000                            100000              ;ERROR MASK
1464
1465
1466  007654  010702                    RP11:   MOV PC,R2               ;MOVING HEAD DISK (PACK)
1467  007656  000423                            BR OTHER
1468  007660  176716                            176716
1469
1470
1471  007662  000005                    TAPES:  RESET
1472  007664  010200                            MOV R2,R0               ;GET THE ADDRESS OF THE BRANCH
1473  007666  005720                            TST (0)+                ;R0 TO POINT AT LAST COMMAND
1474  007670  012001                            MOV (0)+,R1             ;GET THE WORD COUNT ADDRESS
1475  007672  005311                            DEC (1)                 ;SET UP FOR ADVANCE 1 RECORD
1476  007674  005720                            TST (0)+                ;MOVE R0 TO FIRST COMMAND
1477  007676  012041                            MOV (0)+,-(1)           ;COMMAND WORD TO COMMAND REG.
1478  007700  031011                            BIT (0),(1)             ;LOOK FOR DONE INDICATORS
1479  007702  001776                            BEQ .-2                 ;NONE SET, TRY AGAIN
1480  007704  005720                            TST (0)+                ;DONE FIRST COMMAND, CHECK FOR ERROR
1481  007706  031041                            BIT (0),-(1)            ;LOOK FOR SET ERROR BITS
1482  007710  001406                            BEQ OTHER               ;NO ERRORS - TRY THE READ
1483  007712  000112                    AGAIN:  JMP (2)                 ;RERUN FOR ERRORS
1484
1485
1486  007714  167600                    RFVEC:  RF11!160000                     ;RF11 POWER UP VECTOR
1487  007716  000340                            340
1488
```

```
1489  007720  010702                  RC11:   MOV PC,R2               ;FIXED HEAD DISK (64KW)
1490  007722  000401                          BR OTHER
1491  007724  177450                          177450                  ;ADRS OF WORD COUNT (COMMAND+2)
1492                                                                  ;COMMAND WORD (5) IS THE RESET
1493
1494  007726  000005                  OTHER:  RESET
1495  007730  010200                          MOV R2,R0               ;R0 TO POINT AT WORD COUNT ADRS
1496  007732  005720                          TST (0)+                ;POINT TO ADDRESS
1497  007734  012001                          MOV (0)+,R1             ;WORD COUNT ADDRESS TO R1
1498  007736  012711  177000                  MOV #-1000,(1)          ;LOAD WORD COUNT
1499  007742  011041                          MOV (0),-(1)            ;COMMAND TO COMMAND REGISTER
1500  007744  032711  100200                  BIT #100200,(1)         ;CHECK FOR ERROR OR DONE
1501  007750  001775                          BEQ .-4                 ;IF NEITHER, KEEP LOOKING
1502  007752  100757                          BMI AGAIN               ;ERROR, TRY AGAIN
1503  007754  005007                          CLR PC
1504
1505  007756  000000                          0                       ;FILLER
1506  007760  167610                  RKVEC:  RK11!160000                     ;RK POWER UP VECTOR
1507  007762  000340                          340
1508  007764  167720                  RCVEC:  RC11!160000                     ;RC POWER UP VECTOR
1509  007766  000340                          340
1510  007770  167654                  RPVEC:  RP11!160000                     ;RP POWER UP VECTOR
1511  007772  000340                          340
1512  007774  167620                  TCVEC:  TC11!160000                     ;TC11 POWER UP VECTOR
1513  007776  000340                          340
1514
1515                                          .SBTTL  ROM VERSION 1 VALUES
1516                                          .PAGE
```

```
                                        .DSABL  AMA

                                ;DATA PATTERN STORED IN THE GT40 BOOTSTRAP VERSION 1

                                ;       ********** THIS IS A IMAGE LISTING OF THE GT40 <VT40> BOOTSTRAP ********
                                ;
                                ;       THE DATA IS A MIRROR IMAGE OF THAT IN THE BOOTSTRAP ROMS
                                ;       ONLY THE ADDRESS FIELD IS CHANGED

                                ;BOOTVT.S09  5/2/72      <SPECIAL>


                                ;       VT-40 BOOTSTRAP LOADER, VERSION S09, RELEASE R01, 5/2/72

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                                ;                               01754


                                ;       WRITTEN BY JACK BURNESS, SENIOR SYSTEMS ARCHITECT!



                                ;       THIS ROUTINE IS INTENDED TO BE LOADED IN THE ROM PORTION OF THE VT-40.


                                ;       REGISTER DEFINITIONS:

000000                          R0=%0
000001                          R1=%1
000002                          R2=%2
000003                          R3=%3
000004                          R4=%4
000005                          R5=%5
000006                          R6=%6
000007                          R7=%7

000006                          SP=R6
000007                          PC=R7

000000                          RET1=R0         ;RETURN OF VALUE REGISTER.
000001                          INP1=R1         ;ARGUMENT FOR CALLED FUNCTION
000002                          INP2=R2         ;SECOND ARGUMENT.
000003                          WORK1=R3        ;FIRST WORK REGISTER.
000004                          WORK2=R4        ;SECOND WORKING REGISTER.
000005                          SCR1=R5         ;SCRATCH REGISTER.

000003                          LCKSM=WORK1     ;OVERLAPPING DEFINITIONS FOR LOADER PORTION.
000000                          LBYT=RET1
000005                          LBC=SCR1
000001                          LADR=INP1
```

```
1573
1574            036000                          COREND=36000                    ;FIRST LOCATION OF NON-CORE.
1575            166000                          ROMORG=166000                   ;WHERE THE ROM PROGRAM SHOULD GO.
1576
1577            000000                          STARTX=0                        ;WHERE TO START DISPLAYING THE X POSITIONS.
1578            001360                          STARTY=1360                     ;WHERE TO START DISPLAYING THE Y.
1579
1580
1581            022000                          VT40PC=172000-150000                    ;VT40 PROGRAM COUNTER.
1582            027560                          KBDIS=27560             ;TTY INPUT STATUS.
1583            025614                          P10OS=25614             ;PDP-10 OUTPUT STATUS.
1584            025610                          P10IS=25610             ;PDP-10 INPUT STATUS.
1585
1586            027562                          KBDIB=KBDIS+2           ;TTY INPUT BUFFER.
1587            025612                          P10IB=P10IS+2           ;PDP-10 INPUT CHARACTER.
1588            025616                          P10OB=P10OS+2           ;PDP-10 OUTPUT BUFFER.
1589
1590
1591            045776                          P10OC=COREND-2+10000                    ;CHARACTER TO BE SENT TO THE PDP-10
1592            045772                          P10IC=P10OC-4           ;INPUT CHARACTER FROM 10 PLUS ONE SAVE CHARACTER
1593            015770                          STKSRT=P10IC-2-30000                    ;FIRST LOCATION OF STACK.
1594
1595
1596            160000                          JMPDIS=160000                   ;THE VT-40 DISPLAY JUMP INSTRUCTION.
1597
1598
1599            000024                          PWRFAL 24                       ;POWER FAIL RESTART LOCATION.
1600
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1611            016000                          .=16000
1612                                    ;       .-ROMORG                        ;SET THE ORIGIN NOW...!
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1620    016000  012705  000026          STARTA: MOV     #PWRFAL+2,SCR1          ;PICK UP POINTER TO P.F. STATUS.
1621    016004  005015                  CLR     @SCR1                   ;CLEAR IT OUT TO BE SURE.
1622    016006  010745                  MOV     PC,-(SCR1)              ;SET UP THE RESTART LOCATION.
1623
1624    016010  000005                  RESET                           ;RESET THE BUS.
1625
1626    016012  012767  000007  007570  MOV     #7,P10IS                ;INITIALIZE PDP-10 INPUT
1627    016020  012767  000001  011532  MOV     #1,KBDIS                ;INITIALIZE TTY INPUT.
1628    016026  012767  000201  007560  MOV     #201,P10OS              ;INITIALIZE PDP-10 OUTPUT.
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1629
1630
1631
1632  016034  012706  015770          RSTRT:  MOV     #STKSRT,SP              ;SET UP THE STACK NOW!
1633  016040  005001                  CLR     LADR                    ;CLEAR ADDRESS POINTER.
1634  016042  012702  160000          MOV     #JMPDIS,INP2            ;PLACE A DISPLAY JUMP INSTRUCTION IN A REGISTER.
1635  016046  010221                  MOV     INP2,(LADR)+            ;MOVE IT TO LOCATION 0.
1636  016050  012711  166756          MOV     #DISPRG+150000,(LADR)           ;MOVE ADDRESS POINTER INTO 2.
1637  016054  012701  000030          MOV     #PWRFAL+4,LADR          ;SET UP WHERE WE WILL STORE CHARACTERS.
1638  016060  005000                  CLR     RET1                    ;PREPARE TO INSERT A ZERO CHARACTER.
1639  016062  004767  000022          JSR     PC,DOCHAR               ;INSERT IT NOW.
1640  016066  005067  003706          CLR     VT40PC                  ;CLEAR THE DISPLAY PROGRAM COUNTER AND START.
1641
1642  016072  004767  000210          MAJOR:  JSR     PC,GTCHR                ;GT A CHARACTER NOW.
1643  016076  000240                  NOP
1644  016100  000240                  NOP
1645  016102  000240                  NOP
1646  016104  012746  166072          MOV     #MAJOR+150000,-(SP)             ;INSERT IN DISPLAY BUFFER NOW.
1647
1648  016110  010105          DOCHAR: MOV     LADR,SCR1               ;GT CURRENT BUUFER POSITION NOW.
1649  016112  022525                  CMP     (SCR1)+,(SCR1)+         ;BYPASS CURRENT DISPLAY JUMP.
1650  016114  005025                  CLR     (SCR1)+                 ;CLEAR FUTURE ADDRESS FOR JUMP.
1651  016116  010225                  MOV     INP2,(SCR1)+            ;STICK IN TEMPORARY JUMP WHILE WE REPLACE CURREN
1652  016120  005015                  CLR     (SCR1)                  ;A DISPLAY JUMP TO ZERO.
1653  016122  005011                  CLR     (LADR)                  ;NOW REPLACE CURRENT DISPLAY JUMP BY THE CHARACT
1654  016124  050021                  BIS     RET1,(LADR)+            ;IT'S DONE THIS WAY TO WASTE 2 CYCLES.
1655  016126  010211                  MOV     INP2,(LADR)             ;TO AVOID TIMING PROBLEMS WITH THE VT40.
1656  016130  000207                  RTS     PC                      ;AND FINALLY RETURN.
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1673  016132  004767  000124          GT8:    JSR     PC,GTSIX                ;GT SIX BITS NOW.
1674  016136  010046                  MOV     RET1,-(SP)              ;SAVE THE CHARACTER NOW.
1675  016140  000401                  BR      GTP84                   ;BYPASS THE 8'ER
1676  016142  005002          GT84:   CLR     INP2                    ;RESET THE MAGIC REGISTER NOW.
1677  016144  005722          GTP84:  TST     (INP2)+                 ;INCREMENT WHERE TO GO.
1678  016146  066207  166250          ADD     GT8TB+150000(INP2),PC           ;UPDATE PC NOW.
1679
1680          016152          GT8P=.
1681
1682  016152  004767  000104          GT81:   JSR     PC,GTSIX                ;GT A CHARACTER NOW.
1683  016156  010004                  MOV     RET1,WORK2              ;SAVE FOR A SECOND.
1684  016160  006300                  ASL     RET1
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1685  016162  006300                  ASL     RET1                    ;SHIFT TO LEFT OF BYTE
1686  016164  106300                  ASLB    RET1
1687  016166  106116                  ROLB    @SP                     ;PACK THEM IN.
1688  016170  106300                  ASLB    RET1
1689  016172  106116                  ROLB    @SP                     ;A GOOD 8 BIT THING.
1690  016174  012600                  MOV     (SP)+,RET1              ;POP AND RETURN NOW.
1691  016176  000207                  RTS     PC
1692
1693  016200  006300          GT82:   ASL     RET1                    ;WORST CASE. SHIFT 4
1694  016202  006300                  ASL     RET1
1695  016204  106300                  ASLB    RET1
1696  016206  106104                  ROLB    WORK2
1697  016210  106300                  ASLB    RET1
1698  016212  106104                  ROLB    WORK2
1699  016214  106300                  ASLB    RET1
1700  016216  106104                  ROLB    WORK2
1701  016220  106300                  ASLB    RET1
1702  016222  106104                  ROLB    WORK2
1703  016224  010400                  MOV     WORK2,RET1
1704  016226  012604                  MOV     (SP)+,WORK2
1705  016230  000207                  RTS     PC
1706
1707  016232  006100          GT83:   ROL     RET1
1708  016234  006100                  ROL     RET1
1709  016236  006004                  ROR     WORK2
1710  016240  106000                  RORB    RET1
1711  016242  006004                  ROR     WORK2
1712  016244  106000                  RORB    RET1                    ;FINAL CHARACTER ASSEMBLED.
1713  016246  005726                  TST     (SP)+                   ;FUDGE STACK.
1714  016250  000207                  RTS     PC                      ;AND RETURN NOW.
1715
1716          016250          GT8TB   =       .-2                     ;PUSH ZERO CONDITION BACK INTO NEVER-NEVER LAND.
1717
1718  016252  000000                  .WORD   GT81-GT8P
1719  016254  000026                  .WORD   GT82-GT8P
1720  016256  000060                  .WORD   GT83-GT8P
1721  016260  177770                  .WORD   GT84-GT8P
1722
1723
1724  016262  004767  000020  GTSIX:  JSR     PC,GTCHR
1725  016266  020027  000040          CMP     RET1,#40
1726  016272  002546                  BLT     LBAD
1727  016274  020027  000137          CMP     RET1,#137
1728  016300  003143                  BGT     LBAD
1729  016302  000207                  RTS     PC
1730
1731
1732
1733  016304  005726          GTC4P:  TST     (SP)+                   ;UPDATE THE STACK.
1734
1735  016306  012700  015772  GTCHR:  MOV     #P10IC-30000,RET1               ;SET UP POINTER TO THF INPUT CHARACTER.
1736  016312  004767  000064  GTCHL:  JSR     PC,CHECK
1737  016316  005710                  TST     @RET1                   ;ANY CHARACTERS THERE?
1738  016320  001774                  BEQ     GTCHL
1739  016322  011046                  MOV     @RET1,-(SP)             ;PUSH THE CHAR ON THE STACK.
1740  016324  005020                  CLR     (RET1)+                 ;CLEAR THE CHAR GOT FLAG NOW.
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1741  016326  042716  177600            BIC     #-200,(SP)              ;CLEAR AWAY PARITY NOW.
1742  016332  001764                    BEQ     GTCHP                   ;IF ZERO, GT ANOTHER
1743  016334  022716  000177            CMP     #177,(SP)
1744  016340  001761                    BEQ     GTCHP                   ;ALSO IGNORE RUBOUTS.
1745  016342  022710  000175            CMP     #175,@RET1              ;WAS IT A '175'
1746  016346  001007                    BNE     GTNP                    ;NOPE.
1747  016350  011610                    MOV     (SP),@RET1              ;YEP. RESET IN CASE OF ABORT.
1748  016352  021027  000122            CMP     @RET1,#122              ;IS IT AN R
1749  016356  001626                    BEQ     RSTRT                   ;YEP. RESTART
1750  016360  021027  000114            CMP     @RET1,#114              ;IS IT AN L
1751  016364  001455                    BEQ     LOAD                    ;YEP. LOAD.
1752
1753  016366  011610            GTNP:   MOV     (SP),@RET1              ;NOW DO THE FDUGING.
1754  016370  012600                    MOV     (SP)+,RET1
1755  016372  020027  000175            CMP     RET1,#175
1756  016376  001743                    BEQ     GTCHR                   ;IF ALTMODE, LOOP
1757  016400  000207                    RTS     PC
1758
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1765
1766  016402  005767  027370    CHECK:  TST     P100C                   ;DO WE WANT TO OUTPUT?
1767  016406  001410                    BEQ     CHECK1                  ;NO.
1768  016410  105767  007200            TSTB    P100S                   ;WE DO. IS THE 10 READY?
1769  016414  100005                    BPL     CHECK1                  ;NOT QUITE.
1770  016416  016767  027354  007172    MOV     P100C,P100B             ;IT'S READY. SEND THE CHARACTER.
1771  016424  005067  027346            CLR     P100C                   ;AND THE SAVED CHARACTER.
1772
1773  016430  105767  011124    CHECK1: TSTB    KBDIS                   ;HEY, IS THE KEYBOARD READY?
1774  016434  100014                    BPL     CHECK3                  ;NOPE. NO LUCK.
1775  016436  116746  011120            MOVB    KBDIB,-(SP)             ;YEP. SAVE THE CHARACTER NOW.
1776  016442  012767  000001  011110    MOV     #1,KBDIS                ;AND REENABLE THE COMMUNICATIONS DEVICE.
1777
1778  016450  004767  177726    CHECK2: JSR     PC,CHECK                ;IS THE OUTPUT READY?
1779  016454  005767  027316            TST     P100C
1780  016460  001373                    BNE     CHECK2                  ;IF NOT, WAIT TILL DONE.
1781  016462  012667  007130            MOV     (SP)+,P100B             ;AND THEN SEND OUT THE CHARACTER.
1782
1783
1784  016466  105767  007116    CHECK3: TSTB    P10IS                   ;IS THE 10 TALKING TO ME.
1785  016472  100011                    BPL     CHECK4                  ;NOPE. EXIT.
1786  016474  116767  007112  027270    MOVB    P10IB,P10IC             ;GT THE CHARACTER NOW.
1787  016502  052767  177400  027262    BIS     #-400,P10IC             ;MAKE SURE IT'S NONE ZERO.
1788  016510  012767  000007  007072    MOV     #7,P10IS                ;REINITIALIZE COMMUNICATION LINE.
1789
1790  016516  000207            CHECK4: RTS     PC                      ;AND RETURN.
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1807                                    ;       THE    L O A D E R
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1809  016520  005002                    LOAD:   CLR     INP2                    ;RESET TO FIRST 8 BIT CHARACTER.
1810  016522  012712  172000                    MOV     #172000,(INP2)          ;AND ALSO CLEVERLY STOP THE VT40.
1811  016526  012706  015770                    MOV     #STKSRT,SP              ;RESET STACK POINTER NOW.
1812
1813  016532  005003                    LLD2:   CLR     LCKSM                   ;CLEAR THE CHECKSUM
1814  016534  004767  000070                    JSR     PC,LPTR         ;GT A BYTE NOW.
1815  016540  105300                            DECB    LBYT                    ;IS IT ONE?
1816  016542  001373                            BNE     LLD2                    ;NOPE. WAIT AWHILE
1817  016544  004767  000060                    JSR     PC,LPTR         ;YEP. GT NEXT CHARACTER.
1818
1819  016550  004767  000072                    JSR     PC,LGWRD                ;GT A WORD.
1820  016554  010005                            MOV     LBYT,LBC                ;GT THE COUNTER NOW.
1821  016556  162705  000004                    SUB     #4,LBC                  ;CHOP OFF EXTRA STUFF.
1822  016562  022705  000002                    CMP     #2,LBC                  ;NULL?
1823  016566  001437                            BEQ     LJMP                    ;YEP. MUST BE END.
1824  016570  004767  000052                    JSR     PC,LGWRD                ;NOPE. GT THE ADDRESS.
1825  016574  010001                            MOV     LBYT,LADR               ;AND REMEMBER FOR OLD TIMES SAKE.
1826
1827  016576  004767  000026          LLD3:   JSR     PC,LPTR         ;GT A BYTE (DATA)
1828  016602  002010                            BGE     LLD4                    ;ALL DONE WITH THE COUNTER?
1829  016604  105703                            TSTB    LCKSM                   ;YEP. GOOD CHECK SUM?
1830  016606  001751                            BEQ     LLD2                    ;NOPE. LOAD ERROR.
1831
1832  016610  012700                    LBAD:   MOV     (PC)+,RET1              ;SEND OUT SOME CHARACTERS NOW.
1833                                    ;       .BYTE   175,102                 ;'CTRL BAD'
1834  016612     102     175                    .BYTE   102,175                 ;'BAD CTRL'
1835  016614  004767  000110                    JSR     PC,SENDIT
1836  016620  000167  177210                    JMP     RSTRT
1837
1838  016624  110021                    LLD4:   MOVB    LBYT,(LADR)+            ;PLACE THE BYTE IN CORE.
1839  016626  000763                            BR      LLD3                    ;GT ANOTHER ONE.
1840
1841  016630  004767  177276          LPTR:   JSR     PC,GT8                  ;GT 8 BITS NOW.
1842  016634  060003                            ADD     LBYT,LCKSM              ;UPDATE CHECKSUM
1843  016636  042700  177400                    BIC     #177400,LBYT            ;CLEAN UP THE BYTE NOW.
1844  016642  005305                            DEC     LBC                     ;UPDATE THE COUNTER.
1845  016644  000207                            RTS     PC                      ;RETURN NOW.
1846
1847  016646  004767  177756          LGWRD:  JSR     PC,LPTR         ;GT A CHARACTER.
1848  016652  010046                            MOV     LBYT,-(SP)              ;SAVE FOR A SECOND.
1849  016654  004767  177750                    JSR     PC,LPTR         ;GT ANOTHER CHARACTER.
1850  016660  000300                            SWAB    LBYT                    ;NOW ASSEMBLE THE WORD.
1851  016662  052600                            BIS     (SP)+,LBYT              ;AND RETURN WITH A 16 BITER.
1852  016664  000207                            RTS     PC
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1853
1854  016666  004767  177754          LJMP:   JSR     PC,LGWRD                ;GT A WORD
1855  016672  010046                          MOV     LBYT,-(SP)              ;SAVE ON THE STACK.
1856  016674  004767  177730                  JSR     PC,LPTR         ;GT A CHARCTER.
1857  016700  105703                          TSTB    LCKSM                   ;IS IT ZERO?
1858  016702  001342                          BNE     LBAD                    ;YEP. WHAT CRAP.
1859  016704  032716  000001                  BIT     #1,(SP)                 ;IS IT ODD?
1860  016710  001406                          BEQ     LJMP1                   ;YEP. START PROGRAM GOING NOW.
1861  016712  012700                          MOV     (PC)+,RET1              ;TELL PDP-10 WE'VE LOADED OK.
1862                                  ;       .BYTE   175,107                 ;''CTRL GOOD''
1863  016714     107     175                  .BYTE   107,175                 ;''GOOD CTRL''
1864  016716  004767  000006                  JSR     PC,SENDIT
1865  016722  000000                          HALT
1866  016724  000776                          BR      .-2
1867
1868  016726  000136          LJMP1:  JMP     @(SP)+                  ;AND AWAY WE GO.
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1886  016730  004767  177446          SENDIT: JSR     PC,CHECK                ;POLL THE OUTPUT DEVICE NOW.
1887  016734  005767  027036                  TST     P100C                   ;OUTPUT CLEAR?
1888  016740  001373                          BNE     SENDIT                  ;NOPE. LOOP AWHILE LONGER.
1889  016742  010067  006650                  MOV     RET1,P100B              ;SEND OUT THE CHARACTER.
1890  016746  105000                          CLRB    RET1                    ;CLEAR THE BYTE.
1891  016750  000300                          SWAB    RET1                    ;AND SWAP THEM NOW.
1892  016752  001366                          BNE     SENDIT                  ;IF NOT EQUAL, REPEAT.
1893  016754  000207                          RTS     PC
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1911
1912                                    ;       THIS IS THE INITIALIZING VT40 PROGRAM WHICH WILL
1913                                    ;       JUMP TO THE PROGRAM AFTER THE POWER FAIL LOCATIONS
1914                                    ;       WHICH WILL JUMP TO ZERO WHICH WILL JUMP BACK TO HERE.
1915
1916
1917
1918
1919  016756  170256           DISPRG: .WORD   170256          ;LOAD STATUS REGISTER FOR NORMAL OPERATION.
1920  016760  115124                   .WORD   115124          ;SET POINT MODE, 'NORMAL'.
1921  016762  000000                   .WORD   STARTX          ;X COORDINATE
1922  016764  001360                   .WORD   STARTY          ;Y COORDINATE
1923  016766  100000                   .WORD   100000          ;SET CHARACTER MODE.
1924  016770  160000                   .WORD   JMPDIS          ;THEN JUMP TO THE POWERFAIL LOCATION.
1925  016772  000030                   .WORD   PWRFAL+4        ;TO DISPLAY USERS CHARACTERS.
1926  016774  000000                   .WORD   0
1927  016776  000000                   .WORD   0
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1940
1941  000001                   .END
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AGAIN   007712            1483#   1502
ALTMOD= 000175             682#   1003    1163    1196
BELL    006250             823    855#
BLIMIT= 007000             675#    678     768     789     874     893     940     944
BLKOFF= 000020            1244#   1280
BLKON = 000030            1245#   1315
BSTART= 001000             674#    876     896     913     943
CHAR  = 100000             625#
CHARA   001034             208#    408*    409     415     431
CHECK   016402            1736    1766#   1778    1886
CHECK1  016430            1767    1769    1773#
CHECK2  016450            1778#   1780
CHECK3  016466            1774    1784#
CHECK4  016516            1785    1790#
COREND= 036000            1574#   1591
CORSTR= 000004             677#    737
CR      006206             832#
CRLF  = 005015             681#    771
DEV     007474            1361    1386#
DEV1    007422            1364#   1366
DISJMP= 160000             684#    904     942     943     944     960
DISPRG  016756            1636    1919#
DISTOP= 173000             685#   1012    1135
DJMP  = 160000            1252#   1347
DL11IB= 175612             663#    664     982
DL11IS= 175610             662#    663     730*    980     983*
DL11OB= 175616             665#    990*   1037*   1038*
DL11OS= 175614             664#    665     733*    751     753*
DNOP  = 164000            1253#
DOCHAR  016110            1639    1648#
DONE    007554            1405    1416#
DONE0   001536             344#
DONE1   001610             351    358#
DSR     001006             197#    343*
DSTOP = 173400            1255#
DSWR  = 177570             182#    187     505
DUMP    001032             207#    226*    229*    247*    249*    250     255*
D2BTYP  002230             376*    380*    459#    464
END     001524             342#
ENDCOR  006036             740#    741
ERROR1  001136             223    234#
ERROR2  001210             252#
ERRVEC= 000004             183#    503     504*    511*
FF      006256             828    858#
FFLOOP  006262             853    860#    863
FILCNT  001026             205#    420*    425*
FILE0   007214            1277    1280#   1348
FILLER  001024             204#    420
GETCHR  006564             811    1002#   1024
GETDL   006516             980#    985     989     991    1002    1006
GETDL1  006546             981    988#
GETEXT  006650            1004    1010    1030#
GETSIX  006630            1024#   1062    1077
GET8    006664            1062#   1172
GET8TB  006700            1065    1067#
GET81   006712            1067    1077#
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GET82   006740          1068    1089#
GET83   006772          1069    1104#
GET84   006706          1073#
GRAPHX= 120000          1229#   1329
GRAPHY= 124000          1230#   1340
GTBUSE  006424           913#    936
GTCHL   016312          1736#   1738
GTCHP   016304          1733#   1742    1744
GTCHR   016306          1642    1724    1735#   1756
GTNP    016366          1746    1753#
GTP84   016144          1675    1677#
GTSIX   016262          1673    1682    1724#
GT40PC= 172000           670#    671     913*    947     1277*
GT40SR= 172002           671#    855*
GT8     016132          1673#   1841
GT8P  = 016152          1680#   1718    1719    1720    1721
GT8TB = 016250          1678    1716#
GT81    016152          1682#   1718
GT82    016200          1693#   1719
GT83    016232          1707#   1720
GT84    016142          1676#   1721
HEADER  006474           903     942     948     954#
HSR   = 177550          1355#   1387
ICNT    001030           206#    215*    342*
ICOUNT  002210           440     447#
IMAGE   001004           196#    315     515*    518*
INCR  = 000100          1266#   1324
INSERT  006350           836     844     882     890#
INSRTL  006406           894     897     902#
INSRTX  006422           892     907#
INTX  = 040000          1267#   1285    1289    1293    1297
INT0  = 002000          1233#   1284
INT1  = 002200          1234#   1303
INT2  = 002400          1235#   1288
INT3  = 002600          1236#   1305
INT4  = 003000          1237#   1292    1315
INT5  = 003200          1238#   1307
INT6  = 003400          1239#   1296
INT7  = 003600          1240#   1309
ITAL0 = 000040          1259#
ITAL1 = 000060          1260#
JMPADD= 007012           678#    870     881*    960     1012*   1135*
JMPDIS= 160000          1596#   1634    1924
KBDIB = 027562           668#    990    1586#   1775
KBDIS = 027560           667#    668     988    1582#   1586    1627*   1773    1776*
LBAD    016610          1726    1728    1832#   1858
LF      006300           826     867#
LFLOOP  006310           872#    875     877
LFOUND  006330           873     879#
LFSUB   006304           861     870#
LGWRD   016646          1819    1824    1847#   1854
LINE0 - 000004          1247#   1284
LINE1 = 000005          1248#   1288
LINE2 = 000006          1249#   1292
LINE3 = 000007          1250#   1296
LJMP    016666          1823    1854#
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LJMP1   016726            1860    1868#
LLD2    016532            1813#   1816    1830
LLD3    016576            1827#   1839
LLD4    016624            1828    1838#
LOAD    016520            1751    1809#
LOADER  007012            1008    1135#
LOGICA  001600             174     354#
LONGV = 110000            1227#   1284    1288    1292    1296
LOOP    007444            1373#   1380
LOOP1   007522            1404#   1409
LOOP2   007526            1406#   1407    1412
LPDARK= 000200            1258#
LPLITE= 000300            1257#
LPOFF = 000100            1242#
LPON  = 000140            1243#
LPTR    016630            1814    1817    1827    1841#   1847    1849    1856
LSR   = 177560            1356#   1386
L.BAD   007100            1026    1028    1162#   1193
L.GWRD  007126            1147    1152    1179#   1189
L.HALT  007200            1201#
L.JMP   007146            1151    1189#
L.JMP1  007202            1199    1203#
L.LD2   007022            1140#   1143    1159
L.LD3   007066            1156#   1168
L.LD4   007110            1157    1167#
L.PTR   007114            1141    1145    1156    1172#   1179    1181    1191
MAJOR   016072            1642#   1646
MAXSX = 017600            1272#
MAXSY = 000077            1273#
MAXX  = 001777            1268#   1285    1293
MAXY  = 001377            1269#   1282    1290    1298
MINSUY= 000100            1274#
MINUSX= 020000            1270#   1271    1290    1293
MINUSY- 020000            1271#
M7      002336             370     489#
M8      002361             368     391     394     396     490#
M9      002365             379     491#
NORMAL  006212             815     824     836#
NOTHER  006042             738     744#
NUMLIN= 000040             679#    768     769     858     944
NXTCHR  006132             811#    813     819     838     848     856     864     867
ORIGIN= 166000             660#
OTHER   007726            1438    1443    1467    1482    1490    1494#
OUTLIT  006652             734    1037#   1162    1195
O2A     002232             377     381     460#
O2AA    002262             469#    481
POINT = 114000            1228#   1280    1300    1312    1321    1325    1336
PRESTR  006624            1013#   1164
PRG0    001050             215#    358
PRG0R   001054             216#    217
PRG1    001614             190     364#    398
PRG1A   001652             372#
PRG1B   001670             376#    392
PRG1C   001706             380#    388
PRG1D   001756             386     393#
PRMTRS  001040             189     210#
```

```
PSW    = 177776            181#    451*
PTBOOT  007400            1359#
PWRFAL= 000024            1599#   1620    1637    1925
P10IB  = 025612           1587#   1786
P10IC  = 045772           1592#   1593    1735    1786*   1787*
P10IS  = 025610           1584#   1587    1626*   1784    1788*
P100B  = 025616           1588#   1770*   1781*   1889*
P100C  = 045776           1591#   1592    1766    1770    1771*   1779    1887
P100S  = 025614           1583#   1588    1628*   1768
RCVEC   007764            1508#
RC11    007720            1489#   1508
RELATV= 130000            1231#   1315
RES     007506            1399#   1414
RESTRT  006060             765#   1013
RETURN  002214             217*    445*    449#    452
RFVEC   007714            1486#
RF11    007600            1437#   1486
RKVEC   007760            1506#
RK11    007610            1442#   1506
ROMADD  001000             194#    221     244     281     296*    316     372
ROMORG= 166000            1575#
RPVEC   007770            1510#
RP11    007654            1466#   1510
RSTRT   016034            1632#   1749    1836
R0SAV   001010             198#    495*
R1SAV   001012             199#    496*
R2SAV   001014             200#    497*
R3SAV   001016             201#    498*
R4SAV   001020             202#    499*
R5SAV   001022             203#    500*
SAVE05  002372             235     252     257     262     267     285     291     297     332     495#
SCOPE  = 104400            178#    238     273     305     340
SCOPEB  002216             437     443     450#
SCOPEC  002140             171     436#
SCOPEF  002212             440     442*    444*    448#
SCOPEG  002176             439     441     444#
SENDIT  016730            1835    1864    1886#   1888    1892
SETDUN  006126             780     789#
SETUP1  006074             771#    773
SETLP2  006110             779#    786
SETLP3  006116             783#    785
SETUP   006432             776     934#
SHORTV= 104000            1226#   1303    1305    1307    1309
START   006000             196     515     729#
STARTA  016000             518    1620#
STARTX= 000000            1577#   1921
STARTY= 001360            1578#   1922
STATSA= 170000            1254#
STATSB= 174000            1264#   1324
STKPTR= 000500             184#    210     216     280     364
STKSRT= 015770            1593#   1632    1811
STOP    007550            1413#   1417
SWITCH  002424             211     366     503#
SWR     000172             187#    436     438     505*    506     510*    512
SWREG   000170             186#    510
SYNON   000004            *261#
```

```
TAB     006222            825    843#    847
TABLE   007562           1400   1420#
TABLEX  002652            324    542#
TABLE0  002536            321    523#
TABOOT  007500           1397#  1427
TACS  = 177500           1395#  1397
TAPES   007662           1449   1458   1471#
TCVEC   007774           1512#
TC11    007620           1448#  1512
TERM    001036            209#   407*   409
TMPEND= 007776            676#   731    765
TM11    007636           1457#
TPCSR = 177564            179#   345    348    374    382    412    417    423    429    460    470    485*
TPDBR = 177566            180#   344*   347*   384*   419*   422*   427*   431*   472*
TYPEM   001776            367    369    378    390    393    395    405#
TYPEMA  002006            408#   428    432
TYPEMB  002034            410    415#
TYPEMC  002122            416    429#
T1      001066            221#
T1A     001104            224#   232    237
T1B     001150            233    238#
T2      001152            244#
T2A     001170            247#   254    272
T2B     001220            251    255#   259
T2C     001236            256    260#   264
T2D     001252            261    265#   269
T2E     001266            266    270#
T3      001276            280#
T3A     001320            284#   287
T3AA    001312            283#   303
T3B     001332            283    288#
T3C     001342            290#   293
T3D     001354            288    294#
T3E     001364            296#   299
T3F     001400            294    300#
T4      001420            314#
T4A     001434            317#   334    339
T4B     001450            322#   327
T4C     001470            323    328#
T4D     001500            325    332#
T4E     001510            320    331    336#
VT      006244            827    851#
VT40PC= 022000           1581#  1640*
WORDS   001002            195#   222    245    282    338    371    514*   517*
.     - 017000            164#   168    170#   173#   175#   185#   188#   193#   346    375    383    413    418
                          424    430    471    492#   715#  1376   1400   1479   1501   1611#  1680   1716   1866

. ABS.  017000      000      CON    RW     ABS    LCL    I

 ERRORS DETECTED:  0

 CDGTDD,CDGTDD/CRF-CDGTDD
 RUN-TIME: 2 4 .6 SECONDS
 RUN-TIME RATIO: 18/7-2.5
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CORE USED: 7K (13 PAGES)