TR79·F

DRS TR79F UTIL TIM
CZTRBDO

AH-9433D-MC
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IDENTIFICATION

PRODUCT CODE: AC-9431D-MC

PRODUCT NAME: CZTRBD0 TR79 UTILITY PROGRAMS

PRODUCT DATE: FEBURARY 1982

MAINTAINER: MERRIMACK DIAGNOSTIC ENGINEERING

TR79 UTILITY PROGRAM

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1. ABSTRACT

THIS PROGRAM IS IN TWO PARTS, AND IS INTENDED TO PROVIDE THE USER WITH A TOOL FOR TROUBLE-SHOOTING THE TR79 MAGTAPE SUBSYSTEM ON A PDP-11 COMPUTER SYSTEM. THE FIRST PART OF THE PROGRAM ALLOWS THE USER TO GIVE THE MAGTAPE, COMMANDS, TO SIMULATE USER ROUTINES BY MERELY INSERTING THESE COMMANDS IN THE CORE LOCATIONS PROVIDED. THE USER MAY EXECUTE ONE OR SEVERAL INSTRUCTIONS IN ANY LEGAL SEQUENCE. WHILE THE CODE FOR THE DRIVER IS SIMPLE AND USES NO INTERRUPTS, DUE TO THE DESIGN OF THE HARDWARE CERTAIN ERROR CONDITIONS MUST BE IDENTIFIED IN ORDER TO PREVENT MISINTERPRITATION OF THE DESIRED RESULTS.

PART TWO OF THE PROGRAM CONSIST OF SELF CONTAINED ROUTINES TO PERMIT THE USER TO SET UP AND CHECK THE DELAYS CONTAINED WITHIN THE TR79 CONTROLLER, BY USING THE SWITCH REGISTER TO SELECT THE APPROPRIATE ROUTINE.

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2. REQUIREMENTS

2.1 HARDWARE
A. PDP-11 PROCESSOR
B. TR79 MAGTAPE TRANSPORT (HP-7970E DRIVE)
C. TR79F MAGTAPE CONTROLLER

2.2 STORAGE

THIS PROGRAM REQUIRES A MINIMUM OF 4K OF CORE

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3. LOADING

USE STANDARD BINARY LOADING PROCEDURE

4.0 STARTING PROCEDURE

THERE ARE TWO STARTING ADRESSES THAT MAY BE USED

4.1 200 (8): LA 200 SR=0 A START AT THIS ADRESS WILL RESULT IN A PROGRAMMED DEFAULT OPERATION OF A WRITE FORWARD WITH A WORD COUNT OF -20 AND A DATA PATTERN OF ALL 1'S. TO MODIFY THESE PARAMETERS SEE SECTION 7.1 PROGRAM OPERATION
NOTE: ALSO SEE SECTION 5.0 PROGRAM RESTRICTIONS, THE DEFAULT OF WRITE WILL NOT WORK IF TAPE IS AT B.O.T..

4.2 204 (8) LA 204 SR=0 A START AT THIS ADRESS WILL EXECUTE THE SPECIALLY DESIGNED SETUP ROUTINES TO ALLOW THE USER TO SETUP OR VERIFY THE DELAYS WITHIN THE TR79 CONTROLLER.
NOTE: ALLWAYS USE SCRATCH TAPES WHEN TAPE MOTION IS INDICATED.

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5.0 RESTRICTIONS

5.1 A. A PSEUDO-OP OF A 20(8) HAS BEEN PROVIDED TO ALLOW THE USER TO POWER CLEAR BETWEEN OPERATIONS IF DESIRED,HOWEVER THE PROGRAM CAN RECOVER FROM ERRORS. THIS IS A POWER CLEAR AND TAKES 900 MILI-SECONDS TO COMPLETE.
ANY ATTEMPTS TO ISSUE INSTRUCTIONS TO THE CONTROLLER WHILE A POWER CLEAR IS IN PROGRESS WILL RESULT IN ILLEGAL COMMAND BIT SETTING WHICH WILL INHIBIT ANY FURTHER INSTRUCTIONS FROM BEING EXECUTED. A POWER CLEAR IS ALSO GENERATED FROM A BUS INIT WHICH OCCURS FROM A RESET INSTRUCTION. THE DRIVER USES NO RESETS. (USE CAUTION IF YOU MODIFY THE DRIVER PACKAGE.)

B. THE TR79 CONTROLLER CHECKS FOR CERTAIN ILLEGAL FUNCTIONS DUE TO TAPE POSITION OR STATUS, THE DRIVER PACKAGE WILL CHECK THESE CONDITIONS AND HALT AT APPROPRIATE LOCATIONS WITH MEANINGFULL DATA DISPLAYED (SEE SECTION 7.2 ERROR CHECKS).
THE LISTED CONDITIONS WILL P.ODUCE ILLEGAL COMMAND ERRORS:

1. ATTEMPT TO WRITE DATA FROM LOAD POINT WITHOUT AN I.D.B.
2. ATTEMPT TO WRITE A TAPE MARK FROM LOAD POINT
3. ATTEMPT TO MOVE TAPE IN REVERSE FROM LOAD POINT
4. ATTEMPT TO WRITE AN I.D.B. AT OTHERTHAN LOAD POINT
5. ATTEMPT TO WRITE DATA WITH THE WRITE RING REMOVED
6. ISSUE A COMMAND WHILE THE MAGTAPE IS NOT READY
7. ISSUE A COMMAND WHILE THE CONTROLLER IS NOT READY
8. ISSUE A COMMAND WITH INHIBIT BIT SET
9. ILLEGAL FUNCTION CODES 00,03,05,06,11,12,14

C. THE PROGRAM DOES NO DATA CHECKS ON READ OR WRITE DATA TRANSFERRED. IT IS THE RESPONSIBILITY OF THE OPERATOR TO MANUALLY EXAMINE THE BUFFER LOCATIONS TO DETERMINE IF THERE HAVE BEEN ANY PICKED OR DROPPED BITS IF DESIRED.

D. NOTE: HARDWARE OPERATION OF THE TR-79 SPECIFIES THAT EACH CORE WORD LOCATION CONTAIN ONE BYTE (BITS 0-7) OF DATA AND PARITY (BIT 8). THEREFORE WHEN CALCULATING THE WORD COUNT FOR A TRANSFER THE ACTUAL NUMBER OF CORE BYTE LOCATIONS ACCESSED IS EQUAL TO 2X THE NUMBER LOADED IN THE WORD COUNT REGISTER.
ALSO NOTE THAT THE CONTROLLER DOES NOT APPEND PARITY TO THE BYTE BEFORE DOING A WRITE OPERATION. PARITY MUST BE CORRECT IN CORE OTHERWISE ERRORS WILL OCCUR ON
THE TRANSFER (ODD PARITY) IS ALWAYS USED.

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6.0 CONSOLE SWITCH SETTINGS

SW 15 = 1 STOP AFTER EACH OPERATION (ONLY WITH START 200)
0 PROCEED

SW 14 = 1 STOP AT THE END OF EACH PROGRAM PASS (ONLY WITH START 200)
0 PROCEED

SW 7 = 1 ENABLE FOR DELAY ROUTINES (EXECUTE ROUTINE ONLY WITH START 204)
0 ALLOW SELECTION OF DELAY ROUTINES WITH SW 0-3

SW 0 THU 3 = DELAY ROUTINE TO BE EXECUTED (ONLY WITH START 204)

6.1 DELAY SETUP TABLE

SWITCH SETING	DELAY NAME	MODULE TYPE	LOCATION	PRINT PAGE	INPUT PIN	OUTPUT PIN	TIME
00	NO-OP						
01	P CLR	M-302	C-06	T02-2	H2	F2	20 MILI SEC.
02	P CLR OFF	M-306	D-09	T04-1	H2	T2	900 MILI SEC.
03	ERROR CLK	M-302	C-10	T04-2	H2	F2	200 NANO SEC.
04	WRITE ENAB	M-302	C-10	T09-3	M2	T2	40 MICRO SEC.
05	BUFF CONT	M-304	B-18	T11-1	E1	J1	1 MICRO SEC.
06	END WR DAT	M-302	A-16	T11-1	M2	T2	18 MICRO SEC.
07	1ST WD REQ	M-302	A-22	T11-2	H2	F2	100 MICRO SEC.
10	ERASE	M-304	B-18	T09-3	S1	M1	1 MICRO SEC.
11	WRITE IDB	M-302	A-16	T09-1	H2	F2	17 MILI SEC.
12	IDB TIMING	M-302	D-13	T09-1	H2	F2	75 MILI SEC.
13	ABORT	M-306	A-25	T09-3	H2	T2	1.5 SEC.
14	BUSY DELAY	M-304	B-18	T05-1	R1	P1	100 NANO SEC.
15	GO BIT DEL	M-304	B-18	T06-1	D1	H1	1 MICRO SEC.
16	M.S.D.	M-302	A-22	T09-2	M2	T2	900 MILI SEC.
17	NO-OP						

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                              ******************************
                              *   DELAY CONDITION NOTES    *
                              ******************************

6.2   DELAY        $$=FIXED DELAYS
      ------

            00    NO OPERATION PERFORMED WAITING SWITCH SELECTION AND ENABLE

            01    POWER CLEAR PERFORMED  NO TAPE MOTION   DELAY PULSE IS POSITIVE GOING

            02    POWER CLEAR PERFORMED  NO TAPE MOTION   DELAY PULSE IS POSITIVE GOING

            03    NO TAPE MOTION, PROGRAM FORCES AN ERROR WITH THE BGL BIT
                  IN THE TR STATUS REGISTER (BIT 11)  DELAY PULSE IS POSITIVE GOING

            04    TAPE MOTION, PROGRAM DOES A SHORT ERASE WHILE MOVING TAPE
                  TAPE MOTION IS NOT READILY NOTICIBLE WHILE EXECUTING THIS ROUTINE
                  DELAY PULSE IS POSITIVE GOING

      $$    05    TAPE MOTION, PROGRAM DOES A 10 BYTE WRITE, PROGRAM CHECKS
                  FOR LOAD POINT AND WILL WRITE AN I.D.B. BEFORE ENTERING THE
                  DELAY LOOP.  DELAY PULSE IS POSITIVE GOING

            06    SAME CONDITIONS AS 05  DELAY PULSE IS POSITIVE GOING

            07    SAME CONDITIONS AS 05  DELAY PULSE IS POSITIVE GOING

      $$    10    TAPE MOTION, PROGRAM WILL CHECK FOR LOAD POINT THEN DO A
                  MAXIMUM ERASE TO MAKE THE OPERATION CONTINIOUS THE PROGRAM
                  WILL CLEAR THE ERASE COUNT BEFORE THE OPERATION IS DONE.
                  DELAY PULSE IS NEGATIVE GOING

            11    TAPE MOTION, PROGRAM WILL CONTINIOUSLY WRITE  THE I.D.B.
                  DELAY PULSE IS POSITIVE GOING

            12    SAME CONDITIONS AS DELAY 11.  DELAY PULSE IS POSITIVE GOING

            13    PROGRAM WILL REWIND TAPE TO L.P. AND FORCE AN ERROR BY DOING
                  A WRITE DATA. DELAY PULSE IS POSITIVE GOING.

      $$    14    TAPE WILL MOVE TO L.P. , AND DO A MAXIMUM ERASE.
                  WHILE THIS IS HAPPENING PROGRAM WILL LOAD THE COMMAND
                  REGISTER TO PRODUCE A LD CTRL PULSE. DELAY PULSE IS POSITIVE GOING

      $$    15    SAME CONDITIONS AS DELAY 04.  DELAY PULSE IS NEGATIVE GOING

            16    PROGRAM WILL MOVE TAPE TO E.O.T. AND ATTEMPT TO DO A FAST
                  FORWARD TO PRODUCE THE MOTION STOP DELAY. DELAY IS POSITIVE.
                  NOTE: AFTER COMPLETION OF THIS ROUTINE A MANUAL REWIND
                        SHOULD BE PERFORMED.

            17    THIS IS A NO OPERATION SAME AS 00
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7.0 OPERATION

THE PROGRAM IS QUITE SIMPLE HOWEVER IT DOES REQUIRE KNOWLEGE OF THE
OF THE TR-79 MAGTAPE SYSTEM AND AN UNDERSTANDING OF THE PROGRAM
FUNCTIONS AND RESTRICTIONS. THE CODE HAS BEEN ASSEMBLED IN IMMEDIATE
AND ABSOLUTE MODES USING PC ADRESSING. IT IS RECOMMENDED THAT THE
USER READ AND UNDERSTAND THE RESTRICTIONS AND OPERATIONS SECTIONS.

THE DRIVER PROGRAM (LOAD ADRESS 200,START SWITCHES =0) CAN BE MADEB
TO EXECUTE ANY LEGAL SEQUENCE OF OPERATIONS (SEE SECTION 7.3) BY
INSERTING THE COMMANDS IN THE OPERATIONS TABLE, (CORE LOCATIONS 722
THRU 766). EACH COMMAND SHOULD OCCUPY ONE CORE LOCATION BITS 0-4
ONLY. THE TOTAL NUMBER OF COMMANDS TO BE EXECUTED SHOULD THEN BE ENTERED
IN LOCATION 720. THE PROGRAM PARAMETERS MAY BE ALTERED BY CHANGING
THE APPROPRIATE CORE LOCATIONS (SEE SECTION 7.1). PROGRAM DEFAULT
IS A SINGLE WRITE COMMAND OF 20 WORDS OF ALL 1'S FROM LOCATION 2700
WITH MINIMUM DELAY BETWEEN OPERATIONS. THIS DEFAULT WILL NOT WORK
IF THE TAPE IS POSITIONED AT LOAD POINT.

THE DELAY PROGRAM (LOAD 204,START SWITCHES=0) WILL EXECUTE THE DELAY
SET-UP ROUTINES TO ALLOW SET-UP OF ALL THE DELAYS IN THE TR-79 CONTROLLER
THE PROGRAM HAS AN ACTIVE SWITCH REGISTER AFTER STARTING. BY SELECTING
THE DESIRED DELAY ROUTINE IN SWITCH REGISTER 0 THRU 3, AND THEN SETTING
BIT 7 =1 THE ROUTINE WILL BEGIN EXECUTION. TO CHANGE THE DELAY ROUTINE
SET BIT 7=0, WAIT A FEW SECONDS FOR COMPLETION OF THE ROUTINE, THEN
ENTER THE NEW ROUTINE NUMBER IN BITS 0-3 AND SET BIT 7=1. THE DELAY
PROGRAM CONTAINS NO ERROR HALTS, HOWEVER IF ERRORS ARE DETECTED THE
PROGRAM WILL INFORM THE USER BY OUTPUTTING A BELL CODE TO THE CONSOLE
TERMINAL. THE PROGRAM WILL THEN DO A CONTROL RESET AND CONTINUE.

NOTE: THE PROGRAM BUILDS THE CORE DATA BUFFERS EACH TIME THE PROGRAM
IS STARTED. THE PROGRAM DEFAULT IS LOCATION 2700 HOWEVER
THIS MAY BE CHANGED BY MODIFYING LOCATION 242 IN THE CORE
BUILD ROUTINE TO PUT THE BUFFERS ANYPLACE IN THE LOWER 28K.
THIS PROGRAM DOES NOT PROGRAM THE KT AND DOES NOT RELOCATE
ABOVE THE LOWER 28K OF MEMORY.

7.1 PROGRAM PARAMETER LIST AND CORE ADRESSES

PARAMETER	LOCATION	DESCRIPTION
EXTENDED CORE ADDRESS	700	BITS 12 AND 13 OF THIS LOCATION REPRESENT XBA 16 AND XBA 17 OF THE TR CONTROL REGISTER THESE BITS ALLOW RELOCATION OF THE DATA BUFFER.
UNIT SELECT	702	BITS 8+9 IN THIS LOCATION REPRESENT THE UNIT NUMBERS OF THE TAPE DRIVES. A MAXIMUM OF 4 DRIVES PER CONTROLLER DEFAULT IS UNIT 0.
WORD COUNT	704	THIS IS THE 2'S COMPLIMENT OF THE NUMBER OF WORDS TRANSFERRED. SINCE EACH BYTE OCCUPIES A WORD LOCATION THE NUMBER OF CORE LOCATIONS USED IS 2X THE WORD COUNT. PROGRAM DEFAULT IS -20 WORDS.
READ ADRESS	706	CONTAINS ADRESS OF THE READ BUFFER. PROGRAM DEFAULT IS LOCATION 6700.
WRITE ADRESS	710	CONTAINS ADRESS OF THE WRITE BUFFER. THE PROGRAM CONTAINS 4 WRITE PATTERNS CONTIGIOUS IN CORE. LOCATION 2700 = ALL 1'S PATTERN LOCATION 3700 = ALTERNATE 1 AND 0 BYTES LOCATION 4700 = ALTERNATE 1 AND 0 BITS LOCATION 5700 = SLIDING 1 BIT PATTERN PROGRAM DEFAULT IS LOCATION 2700
ERASE COUNT	712	CONTAINS A 2'S COMPLIMENT NUMBER PROPORTIONAL TO THE AMOUNT OF TAPE TO BE ERASED. THIS NUMBER IS LOADED INTO THE WORD COUNT REGISTER PRIOR TO AN ERASE COMMAND BIENG PERFORMED. PROGRAM DEFAULT IS 77777 . EACH INCREMENT CAUSES .02 INCHES OF TAPE TO BE ERASED.
OPERATION DELAY	714	CONTAINS A NUMBER USED IN A TIMER BETWEEN OPERATIONS DEFAULT =000001 MINIMUM DELAY
OPERATION DELAY MULT.	716	THIS IS USED IN CONJUNCTION WITH LOC. 714 AS A MULTIPLIER IN THE DELAY TIMER. DEFAULT IS 000004 MINIMUM DELAY. INCREASING THIS NUMBER WILL ALLOW MORE TIME BETWEEN OPERATIONS.
OPERATIONS NUMBER	720	THIS LOCATION CONTAINS THE NUMBER OF OPERATIONS TO BE PERFORMED IN THE OP TABLE. DEFAULT = 1 .
OPERATIONS TABLE	722 THRU 766	THIS IS THE BEGINNING OF THE OPERATIONS TABLE. ALL OPERATIONS TO BE PERFORMED SHOULD BE ENTERED IN THE DESIRED SEQUENCE IN THIS TABLE. DEFAULT IS A WRITE OPERATION.

7.2 ERROR CHECKS AND HALTS

LOCATION	DESCRIPTION
1320	HALT HERE IF THERE WAS AN ATTEMPT TO EXECUTE AN ILLEGAL FUNCTION, DUE TO TAPE POSITION OR SEQUENCE OF INSTRUCTIONS. THE ILLEGAL COMMAND IS DISPLAYED IN R0 WHEN THE PROGRAM HALTS. SEE SECTION 5.1B FOR ILLEGAL FUNCTIONS
1332	HALT HERE IF THERE WAS A HARDWARE ERROR ON THE PREVIOUS OPERATION IF IT IS DESIRED TO BYPASS THE ERROR FLAG NOP THIS LOCATION. THE COMMAND AND STATUS REGISTER SHOULD BE EXAMINED AT THIS TIME TO DETERMINE THE PROBABLE CAUSE OF THE ERROR. PRESSING CONTINUE WILL CLEAR THE ERROR BY EXECUTING A CONTROL RESET.
1350	HALT HERE IF YOUR OPERATION TABLE LOC.722-766 HAS AN OPERATION THAT IS NOT DEFINED IN THE LEGAL FUNCTION CODES. R0 HAS THE BAD CODE IN IT,CHECK YOUR TABLE IN LOCATIONS 722 THRU 766.
1406	HALT HERE IF BIT 15 OF THE SWR IS SET. THIS IS THE HALT BETWEEN INSTRUCTIONS.
1432	HALT HERE IF BIT 14 OF THE SWR IS SET. THIS IS THE HALT BETWEEN PASSES OF INSTRUCTIONS IN THE OP TABLE.

7.3 TABLE OF LEGAL FUNCTIONS AND CODES FOR USE IN OPERATIONS TABLE (LOC 722-766)

CODE	FUNCTION
00	**** ILLEGAL ****
01	WRITE DATA (ILLEGAL IF EXECUTED FROM LOAD POINT)
02	READ (DATA, TAPE MARK OR I.D.B.)
03	**** ILLEGAL ****
04	SPACE REVERSE (ILLEGAL IF ISSUED FROM LOAD POINT)
05	**** ILLEGAL ****
06	**** ILLEGAL ****
07	ERASE
10	REWIND (TAPE MOVES AT 160 I.P.S.) ILLEGAL IF ISSUED FROM LOAD POINT.
11	**** ILLEGAL ****
12	**** ILLEGAL ****
13	FAST FORWARD (TAPE MOVES FORWARD AT 160 I.P.S.)
14	**** ILLEGAL ****
15	WRITE I.D.B. (ILLEGAL IF ISSUED AT OTHER THAN LOAD POINT)
16	WRITE TAPE MARK (ILLEGAL IF ISSUED FROM LOAD POINT)
17	OFFLINE (REQUIRES MANUAL INTERVENTION)
20	CONTROL RESET (PROGRAM PSEUDO OP)

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                                        8.  PROGRAM LISTING



                        .ENABLE ABS,AMA
                                .TITLE TR79 UTILITY DRIVER
000000                          .ASECT

                        ;***************************************
                        ;*   GENERAL REGISTER DEFINITIONS  *
                        ;***************************************

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

                        ;***********************************
                        ;*  TR79  REGISTER DEFINITIONS  *
                        ;***********************************

164000                      TRCOM=164000
164002                      TRSTAT=164002
164004                      TRWC=164004
164006                      TRBA=164006

                        ;***************************************
                        ;*  PROCESSOR REGISTER DEFINITIONS *
                        ;***************************************

177776                      PSW=177776
177570                      SWR=177570

                        ;***********************
                        ;*   TTY REGISTERS    *
                        ;***********************

177564                      TTSTAT=177564
177566                      TTBUF=177566
```

```
                                ;
                                ;
                                ;
                                ;
                                ;               ******************
                                ;               *  TRAP CATCHERS *
                                ;               ******************
                                ;
        000000                                  .=0
        000200                                  .REPT  200
                                                .+2
                                                HALT
                                                .ENDR
                                ;
                                ;
                                ;               **************************************
                                ;               *   STARTS AND CORE BUFFER BUILD    *
                                ;               **************************************
                                ;
                                ;
        000200                                  .=200
000200  000137  000230          BEGIN:          JMP @#CORBIL        ;NORMAL START
000204  005237  000356          BEGIN2:         INC @#NORST         ;SETS FLAG TO DETERMINE WHO STARTED
000210  000137  000230                          JMP @#CORBIL        ;START HERE FOR DELAY ROUTINES
000214  000777                          000777
000216  000777                          000777
000220  000400                          000400
000222  000777                          000777
000224  000525                          000525
000226  000652                          000652
000230  012701  000214          CORBIL: MOV     #214,R1             ;SET UP PATTERN GENERATOR
000234  012703  000216                  MOV     #216,R3             ;SET UP PATTERN GENERATOR
000240  012702  002700          X1:     MOV     #2700,R2            ;SET UP ADRESS POINTER
000244  012700  177400          X2:     MOV     #177400,R0          ;SET UP COUNTER
000250  011122                  X3:     MOV     (R1),(R2)+          ;DO IT
000252  005200                          INC     R0                  ;KEEP TRACK OF HOW MANY
000254  001403                          BEQ     X4                  ;CHECK FOR DONE
000256  011322                          MOV     (R3),(R2)+          ;DO IT
000260  005200                          INC     R0                  ;KEEP COUNTING
000262  001372                          BNE     X3                  ;LOOP HERE
000264  062701  000004          X4:     ADD     #4,R1               ;NEXT PATTERN
000270  062703  000004                  ADD     #4,R3               ;GO TO NEXT PATTERN
000274  022701  000230                  CMP     #230,R1             ;DONE YET
```

```
                                        ;
                                        ;
                        BNE     X2                      ;NOT DONE YET
SLB:                    CLR     R0                      ;CLEAR THE PATTERN GENERATOR
                        CLR     R1                      ;CLEAR THE PATTERN COUNTER
                        INC     R0                      ;SET BIT IN PATTERN
SLB1:                   INC     R1                      ;KEEP COUNT
                        MOV     R0,(R2)+                ;PUT IT IN CORE
                        CMP     #6700,R2                ;SEE IF WERE FINISHED
                        BEQ     SLBDON                  ;YES JUMP OUT
                        CMP     #11,R1                  ;CHECK ON THE BIT POSITION
                        BEQ     SLB                     ;RESET THE SLIDING BIT
                        ASL     R0                      ;SHIFT THE BIT
                        BR      SLB1                    ;LOOP AGAIN
SLBDON:                 TST     @#NORST                 ;SEE WHERE THE START CAME FROM
                        BEQ     ALD                     ;IF = 0 MUST HAVE BEEN START 200
                        CLR     @#NORST                 ;CLEAR IT OUTFOR NEXT TIME
                        JMP     @#DRTN                  ;NOT = GO TO 204 START
ALD:                    JMP     @#START                 ;GO TO A 200 START
NORST:                  000000                          ;TEMPORARY LOCATION
                        ;
                        ;                       **************
                        ;                       *   STACKS   *
                        ;                       **************
                        ;
                                .=500
SUBSTK:                 000000                          ;SUBROUTINE STACK
                        ;
                        ;
                        ;
                                .=600
                        ;STACK:  000000                  ;SET STACK HERE
                        ;
                        ;
                        ;
```

```
                                ;
                                ;
                                ;                       ****************************************
                                ;                       *  PROGRAM CONSTANTS AND VARIABLES *
                                ;                       ****************************************
                                ;
                                          .=664
000664  000000        SWRTEM:   000000    ;TEMP STORAGE FOR SWITCH REGISTER
000666  000000        TIMMUL:   000000    ;CONTAINS DELAY MULTIPLIERS
000670  000000        COMTEM:   000000    ;TEMP STORAGE FOR COMMAND REGISTER
000672  000000        STTEM:    000000    ;TEMP STORAGE FOR STATUS REGISTER
000674  000000        TEMP1:    000000    ;TEMP STORAGE FOR THE NUMBER OF OPERATIONS TO BE PERFORMED
000676  000000        TEMP2:    000000    ;TEMP STORAGE FOR THE OPERATION BIENG PERFORMED
000700  000000        EXTCOR:   000000    ;BITS 12 AND 13 ARE XBA 16AND XBA 17
000702  000000        UNIT:     000000    ;UNIT SELECT BITS 8 AND 9
000704  177760        WCNT:     -20       ;WORD COUNT
000706  006700        RADDR:    006700    ;START OF READ BUFFER
000710  002700        WADDR:    002700    ;START OF WRITE BUFFER
000712  177777        ERSCNT:   177777    ;CONTAINS LENGTH OF ERASURE WHEN DOING AN ERASE
000714  000001        OPDLY:    000001    ;OPERATION DELAY
000716  000001        OPDLX:    000001    ;OPERATION DELAY MULTIPLIER
000720  000001        OPNUM:    000001    ;NUMBER OF OPERATIONS TO BE PERFORMED
                                ;
                                ;               ****************************************************
                                ;               *   TABLE OF OPERATIONS TO BE PERFORMED MAX =23 *
                                ;               ****************************************************
                                ;
000722  000001        OPTBL:      1         ;1ST OPERATION
000724  000000                    0         ;2ND OPERATION
000726  000000                    0         ;3RD OPERATION
000730  000000                    0         ;4TH OPERATION
000732  000000                    0         ;5TH OPERATION
000734  000000                    0         ;6TH OPERATION
000736  000000                    0         ;7TH OPERATION
000740  000000                    0         ;10TH OPERATION
000742  000000                    0         ;11TH OPERATION
000744  000000                    0         ;12TH OPERATION
000746  000000                    0         ;13TH OPERATION
000750  000000                    0         ;14TH OPERATION
000752  000000                    0         ;15TH OPERATION
000754  000000                    0         ;16TH OPERATION
000756  000000                    0         ;17TH OPERATION
000760  000000                    0         ;20TH OPERATION
000762  000000                    0         ;21ST OPERATION
000764  000000                    0         ;22ND OPERATION
000766  000000                    0         ;23RD OPERATION
                                ;
                                ;
                                ;
```

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                                        ;
                                        ;               *****************************************************
                                        ;               *   HOUSE KEEPING AND INITIAL PROGRAM PARAMETERS    *
                                        ;               *****************************************************
                                        ;
        001000                                                  .=1000
001000  012706  000600          START:  MOV     #600,SP                 ;SET UP STACK AT LOC. 600
001004  012737  000340  177776          MOV     #340,@#PSW              ;SET PRIORITY LEVEL 7 NO INTERRUPTS ALLOWED
001012  032737  004000  164000  1$:     BIT     #4000,@#TRCOM           ;WAIT FOR THE INITIAL 900 MS.POWER CLEAR TO SUBSIDE
001020  001374                          BNE     1$                      ;LOOP UNTILL CONTROL IS READY
001022  013701  000720                  MOV     @#OPNUM,R1              ;R1 CONTAINS HOW MANY OPERATIONS WILL BE DONE
001026  042737  176377  000702  UNUM:   BIC     #176377,@#UNIT          ;STRIP OFF EVERYTHING EXCEPT BITS 8 AND 9 TO SET UP UNI
                                        ;
                                        ;                       *************************************
                                        ;                       *   SET UP OPERATIONS, COMPARITOR   *
                                        ;                       *************************************
                                        ;
001034  012702  000722                  MOV     #OPTBL,R2               ;R2 CONTAINS THE POINTER TO THE START OF THE OPERATINS
001040  012737  000011  000674  LOOP:   MOV     #9.,@#TEMP1             ;THE NUMBER OF LEAGAL OPERATIONS
001046  012703  001440                  MOV     #LEGOPS,R3              ;POINTER TO THE BEGINNING OF THE LEGAL OPERATIONS COMPA
001052  012237  000676                  MOV     (R2)+,@#TEMP2           ;GET THE OPERATION AND PUT IT IN TEMP 2
001056  023723  000676          2$:     CMP     @#TEMP2,(R3)+           ;CHECK IT AGAINST THE LEGAL FUNCTIONS
001062  001422                          BEQ     CLINH                   ;IF ITS LEGAL CONTINUE TO EXECUTE IT
001064  005337  000674                  DEC     TEMP1                   ;WASN'T THAT OPERATION SUBTRACT 1
001070  001372                          BNE     2$                      ;TRY NEXT ONE
```

```
                                ;
                                ;
                                ;                       ************************************
                                ;                       *   CHECK FOR A CONTROL RESET      *
                                ;                       ************************************
                                ;
001072  022737  000020  000676          CMP   #20,@#TEMP2       ;SEE IF ITS A CONTROL RESET (PSEUDO OP)
001100  001402                          BEQ   CRES              ;MUST BE A CONTROL RESET JUMP TO CRES
001102  000137  001344                  JMP   @#ILFUT           ;IT MUST BE ILLEGAL FUNCTION STOP THE PROGRAM
001106  052737  004000  164000  CRES:   BIS   #4000,TRCOM       ;MUST BE A POWER CLEAR SO DO IT TAKES 900 MILI SECONDS
001114  032737  004000  164000  3$:     BIT   #4000,TRCOM       ;SEE IF DONE WITH POWER CLEAR YET
001122  001374                          BNE   3$                ;WAIT UNTILL DONE
001124  000137  001264                  JMP   FUDONE            ;GET BACK INTO PROGRAM
                                ;
                                ;
                                ;                       ************************************************
                                ;                       *   CLEAR INHIBIT BIT AND SET UP OPERATION     *
                                ;                       ************************************************
                                ;
001130  005037  164002  CLINH:   CLR   @#TRSTAT          ;CLEAR OUT THE INHIBIT BIT
001134  162703  001442          SUB   #LEGOPS+2,R3      ;GET AN OFFSET VALUE
001140  060307                  ADD   R3,PC             ;ADD IT TO THE PC AND GO THERE
                                ;
                                ;
                                ;                       ****************************************
                                ;                       *   OPERATIONS DIRECTORY TABLE         *
                                ;                       ****************************************
                                ;
                                ;
001142  000422          W:      BR    WRITE             ;WRITE INSTRUCTION
001144  000425          R:      BR    READ              ;READ INSTRUCTION
001146  000401          SR:     BR    .+4               ;SPACE REVERSE INSTRUCTION
001150  000432          ER:     BR    ERSE              ;ERASE COMMAND
001152  000240          REWD:   NOP                     ;REWIND COMMAND
001154  000240          FFOR:   NOP                     ;FAST FORWARD COMMAND
001156  000240          IDB:    NOP                     ;WRITE ID BURST
001160  000240          WTM:    NOP                     ;WRITE TAPE MARK
```

```
                                ;
                                ;
                                ;                       ****************************************
                                ;                       *   SET UP UNIT NUMBER AND GO BIT      *
                                ;                       ****************************************
                                ;
001162  006337  000676          SGOB:   ASL   @#TEMP2             ;SHIFT THE FUNCTION INTO THE PROPER BIT POSITIONS
001166  053737  000702  000676          BIS   @#UNIT,@#TEMP2      ;SET THE UNIT # BITS
001174  053737  000700  000676          BIS   @#EXTCOR,@#TEMP2    ;SET THE MEMORY EXTENSION BITS
001202  005237  000676                  INC   @#TEMP2             ;SET THE GO BIT
001206  000417                         BR  EXECUT                ;JUMP TO THE EXECUTION ROUTINE
                                ;
                                ;
                                ;
                                ;                   ************************************
                                ;                   *   OPERATIONS SETUP ROUTINES      *
                                ;                   ************************************
                                ;
001210  013737  000710  164006  WRITE:  MOV   @#WADDR,@#TRBA      ;SET UP WRITE BUFFER AREA
001216  000403                         BR    WR1WC               ;CONTINUE ON TO SET UP W.C.
001220  013737  000706  164006  READ:   MOV   @#RADDR,@#TRBA      ;SET UP READ BUFFER ADRESS
001226  013737  000704  164004  WR1WC:  MOV   @#WCNT,@#TRWC       ;SET UP WORD COUNT
001234  000752                         BR    SGOB                ;SET UP GO BIT
001236  013737  000712  164004  ERSE:   MOV   @#ERSCNT,@#TRWC     ;SET NUMBER TO INDICATE AMOUNT OF TAPE TO BE ERASED
001244  000746                         BR    SGOB                ;SET UP GO BIT
                                ;
                                ;
                                ;                   ************************************************************
                                ;                   *   ROUTINE TO EXECUTE THE FUNCTION AND CHECK FOR DONE     *
                                ;                   ************************************************************
                                ;
001246  000240                  EXECUT: NOP
001250  013737  000676  164000          MOV   @#TEMP2,@#TRCOM     ;DO THE FUNCTION
001256  105737  164000          7$:     TSTB  @#TRCOM             ;SEE IF DONE YET
001262  100375                         BPL   7$                  ;WAIT FOR IT
                                ;
```

```
                                              ;
                                              ;
                                              ;                     **********************************************
                                              ;                     *   ROUTINE TO CHECK FUNCTION WHEN DONE     *
                                              ;                     **********************************************
                                              ;
                                              ;
001264  013737  164002  000672  FUDONE:   MOV   @#TRSTAT,@#STTEM   ;SAVE STATUS
001272  013737  164000  000670            MOV   @#TRCOM,@#COMTEM   ;SAVE COMMAND REGISTER
001300  032737  040000  000670            BIT   #40000,@#COMTEM    ;WAS IT AN ILLEGAL COMMAND DUE TO SEQUENCE OR TAPE POSI
001306  001405                            BEQ   ERDONE             ;NO ERROR HERE
001310  006237  000676          ILLCOM:   ASR   @#TEMP2            ;STRIP OFF THE GO BIT
001314  013700  000676                    MOV   @#TEMP2,R0         ;PUT BAD COMMAND IN R0
001320  000000                  ERR14:    HALT                     ; STOP WITH BAD COMMAND DISPLAYED
001322  032737  100000  000670  ERDONE:   BIT   #100000,@#COMTEM   ;SEE IF ERROR BIT IS SET
001330  001410                            BEQ   OPDEL              ;NO ERRORS CONTINUE
001332  000000                  ERR15:    HALT                     ;GOT AN ARROR NOP THIS HALT TO CONTINUE
001334  000137  001106                    JMP   @#CRES             ;IF YOU GOT AN ERROR ONLY RECOVERY IS WITH A CONTROL RE
001340  006237  000676          ILLFUN:   ASR   @#TEMP2            ;STRIP OFF GO BIT
001344  013700  000676          ILFUT:    MOV   @#TEMP2,R0         ;PUT THE BAD CODE IN R0 TO DISPLAY WHEN HALTED
001350  000000                  ERRIF:    HALT                     ;GOT AN ILLEGAL FUNCTION CHECK YOUR PROGRAM LOCATION 72
                                              ;
                                              ;
```

```
                                ;
                                ;                       ********************************************
                                ;                       *   OPERATION DELAY BETWEEN INSTRUCTIONS   *
                                ;                       ********************************************
                                ;
001352  013737  000716  000666 OPDEL:    MOV  @#OPDLX,@#TIMMUL  ;SET OP OPERATIONS DELAY MULTIPLIER
001360  013700  000714                   MOV  @#OPDLY,R0        ;SET UP OPERATIONS DELAY TIMER
001364  005300                  8$:      DEC  R0                ;TIMER IS TICKING
001366  001376                           BNE  8$                ;GET MORE TIME
001370  005337  000666                    DEC  @#TIMMUL          ;COUNT DOWN THE MULTIPLIER
001374  001373                           BNE  8$                ;GET MORE TIME
001376  032737  100000  177570           BIT  #100000,@#SWR     ;TIMES UP CHECK SWITCHES TO SEE IF WE HALT OR CONTINUF
001404  001401                           BEQ  .+4               ;DONT STOP NOW SKIP THE HALT
001406  000000                  INSHLT:  HALT                   ;STOP BETWEEN INSTRUCTIONS
001410  005301                           DEC  R1                ;-1 FROM THE NUMBER OF OPERATIONS IN R1
001412  001001                           BNE  9$                ;GO AND DO THE NEXT INSTRUCTION
001414  000401                           BR   .+4               ;SKIP THE JUMP
001416  000137  001040          9$:      JMP  @#LOOP            ;DO THE LOOP AGAIN
001422  032737  040000  177570           BIT  #40000,@#SWR      ;CHECK SWITCHES TO SEE IF WE WANT TO STOP AT END OF PAS
001430  001401                           BEQ  REST              ;DO THE NEXT PASS SKIP THE HALT
001432  000000                  PASHLT:  HALT                   ;STOP BETWEEN PASSES
001434  000137  001000          REST:    JMP  @#START           ;GO DO IT AGAIN (NEXT PASS)
                                ;
                                ;
                                ;                       ******************************************
                                ;                       *   LEGAL OPERATIONS COMPARITOR TABLE    *
                                ;                       ******************************************
                                ;
001440  000001          LEGOPS:  00001                  ;WRITE
001442  000002                   00002                  ;READ
001444  000004                   00004                  ;SPACE REVERSE
001446  000007                   00007                  ;ERASE
001450  000010                   00010                  ;REWIND
001452  000013                   00013                  ;FAST FORWARD
001454  000015                   00015                  ;WRITE IDB
001456  000016                   00016                  ;WRITE TAPE MARK
001460  000017                   00017                  ;OFFLINE
                                ;
```

```
                                    ;
                                    ;
                                    ;                   ****************************************
                                    ;                   *   DELAY SET-UP PROGRAM ROUTINES     *
                                    ;                   ****************************************
                                    ;
                                    ;
        001462                                          .=1462
001462  012706  000600              DRTN:    MOV  #600,SP             ;SET STACK
001466  012705  000500                       MOV  #500,R5             ;SET UP SUBROUTINE STACK
001472  012737  000340  177776               MOV  #340,@#PSW          ;SET PRIORITY 7 NO INTERRUPTS ALLOWED
001500  032737  004000  164000  DROUTS:      BIT  #4000,@#TRCOM       ;CHECK FOR INITIAL POWER CLEAR TO SUBSIDE
001506  001774                               BEQ  DROUTS              ;WAIT TILL DONE
001510  013737  177570  000664  BR1:         MOV  @#SWR,@#SWRTEM      ;GET SWITCHES AND PUT THEM IN STORAGE
001516  105737  000664                       TSTB @#SWRTEM            ;SEE IF ENABLE IS UP YET
001522  100372                               BPL  BR1                 ;LOOP UNTILL ENABLE IS UP
001524  042737  177760  000664               BIC  #177760,@#SWRTEM    ;MASK BITS AND GET A NUMBER BETWEEN 0-16
001532  006337  000664                       ASL  @#SWRTEM            ;SHIFT IT LEFT TO MULTIPLY BY 2
001536  006337  000664                       ASL  @#SWRTEM            ;SHIFT AGAIN MULTIPLY BY 2 TO GET OFFSET
001542  063707  000664                       ADD  @#SWRTEM,PC         ;ADD IT TO THE PC AND GO THERE
                                    ;
                                    ;
```

```
844                                     ;
845                                     ;
846                                     ;       ************************************************
847                                     ;       *   INDEX TABLE OF DELAY PROGRAM DIRECTIVES    *
848                                     ;       ************************************************
849                                     ;
850                                     ;
851  001546  000137  001510    TABLE:     JMP   @#BR1           ;DELAY 0 IS A NO-OP
852  001552  000137  001646               JMP   @#BR2           ;DELAY 1 IS FOR POWER CLEAR
853  001556  000137  001646               JMP   @#BR2           ;DELAY 2 IS FOR POWER CLEAR
854  001562  000137  001702               JMP   @#BR3           ;DELAY 3 IS FOR ERROR CLK
855  001566  000137  001752               JMP   @#BR4           ;DELAY 4 IS FOR WRITE ENABLE
856  001572  000137  002014               JMP   @#BR5           ;DELAY 5 IS FOR OUT BUFF FLAG
857  001576  000137  002014               JMP   @#BR5           ;DELAY 6 IS FOR END WRITE DATA
858  001602  000137  002014               JMP   @#BR5           ;DELAY 7 IS FOR FIRST WORD WRITE REQUEST
859  001606  000137  002150               JMP   @#BR10          ;DELAY 10 IS FOR ERASE
860  001612  000137  002234               JMP   @#BR11          ;DELAY 11 IS FOR WRITE I.D.B.
861  001616  000137  002234               JMP   @#BR11          ;DELAY 12 IS FOR I.D.B. TIMING
862  001622  000137  002354               JMP   @#BR16          ;DELAY 13 IS FOR ABORT WINDOW
863  001626  000137  002070               JMP   @#BR6           ;DELAY 14 IS FOR LD CTRL + BUSY
864  001632  000137  001752               JMP   @#BR4           ;DELAY 15 IS FOR GO PULSE DELAY
865  001636  000137  002274               JMP   @#BR14          ;DELAY 16 IS FOR M.S.D. DELAY
866  001642  000137  001510               JMP   @#BR1           ;DELAY 17 IS A NO-OP
867                                     ;
868                                     ;
869                                     ;
870                                     ;
```

```
                                        ;*************************************
                                        ;*   ROUTINE FOR DELAYS 1 AND 2   *
                                        ;*************************************
001646  004537  002502          BR2:    JSR     R5,@#PCL        ;DO A POWER CLEAR
001652  005000                  BR2A:   CLR     R0              ;CLEAR THE TIMER
001654  012701  000004                  MOV     #4,R1           ;SET TIMING DELAY MULTIPLIER
001660  005300                          DEC     R0              ;TIMER IS TICKING
001662  001376                          BNE     BR2A            ;WAIT TILL ITS DONE
001664  005301                          DEC     R1              ;ONCE THROUGH THE TIMING LOOP
001666  001374                          BNE     BR2A            ;REPEAT LOOP IF MULTIPLIER IS NON ZERO
001670  105737  177570                  TSTB    @#SWR           ;CKECK FOR A LOOP
001674  100764                          BMI     BR2             ;DO IT AGAIN
001676  000137  001510                  JMP     @#BR1           ;GET NEXT TEST
                                        ;*****************************
                                        ;*   ROUTINE FOR DELAY 3     *
                                        ;*****************************
001702  012700  000070          BR3:    MOV     #70,R0                  ;SET UP DELAY MULTIPLIER
001706  012701  000004                  MOV     #4,R1                   ;SET TIMING DELAY MULTIPLIER
001712  052737  004000  164002          BIS     #4000,@#TRSTAT          ;FORCE AN ERROR WITH B.G.L. BIT
001720  005300                  13$:    DEC     R0                      ;TIMER IS TICKING
001722  001376                          BNE     13$                     ;CHECK TIMER
001724  005037  164002                  CLR     @#TRSTAT                ;OK NOW CLEAR THE BIT
001730  005301                          DEC     R1                      ;ONCE THROUGH TIMING LOOP
001732  001372                          BNE     13$                     ;REPEAT LOOP IF MULTIPLIER IS NON ZERO
001734  105737  177570                  TSTB    @#SWR                   ;SEE IF WE WANT TO DO IT AGAIN
001740  100760                          BMI     BR3                     ;OK LOOP BACK
001742  004537  002502                  JSR     R5,@#PCL                ;DONE HERE DO A POWER CLEAR AND GET THE NEXT ONE
001746  000137  001510                  JMP     @#BR1                   ;GET THE NEXT DELAY DIRECTIVE
                                        ;*************************************
                                        ;*   ROUTINE FOR DELAY 4 AND 15   *
                                        ;*************************************
001752  004537  002522          BR4:    JSR   R5,@#RDY          ;CHECK FOR READY
001756  012737  177777  164004  BR4A:   MOV   #-1,@#TRWC        ;THIS NUMBER IS USED FOR AN ERASE COUNT
001764  012737  000017  164000          MOV   #17,@#TRCOM       ;DO THE ERASE
001772  004537  002522                  JSR   R5,@#RDY          ;WAIT TILL DONE
001776  004537  002540                  JSR   R5,@#ERCK         ;SEE IF WE ERRORED OUT
002002  105737  177570                  TSTB  @#SWR             ;SEE IF WE LOOPON TEST
002006  100763                          BMI   BR4A              ;LOOP HERE AND DO IT AGAIN
002010  000137  001510                  JMP   @#BR1             ;GET OUT AND GET NEXT DELAY DIRECTIVE
```

```
                                ;
                                ;                    ****************************************
                                ;                    *   ROUTINE FOR DELAY 5 , 6 AND 7      *
                                ;                    ****************************************
                                ;
002014  004537  002570          BR5:    JSR   R5,@#OFLP          ;SEE IF WE ARE AT LOAD POINT
002020  005037  164002                  CLR   @#TRSTAT           ;CLEAR INHIBIT BIT
002024  012737  177774  164004  BR5A:   MOV   #-4,@#TRWC         ;SET UP FOR A 10 BYTE WRITE
002032  013737  000710  164006          MOV   @#WADDR,@#TRBA     ;SET UP THE WRITE ADRESS BUFFER
002040  012737  000003  164000          MOV   #3,@#TRCOM         ;DO THE WRITE
002046  004537  002522                  JSR   R5,@#RDY           ;WAIT FOR READY
002052  004537  002540                  JSR   R5,@#ERCK          ;CHECK FOR ERRORS
002056  105737  177570                  TSTB  @#SWR              ;SEE IF WE WANT TO LOOP
002062  100760                          BMI   BR5A               ;LOOP HERE AND DO IT AGAIN
002064  000137  001510                  JMP   @#BR1              ;GET OUT AND GET NEXT DELAY DIRECTIVE
                                ;
                                ;                    ******************************
                                ;                    *   ROUTINE FOR DELAY 14     *
                                ;                    ******************************
                                ;
002070  004537  002624          BR6:    JSR   R5,@#REW           ;DO A REWIND GET TO B.O.T.
002074  004537  002654          BR6C:   JSR   R5,@#ETS           ;CHECK FOR END OF TAPE ANYWAY
002100  005037  164002                  CLR   @#TRSTAT           ;CLEAR THE INHIBIT BIT
002104  005037  164004                  CLR   @#TRWC             ;CLEAR THE WORD COUNT
002110  012737  000017  164000          MOV   #17,@#TRCOM        ;DO AN ERASE
002116  005037  164000  BR6A:   CLR   @#TRCOM           ;FORCE A LOAD PULSE
002122  105737  177570                  TSTB  @#SWR              ;SEE IF WE WANT TO LOOP
002126  100004                          BPL   BR6B               ;ALL DONE
002130  105737  164000                  TSTB  @#TRCOM            ;SEE IF ERASE IS DONE YET
002134  100370                          BPL   BR6A               ;NOT DONE DO ANOTHER LOAD PULSE
002136  000756                          BR    BR6C               ;DO IT AGAIN
002140  004537  002502  BR6B:   JSR   R5,@#PCL           ;DO A CLEAR AND EXIT
002144  000137  001510                  JMP   @#BR1              ;GO BACK TO MAIN
```

```
                                   ;
                                   ;
                                   ;                ********************************
                                   ;                *   ROUTINE FOR DELAY  10      *
                                   ;                ********************************
                                   ;
002150  004537  002654             BR10:    JSR     R5,@#ETS            ;CHECT FOR E.O.T.
002154  004537  002570                      JSR     R5,@#OFLP           ;GET US OFF LOAD POINT
002160  005037  164002                      CLR     @#TRSTAT            ;CLEAR INHIBIT
002164  012737  000017  164000              MOV     #17,@#TRCOM         ;DO A MAXIMUM ERASE
002172  012700  005000             BR10A:   MOV     #5000,R0            ;SET UP COUNTER
002176  012701  000004                      MOV     #4,R1               ;SET TIMING LOOP MULTIPLIER
002202  005300                     BR10B:   DEC     R0                  ;START COUNTDOWN
002204  001376                              BNE     BR10B               ;TIMER IS TICKING
002206  005301                              DEC     R1                  ;ONCE THROUGH TIMING LOOP
002210  001374                              BNE     BR10B               ;REPEAT LOOP IF MULTIPLIER IS NON ZERO
002212  005037  164004                      CLR     @#TRWC              ;RE ESTABLISH THE ERASE COUNT TO 0
002216  105737  177570                      TSTB    @#SWR               ;SEE IF WE LOOP HERE
002222  100763                              BMI     BR10A               ;DO IT AGAIN
002224  004537  002502                      JSR     R5,@#PCL            ;DO A POWER CLEAR
002230  000137  001510                      JMP     @#BR1               ;GET OUT AND GET THE NEXT DELAY DIRECTIVE
                                   ;
                                   ;
                                   ;
                                   ;
                                   ;
```

```
                                ;
                                ;                ************************************
                                ;                *   ROUTINE FOR DELAY 11 AND 12    *
                                ;                ************************************
                                ;
002234  004537  002624  BR11:   JSR   R5,@#REW        ;DO A REWIND
002240  012737  000033  164000  MOV   #33,@#TRCOM     ;WRITE AN I.D.B.
002246  004537  002522          JSR   R5,@#RDY        ;CHECK FOR DONE
002252  004537  002540          JSR   R5,@#ERCK       ;SEE IF ANY ERRORS UP
002256  105737  177570          TSTB  @#SWR           ;SEE IF WE WANT TO LOOP
002262  100764                  BMI   BR11            ;LOOP BACK DO IT AGAIN
002264  004537  002502          JSR   R5,@#PCL        ;DO A POWER CLEAR
002270  000137  001510          JMP   @#BR1           ;GET OUT AND GET NEXT DELAY DIRECTIVE
                                ;
                                ;
                                ;
                                ;
                                ;                ********************************
                                ;                *   ROUTINE FOR DELAY  16    *
                                ;                ********************************
                                ;
002274  105737  164002  BR14:   TSTB  @#TRSTAT       ;CHECK FOR EOT UP
002300  100407                  BMI   BR14A           ;SKIP THE FAST FORWARD
002302  005037  164002          CLR   @#TRSTAT        ;CLEAR INHIBIT
002306  012737  000027  164000  MOV   #27,@#TRCOM     ;DO A FAST FORWARD
002314  004537  002522          JSR   R5,@#RDY        ;WAIT TILL DONE
002320  005037  164002  BR14A:  CLR   @#TRSTAT        ;CLEAR INHIBIT
002324  012737  000027  164000  MOV   #27,@#TRCOM    ;TRY A FAST FORWARD ,SHOULD PPODUCE ERROR
002332  004537  002522          JSR   R5,@#RDY        ;WAIT TILL DONE
002336  105737  177570          TSTB  @#SWR           ;SEE IF WE LOOP HERE
002342  100766                  BMI   BR14A           ;YES LOOP HERE
002344  004537  002502          JSR   R5,@#PCL        ;DO A POWER CLEAR
002350  000137  001510          JMP   @#BR1           ;GET OUT DO NEXT DELAY
                                ;
```

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                                        ;
                                        ;               ********************************
                                        ;               *   ROUTINE FOR DELAY  13      *
                                        ;               ********************************
                                        ;
002354  004537  002624          BR16:   JSR     R5,@#REW        ;DO A REWIND
002360  005037  164002                  CLR     @#TRSTAT        ;CLEAR INHIBIT
002364  012737  177000  164004          MOV     #177000,@#TRWC  ;SET UP ERASE COUNT
002372  012737  000017  164000          MOV     #17,@#TRCOM     ;DO AN ERASE
002400  004537  002522                  JSR     R5,@#RDY        ;WAIT FOR IT
002404  004537  002624                  JSR     R5,@#REW        ;REWIND IT
002410  004537  002570                  JSR     R5,@#OFLP       ;GET OFF LOAD POINT LEGALLY
002414  012737  177760  164004  BR16A:  MOV     #-20,@#TRWC     ;SET UP W.C.
002422  012737  003600  164006          MOV     #3600,@#TRBA    ;SET UP CORE ADDRESS
002430  005037  164002                  CLR     @#TRSTAT        ;CLEAR THE INHIBIT
002434  012737  000003  164000          MOV     #3,@#TRCOM      ;NOW TRY TO WRITE NOTHING,SHOULD ABORT
002442  012701  000040          BR16B:  MOV     #40,R1          ;SET UP TIME MULTIPLIER
002446  005000                  BR16D:  CLR     R0              ;CLEAR TIMER
002450  005200                  BR16C:  INC     R0              ;TIMES WAISTING
002452  001376                          BNE     BR16C           ;TIMER RUNNING
002454  005301                          DEC     R1              ;-1 FROM MULTIPLIER
002456  001373                          BNE     BR16D           ;SEE IF DONE YET
002460  004537  002502                  JSR     R5,@#PCL        ;CLEAR ERRORS
002464  105737  177570                  TSTB    @#SWR           ; LOOP ???
002470  100751                          BMI     BR16A           ;DO IT AGAIN
002472  004537  002502                  JSR     R5,@#PCL        ;POWER CLEAR
002476  000137  001510                  JMP     @#BR1           ;ALL DONE GET SOME MORE
                                        ;
```

```
1038                                    ;
1039                                    ;
1040                                    ;
1041                                    ;                       ************************************
1042                                    ;                       *   SUBROUTINE FOR POWER CLEAR     *
1043                                    ;                       ************************************
1044                                    ;
1045                                    ;
1046  002502  052737  004000  164000  PCL:     BIS   #4000,@#TRCOM         ;SET POWER CLEAR
1047  002510  032737  004000  164000  PCL1:    BIT   #4000,@#TRCOM         ;WAIT FOR 900 MILI SECONDS
1048  002516  001374                         BNE   PCL1                  ;STILL WAITING
1049  002520  000205                         RTS   R5                    ;RETURN TO MAIN ROUTINE
1050                                    ;
1051                                    ;
1052                                    ;
1053                                    ;                  ************************************************
1054                                    ;                  *   SUBROUTINE FOR READY AND CLEAR INHIBIT     *
1055                                    ;                  ************************************************
1056                                    ;
1057                                    ;
1058  002522  105737  164000          RDY:     TSTB  @#TRCOM               ;CHECK ON DONE BIT
1059  002526  100375                           BPL   RDY                   ;WAIT TILL DONE
1060  002530  042737  000001  164002  IHB:     BIC   #1,@#TRSTAT           ;CLEAR THE INHIBIT BIT
1061  002536  000205                           RTS   R5                    ;RETUN TO MAIN ROUTINE
1062                                    ;
1063                                    ;
1064                                    ;
1065                                    ;                  ****************************************
1066                                    ;                  *   SUBROUTINE TO CHECK FOR ERRORS     *
1067                                    ;                  ****************************************
1068                                    ;
1069                                    ;
1070  002540  005737  164000          ERCK:    TST   @#TRCOM               ;SEE IF ERROR IS UP
1071  002544  100010                           BPL   ERCK2                 ;NO ERRORS JUMP OUT
1072  002546  012737  000007  177566           MOV   #7,@#TTBUF            ;GOT AN ERROR RING A BELL
1073  002554  105737  177564          ERCK1:   TSTB  @#TTSTAT              ;WAIT HERE
1074  002560  100375                           BPL   ERCK1                 ;WAIT HERE
1075  002562  004537  002502                    JSR   R5,@#PCL              ;CLEAR THE ERROR WITH A POWER CLEAR
1076  002566  000205                  ERCK2:   RTS   R5                    ;GO BACK TO MAIN
1077                                    ;
```

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1078
1079                                    ;
1080                                    ;       ************************************************
1081                                    ;       *   SUBROUTINE TO GET OFF LOAD POINT LEGALLY   *
1082                                    ;       ************************************************
1083                                    ;
1084                                    ;
1085  002570  032737  000040  164002  OFLP:   BIT   #40,@#TRSTAT           ;SEE IF LOAD POINT IS UP
1086  002576  001411                        BEQ   OFLP1                   ;NO LP JUMP OUT
1087  002600  005037  164002               CLR   @#TRSTAT                ;CLEAR THE INHIBIT
1088  002604  012737  000033  164000       MOV   #33,@#TRCOM             ;WRITE AN I.D.B.
1089  002612  004537  002522               JSR   R5,@#RDY                ;WAIT FOR READY
1090  002616  004537  002540               JSR   R5,ERCK                 ;CHECK FOR ERRORS
1091  002622  000205                OFLP1:  RTS   R5                      ;GO BACK TO MAIN
1092                                    ;
1093                                    ;
1094                                    ;
1095                                    ;           ****************************************
1096                                    ;           *   SUBROUTUNE FOR REWIND AND L.P.   *
1097                                    ;           ****************************************
1098                                    ;
1099  002624  032737  000040  164002  REW:    BIT   #40,@#TRSTAT            ;AT LOAD POINT??
1100  002632  001007                        BNE   REW2                    ;YES DON'T NEED REWIND
1101  002634  005037  164002        REW1:   CLR   @#TRSTAT                ;CLR THE INHIBIT
1102  002640  012737  000021  164000       MOV   #21,@#TRCOM             ;DO A REWIND
1103  002646  004537  002522               JSR   R5,@#RDY                ;WAIT TILL DONE
1104  002652  000205                REW2:   RTS   R5                      ;GO BACK
1105                                    ;
1106                                    ;           ******************************
1107                                    ;           *   SUBROUTINE FOR E.O.T.    *
1108                                    ;           ******************************
1109                                    ;
1110  002654  105737  164002        ETS:    TSTB  @#TRSTAT                ;IS END OF TAPE UP ?
1111  002660  100002                        BPL   ETS1                    ;NOT AT E.O.T.
1112  002662  004537  002624               JSR   R5,@#REW                ;DO A REWIND
1113  002666  000205                ETS1:   RTS   R5                      ;GET BACK
1114                                    ;
1115                                    ;
1116                                    ;
```

```
1117
1118
1119                    ;*********************************
1120                    ;*   WRITE BUFFER PATTERNS       *
1121                    ;*********************************
1122
1123
1124                        .=2700
1125                        .REPT   1000            ;ALL 1'S
1126                        .WORD   000777          ;PATTERN = 0 000 000 111 111 111
1127                        .ENDR
1128
1129
1130                        .=3700
1131                        .REPT   1000            ;1'S AND 0'S ALTERNATE WORDS
1132                        .WORD   000400          ;PATTERN = 0 000 000 100 000 000
1133                        .WORD   000777          ;PATTERN = 0 000 000 111 111 111
1134                        .ENDR
1135
1136
1137                        .=4700
1138                        .REPT   1000            ;ALTERNATE BITS
1139                        .WORD   000525          ;PATTERN = 0 000 000 101 010 101
1140                        .WORD   000652          ;PATTERN = 0 000 000 110 101 010
1141                        .ENDR
1142
1143
1144                        .=5700
1145                        .REPT   1000            ;SLIDING 1 BIT
1146                        .WORD   000001          ;PATTERN = 0 000 000 000 000 001
1147                        .WORD   000002          ;PATTERN = 0 000 000 000 000 010
1148                        .WORD   000004          ;PATTERN = 0 000 000 000 000 100
1149                        .WORD   000010          ;PATTERN = 0 000 000 000 001 000
1150                        .WORD   000020          ;PATTERN = 0 000 000 000 010 000
1151                        .WORD   000040          ;PATTERN = 0 000 000 000 100 000
1152                        .WORD   000100          ;PATTERN = 0 000 000 001 000 000
1153                        .WORD   000200          ;PATTERN = 0 000 000 010 000 000
1154                        .WORD   000400          ;PATTERN = 0 000 000 100 000 000
1155                        .ENDR
1156
1157
1158                    ;*************************
1159                    ;*   READ BUFFER AREA    *
1160                    ;*************************
1161
1162
1163                        .=6700                  ;1000 WORD LOCATIONS RESERVED FOR READ BUFFER
1164
1165
1166    000001              .END
```

CZTRBD.P11 18-NOV-81 09:16 CROSS REFERENCE TABLE -- USER SYMBOLS

ALD	000352	586	589#											
BEGIN	000200	549#												
BEGIN2	000204	550#												
BR1	001510	835#	837	851	866	884	901	914	929	948	969	987	1008	1036
BR10	002150	859	955#											
BR10A	002172	959#	967											
BR10B	002202	961#	962	964										
BR11	002234	860	861	980#	985									
BR14	002274	865	997#											
BR14A	002320	998	1002#	1006										
BR16	002354	862	1015#											
BR16A	002414	1022#	1034											
BR16B	002442	1026#												
BR16C	002450	1028#	1029											
BR16D	002446	1027#	1031											
BR2	001646	852	853	875#	883									
BR2A	001660	878#	879	881										
BR3	001702	854	890#	899										
BR4	001752	855	864	907#										
BR4A	001756	908#	913											
BR5	002014	856	857	858	920#									
BR5A	002024	922#	928											
BR6	002070	863	936#											
BR6A	002116	941#	945											
BR6B	002140	943	947#											
BR6C	002074	937#	946											
CLINH	001130	678	702#											
COMTEM	000670	615#	768*	769	774									
CORBIL	000230	549	551	558#										
CRES	001106	689	691#	777										
DROUTS	001500	833#	834											
DRTN	001462	588	830#											
ER	001150	715#												
ERCK	002540	911	926	983	1070#	1090								
ERCK1	002554	1073#	1074											
ERCK2	002566	1071	1076#											
ERDONE	001322	770	774#											
ERRIF	001350	780#												
ERR14	001320	773#												
ERR15	001332	776#												
ERSCNT	000712	624#	746											
ERSE	001236	715	746#											
ETS	002654	937	955	1110#										
ETS1	002666	1111	1113#											
EXECUT	001246	731	755#											
EXTCOR	000700	619#	729											
FFOR	001154	717#												
FUDONE	001264	694	767#											
IDB	001156	718#												
IHB	002530	1060#												
ILFUT	001344	690	779#											
ILLCOM	001310	771#												
ILLFUN	001340	778#												
INSHLT	001406	797#												
LEGOPS	001440	675	703	812#										
LOOP	001040	674#	801											

CZTRBD.P11 18-NOV-81 09:16 CROSS REFERENCE TABLE -- USER SYMBOLS

```
NORST   000356          550*   585    587*   590#
OFLP    002570          920    956    1021   1085#
OFLP1   002622          1086   1091#
OPDEL   001352          775    789#
OPDLX   000716          626#   789
OPDLY   000714          625#   790
OPNUM   000720          627#   665
OPTBL   000722          633#   673
PASHLT  001432          804#
PCL     002502          875    900    947    968    986    1007   1032   1035   1046#  1075
PCL1    002510          1047#  1048
PSW   = 177776          513#   662*   832*
R       001144          713#
RADDR   000706          622#   743
RDY     002522          907    910    925    982    1001   1004   1019   1058#  1059   1089   1103
READ    001220          713    743#
REST    001434          803    805#
REW     002624          936    980    1015   1020   1099#  1112
REWD    001152          716#
REW1    002634          1101#
REW2    002652          1100   1104#
SGOB    001162          727#   745    747
SLB     000302          574#   582
SLBDON  000334          580    585#
SLB1    000310          577#   584
SR      001146          714#
START   001000          589    661#   805
STTEM   000672          616#   767*
SUBSTK  000500          597#
SWR   = 177570          514#   795    802    835    882    898    912    927    942    966    984    1005   1033
SWRTEM  000664          613#   835*   836    838*   839*   840*   841
TABLE   001546          851#
TEMP1   000674          617#   674*   679*
TEMP2   000676          618#   676*   677    688    727*   728*   729*   730*   756    771*   772    778*   779
TIMMUL  000666          614#   789*   793*
TRBA  = 164006          506#   741*   743*   923*   1023*
TRCOM = 164000          503#   663    691*   692    756*   757    768    833    909*   924*   940*   941*   944
                        958*   981*   1000*  1003*  1018*  1025*  1046*  1047   1058   1070   1088*  1102*
TRSTAT= 164002          504#   702*   767    892*   895*   921*   938*   957*   997    999*   1002*  1016*  1024*
                        1060*  1085   1087*  1099   1101*  1110
TRWC  = 164004          505#   744*   746*   908*   922*   939*   965*   1017*  1022*
TTBUF = 177566          522#   1072*
TTSTAT= 177564          521#   1073
UNIT    000702          620#   666*   728
UNUM    001026          666#
W       001142          712#
WADDR   000710          623#   741    923
WCNT    000704          621#   744
WRITE   001210          712    741#
WR1WC   001226          742    744#
WTM     001160          719#
X1      000240          560#
X2      000244          561#   573
X3      000250          562#   567
X4      000264          564    568#
.     = 002670          536#   541    548#   596#   601#   612#   660#   714    796    800    829#
```

CZTRDD.P11 18-NOV-81 09:16 CROSS REFERENCE TABLE -- USER SYMBOLS

. ABS. 002670 000

ERRORS DETECTED: 0

CZTRBD/I,CZTRBD.SEQ/CRF/SOL/NL:TOC=CZTRBD.P11
RUN-TIME: 1 2 .2 SECONDS
RUN-TIME RATIO: 6/4=1.4
CORE USED: 16K (31 PAGES)