RX211,RXV11

UTILITY DRIVER
CZRXCA0

AH-E510A-MC

FICHE 1 OF 1

JAN 1979
digital
MADE IN USA

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IDENTIFICATION

PRODUCT CODE: AC-E509A-MC

PRODUCT NAME: CZRXCA0 RX02 UTIL DRVR

DATE CREATED. DEC 1978

MAINTAINER: DIAGNOSTIC ENGINEERING

AUTHOR: L.S. PRUCHA

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                        1.0     ABSTRACT
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                                THIS PROGRAM IS INTENDED AS A BRUTE FORCE ROUTINE  TO  EXECUTE
                                AN  OPERATION OR SERIES OF OPLRATIONS, CONTINUOUSLY REGARDLESS
                                OF THE RESULTS OF THE OPERATION.  BECAUSE OF THE COMPLEXITY OF
                                THE  RX01,02 FLOPPY DISK SYSTEM AS OPERATED ON THE UNIBUS, IT
                                IS NOT ALWAYS POSSIBLE TO PROVIDE FOR EVERY CONTINGENCY IN THE
                                NORMAL  PROGRAMS  THEREFORE  THIS UTILITY DRIVER WILL ALLOW AN
                                OPERATOR TO EXECUTE ANYTHING DESIRED IN ANY ORDER.  THERE  ARE
                                NO  ERROR  CHECKS  OR  PRINTOUTS  MADE, AND ANY VARIATION FROM
                                PRESET  SEQUENCES  AND  VALUES  ARE  MADE  BY   CHANGING   THE
                                APPROPIATE MEMORY LOCATIONS.


                        2.0     REQUIREMENTS
                                ------------

                        2.1     HARDWARE
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                                1.  ANY PDP-11 PROCESSOR
                                2.  RX11, RXV11, RX211, OR RXV21 BUS INTERFACE
                                3.  RX01 OR RX02 DEVICE

                        2.2     STORAGE
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                                THIS PROGRAM REQUIRES AT LEAST 2K OF CORE


                        3.0     LOADING PROCEDURE
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                                USE STANDARD BINARY LOADING PROCEDURE


                        4.0     STARTING PROCEDURE
                                ------------------

                                THE PROGRAM IS ALWAYS STARTED AT LOCATION 200(8)
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5.0     CONSOLE SWITCH SETTINGS   <SEE NOTE BELOW>
        ------------------------------------------

        HARDWARE SWITCH REG OR IF SOFTWARE SWITCH REG --> (SFSWR  LOC:760)
        -------------------------------------------------------------------

        SW 15=1 (100000)    - STOP ON EACH OPERATION
             =0             - CONTINUE

        SW 14=1 (040000)    - STOP ON END OF SEQUENCE
              0             - CONTINUE

        SW 13 1 (020000)    - INTIALIZE DEVICE BEFORE EACH OPERATION
              0             - NO INTALIZATION BETWEEN OPERATIONS

        SW 12-6 (6-0,RXTA) - TRACK ADDRESS

        SW 5-0  (4-0,RXSA) - SECTOR ADDRESS


               ******   SOFTWARE OR HARDWARE SWITCH REGISTER   ******
                                 .            .            .            !
         ----.------------------------------------------------------------.
             .15 .14 . 13. 12. 11. 10. 09! 08. 07.06 .05 !04 !03 !02 .01 .00
         ----------------------------------------------------------------.
         .   . OP.SEQ. OP.         TRACK ADDRESS        .       SECTOR ADDRESS
         SWR !HLT!HLT.INT.                              .
        ------------------------------------------------------------------------


        NOTE:   IF PROCESSOR DOES NOT HAVE HARDWARE SWITCH REGISTER AT LOCATION
                177570 THEN THE PROGRAM WILL USE ITS OWN INTERNAL SOFTWARE SWITCH
                REGISTER AT 760.  THE PROGRAM WILL DETECT THE NON-EXISTENCE
                OF A HARDWARE SWITCH REGISTER.
```

6.0 OPERATION

THE PROGRAM OPERATION IS QUITE SIMPLE, BUT DOES REQUIRE THE OPERATOR TO HAVE KNOWLEDGE OF THE RX01,02 FLOPPY DISK SYSTEM AS OPERATED BY RX11,RX211 UNIBUS INTERFACE. THE OPERATOR MUST BE ABLE TO DECIDE WHICH SEQUENCE OF OPERATIONS IS REQUIRED, AND WHAT VALUES TO ASSIGN TO THE VARIOUS PARAMETERS REQUIRED TO EXECUTE THEM. THE OPERATION SEQUENCE IS SET UP BY LOADING A TABLE WITH THE FUNCTION CODES OF THE DESIRED OPERATIONS AND SETTING THE NUMBER OF OPERATIONS IN A COUNTER. THE PROGRAM IS SET UP TO OPERATE IN SIGNLE DENSITY MODE, WITH UNIT 0 PRESELECTED, AND TO DO AN EMPTY BUFFER OPERATION. THE OPERATION SEQUENCE WILL BE EXECUTED CONTINUOSLY IF LOADED AND STARTED AT 200(8) WITH NO CHANGES MADE AND SWITCHES 14 AND 15 SET AT ZERO(0). THE FOLLOWING IS THE LIST OF PARAMETERS WHICH MAY BE VARIED AND A DESCRIPTION OF EACH ALONG WITH THEIR CORE LOCATION:

PARAMETER	LOCATION	DESCRIPTION
RXCS	600	ADDRESS OF RX CONTROL + STATUS REG
RXDB	602	ADDRESS OF RX DATA BUFFER REG
PSW	604	ADDRESS OF PROCESSOR STATUS WORDS
SWR	606	ADDRESS OF SWITCH REGISTER WORD
SETCS	700	SET PART OF RXCS WORD - BIT#4 UNIT SELECT BIT#6 INTERRUPT ENABLE BIT#8 DENSITY SELECT (RX02,XX ONLY) BIT#9 SIDE SELECT (RXXX ONLY)
WRDCNT	702	WORD COUNT- SET NUMBER OF WORDS TO BE TRANSFERRED RX02,XX (RX01-N/A)
RDYDLY	704	READY DELAY- THIS DELAY VALUE IS USED BY THE PROGRAM TO ESTABLISH A MAXIMUM TIME TO AWAIT THE COMPLETION OF AN OPERATION BEFORE PROCEEDING TO THE NEXT. **(DEFAULT IS APPROX 435 MS FOR PDP-11/20)**
RDYDX	706	READY MULTIPLIER- IF THE VALUE SET INTO 704 DOES NOT ALLOW ENOUGH TIME, INCREASE THE SIZE OF THE MULTIPLIER. EACH INCREMENT OF THE MULTIPLIER WILL CAUSE THE 704 DELAY TO BE EXECUTED THAT MANY MORE TIMES.
OPNUM	710	OPERATION NUMBER- THIS IS THE NUMBER OF OPERATIONS TO BE PERFORMED IN A SEQUENCE AND SHOULD REFLECT THE NUMBER OF OPERATIONS SET INTO THE FUNCTION TABLE. (16 MAXIMUM)

```
                                FUNTAB      712-750   FUNCTION TABLE-
                                                      THIS TABLE (CONSISTING OF 16 WORD LOCATIONS) IS TO
                                                      BE LOADED WITH THE FUNCTION CODES FOR EACH
                                                      OPERATION TO BE PERFORMED IN SEQUENCE.  THE
                                                      NUMBER OF ENTERIES MAY BE FROM ONE(1) TO
                                                      SIXTEEN(16).  MAKE SURE THAT THE NUMBER OF
                                                      FUNCTION CODES SET IN THE TABLE IS REFLECTED
                                                      BY THE NUMBER IN LOCATION 710 (OPNUM).

                                SOFTSR      760       SOFTWARE SWITCH REGISTER - USED FOR
                                                      SWITCHLESS PROCESSORS.

                                ERRTAB      3700      ERROR TABLE- ERROR REG FOR RESP. FUCTIONS
                                INTAB       4000      INPUT TABLE- RX DATA BUFFER INTO TABLE
                                OUTAB       5000      OUTPUT TABLE- TABLE INTO RX DATA BUFFER

                                XETBA       4400      EXTENDED ERROR TABLE - THIS TABLE CONTAINS
                                                      RESULTS OF READ ERROR CODE OPERATION IN
                                                      FUNCTION TABLE - SEE TABLE DESCRIPTIONS BELOW.

                                NOTE:  RXXX + XX ARE REFERENCES TO DEVICE FUTURE EXPANSION.
```

6.1 FUNCTION CODES

0 FILL BUFFER
1 EMPTY BUFFER
2 WRITE SECTOR
3 READ SECTOR
4 SET DENSITY(RX02 ONLY)
5 READ STATUS
6 WRITE SECTOR WITH DELETED DATA
7 READ ERROR CODE

6.2 DATA FORMATS (RELATIVE TO DENSITY)

SINGLE DENSITY: 64 WORD/SECTOR RX01,02,XX
DOUBLE DENSITY: 128 WORDS/SECTOR RX02,XX ONLY

6.3 DENSITY (BIT 8 OF CONTROL STATUS WORD, RX02,XX ONLY)

0 DOUBLE FREQUENCY (OR FM) SINGLE DENSITY
1 MILLER CODE (OR MCM) DOUBLE DENSITY

6.4 UNIT SELECT (BIT 4 OF CONTROL STATUS WORD)

SET TO DEVICE UNIT ADDRESS (0-1)

6.5 SIDE SELECT (BIT9 OF CONTROL STATUS WORD, RXXX ONLY)

SET TO SIDE ADDRESS (0-1)

6.6 HARDWARE REGISTERS

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00	
RXCS:	ERR	INT	XM	XM	RX2		SID	DEN	TR	IE	DON	DRV	FUN	FUN	FUN	GO	
RXWC:	WORD COUNT																(RX02)
RXBA:	BUS ADDRESS										REGISTER						(RX02)
RXFS:			NXM	WC OVF	SID #1	DRV #1	DRV RDY	DEL DAT	DSK DEN	DEN	AC ERR	INT	SID LOW	CRC DON	RDY		
RXDB:	DATA BUFFER																
RXTA:	0								TRACK ADDRESS								
RXSA:	0							0	0		SECTOR ADDRESS						

NOTE: RXXX + XX ARE REFERENCES TO DEVICE FUTURE EXPANSION.

```
                        6.7     DEVICE ERROR CODES
                                ------------------

                                KNXDV0=10       /DRIVE 0 FAILED TO SEE HOME ON INITIALIZE.  NO ERROR BIT
                                KNXDV1-20       /DRIVE 1 FAILED TO SEE HOME ON INITIALIZE.  NO ERROR BIT
                                KERTRK 40       /TRIED TO ACCESS A TRACK GREATER THAN 76.
                                KHOMERR=50      /HOME WAS FOUND BEFORE DESIRED TRACK WAS REACHED.
                                KSELFER-60      /SELF DIAGNOSTIC ERROR.
                                KNXHDR=70       /DESIRED SECTOR COULD NOT BE FOUND AFTER LOOKING AT 52 HEADERS.
                                KWPROT-100      /WRITE FUNCTION ATTEMPTED ON A WRITE PROTECTED DISK.
                                KTIMERR=110     /MORE THAN 40 MICROSECONDS AND NO SEPCLOCK SEEN.
                                KNXPRAM-120     /A PREAMBLE COULD NOT BE FOUND.
                                KNXIDAM=130     /PREAMBLE FOUND BUT NO ID MARK FOUND WITHIN ALLOWABLE TIME.
                                KNCHCER=140     /CRC ERROR ON WHAT APPEARED TO BE A HEADER.  ERROR IS NOT ASSERT
                                KTKSKER-150     /THE TRACK ADDRESS OF A GOOD HEADER DOES NOT COMPARE WITH THE DE
                                KXSTRYS=160     /TOO MANY TRIES FOR AN IDAM.
                                KNODAM-170      /DATA AM NOT FOUND IN ALLOTTED TIME.
                                KDCRCER 200     /CRC ERROR ON READING THE SECTOR FROM THE DISK.
                                KMANER 220      /R/W ELECTRONICS FAILED MAINTENANCE MODE TEST.
                                KWCNOV=230      /WORD COUNT OVERFLOW.
                                KSTDER=240      /WRONG KEY WORD FOR SET MEDIA DENSITY COMMAND.

                        7.0     PROGRAM DESCRIPTION
                                -------------------

                                IN ORDER TO MAINTAIN THE CONTINUOUS EXECUTION OF THE
                                OPERATIONS DESCRIBED THE PROGRAM IS ORGANIZED AS FOLLOWS:

                                        START
                                        DETERMINE IF SWITCHLESS PROCESSOR
                                        DETERMINE IF LSI PROCESSOR
                                        INITIALIZE THE RX
                                        GET RX STATUS WORD              (WORD COUNT, UNIT SELECT)
                                        GET SWITCH REGISTER
                                        INITIALIZE RX IF SWITCH 13 1
                                        EXECUTE OPERATION (SET FUNCTION AND FROM OP TABLE AND SET GO 1)
                                        AWAIT END OF OPERATION (READY DELAY)
                                        STOP IF SWITCH 15=1
                                        STOP IF LAST OPERATION IN SEQUENCE AND SWITCH 14 1
                                        POINT TO NEXT FUNCTION CODE IN OP TABLE
                                        JUMP BACK TO GET SWITCH REGISTER.


                        7.1     FLOW
                                ----

                                ;BEGINROUTINE [MOD 0.0 CONTROL]
                                ;   INITIALIZE STACK
                                ;   IF HARDWARE REG
                                ;   :   THEN
                                ;   :       SET SWITCH_REG ADDRESS-HARDWARE SWITCH REG ADDRESS
                                ;   :   ELSE
                                ;   :       SET SWITCH_REG ADDRESS SOFTWARE SWITCH REG ADDRESS
                                ;   ENDIF
                                ;   IF NOT LSI_PROCESSOR
                                ;   :   THEN
```

```
;   :     SET NORMAL PROCESSOR PRI
;   :   ELSE
;   :     SET LSI PROCESSOR PRI + SET LSI_FLAG
;   ENDIF
;   CALL OUTPUT [MOD 3.0]-OUTPUT INITIALIZE TO RX (INTWD,CSAD)
;   CALL INPUT [MOD 1.0]-GET RX CSR (DNWD,CSAD,TYIN,CSWD)
;   BEGINDO
;   :   CALL INPUT [MOD 1.0]-GET SWITCH REG (SWAD,TYIN,SWWD)
;   :   CALL PROCESS [MOD 7.0]-FORMAT TABLE ENTRY (TE,SETFW,FNWD)
;   :   IF SWR BITB-1
;   :   :  THEN
;   :   :     CALL OUTPUT [MOD 3.0]-INITIALIZE RX (CSAD,INITWD)
;   :   ENDIF
;   :   CALL OUTPUT [MOD 3.0]-SEND FUNCTION WORD TO RX (CSAD,FW,CSWD,WC,SWWD,ETAD,TE)
;   :   IF FW [FUNCTION WORD]-EMPTY BUFFER
;   :   :  THEN
;   :   :     IF DEVICE=RX02 <RXCS BIT11=0>
;   :   :     :  THEN
;   :   :     :     SET TYIN-64
;   :   :     :     CALL INPUT [MOD 1.0]-GET RX01 INPUT BUFFER (DBAD,TYIN)
;   :   :     ENDIF
;   :   ENDIF
;   :   CALCULATE ERROR TABLE ADDRESS <ETAD ETBA+2TE>
;   :   IF ERROR_STATUS_FLAG 1 <ERSTAT=1>
;   :   :  THEN
;   :   :     CALL INPUT [MOD 1.0]-GET ERROR WORD (DBAD,TYIN,ERWD)
;   :   :     SAVE ERROR WORD (ERWD) IN ERROR TABLE AT (ERAD)
;   :   :  ELSE
;   :   :     CALL INPUT [MOD 1.0]-GET STATUS WORD (CSAD,CSWD,TYIN)
;   :   :     IF RX CSR BIT15=1 [ERROR BIT]
;   :   :     :  THEN
;   :   :     :     CALL INPUT [MOD 1.0]-GET ERROR WORD (DBAD,TYIN,ERWD)
;   :   :     :     SAVE ERROR WORD (ERWD) IN ERROR TABLE AT (ERAD)
;   :   :     ENDIF
;   :   ENDIF
;   :   CLEAR ERROR_STATUS_FLAG <ERSTAT>
;   :   ADVANCE TABLE ENTRY <TE TE+1>
;   :   IF SWR BIT15=1
;   :   :  THEN
;   :   :     HALT
;   :   :     IF TABLE ENTRY=TABLE LENGTH <TE TL>
;   :   :     :  THEN
;   :   :     :     SET TABLE ENTRY-0
;   :   :     ENDIF
;   :   :  ELSE
;   :   :     IF TABLE ENTRY TABLE LENGTH <TE T
;   :   :     :  THEN
;   :   :     :     IF SWR BIT14 1
;   :   :     :     :  THEN
;   :   :     :     :     HALT
;   :   :     :     ENDIF
;   :   :     :     SET TABLE ENTRY 0 <TE=0>
;   :   :     ENDIF
;   :   ENDIF
;   ENDDO
;ENDROUTINE
```

7.2 TABLES

1. THE DATA INPUT (FROM RX) TABLE IS AT LOCATION 4000.

2. THE DATA OUTPUT (TO RX) TABLE IS AT LOCATION 5000.

3. THE ERROR TABLE IS AT LOCATION 3700.

   - ERRORS ARE STORED IN THIS TABLE, ONE WORD FOR ONE WORD IN SEQUENCE CORRESPONDING WITH FUNCTION CODE TABLE. (SEE FUNCTION TABLE BELOW)

   - OPERATION-ERRORS ARE STORED FOR EACH MAINT READ STATUS FUNCTION SELECTED OR ON ANY OTHER FUNCTION IF AN ERROR OCCURRED. THE LOCATION IS ZEROED IF THESE TWO CONDITIONS ARE NOT MET.

4. THE EXTENDED ERROR CODE TABLE IS AT LOCATION 4400.

   - THE RESULTS OF A READ ERROR CODE ARE STORED IN THIS TABLE.

   - OPERATION - IF A READ ERROR CODE FUNCTION IS USED THEN THE RESULTS ARE STORED IN THIS TABLE WITH A STARTING ADDRESS AS SHOWN IN THE FUNCTION TABLE BELOW. THE NEXT 8 BYTES CONTAIN RESULTS OF THE FUNCTION.

5. THE FUNCTION TABLE IS AT LOCATION 712.

8.0 LISTING INDEX

8.1 LISTING

&

```
                                        .NLIST TTM
                                        .TITLE  RX01,2,X UTILITY DRIVER
                                        ;MAINDEC-11-
                                        ;7 FEB 77   UPDATE: 18-APR-78
                                        ;L.PRUCHA  V: 3
                                        ;THIS SOURCE TAKEN FROM BRUT2.LSI
                                        .ENABLE ABS.AMA
                                        .MCALL ..V2..,.REGDEF

                000000                  . 0
000000  000000                          .WORD   0
000002  000000                          .WORD   0
000004  000000                          .WORD   0
000006  000000                          .WORD   0
000010  000000                          .WORD   0
000012  000000                          .WORD   0
000014  000000                          .WORD   0
000016  000000                          .WORD   0
000020  000000                          .WORD   0
000022  000000                          .WORD   0

                000200                  .-200
000200  000167  000574                  JMP     START

                                ;***** RX INTERRUPT VECTOR *****

                000264                  . 264                   ;RX INTERRUPT HANDLER ADDRESS
000264  003452                          RXINTR                  ;IF INTERRUPTS ARE USED AND VECTOR ADDRESS
000266  000340                          340                     ;IS NOT 264, THEN THIS MUST BE MODIFIED.

                000600                  .-600
                                ;***** RX01,2,X REGISTERS *****

000600  177170                  RXCS:   177170
000602  177172                  RXDB:   177172

                                ;***** PROCESSOR ADDRESSES *****

000604  177776                  PSW:    177776
000606  000760                  SWR:    760

                                ;***** CONTSTANTS *****

000610  177570                  HDSWR:  177570                  ;HARDWARE SWITCH REG ADDRESS
000612  000760                  SFSWR:  760                     ;SOFTWARE SWITCH REG ADDRESS
000614  000004                  BTRP:   4                       ;BUS TRAP ADDRESS
000616  000006                  BTRP2:  6                       ;BUS TRAP PRI LEVEL
```

```
                        000700          .=700
                                ;***** SET PARAMETERS DESIRED FOR UNIT UNDER TEST *****
                                
000700  000000          SETCS:  0               ;SET RXCS-USED TO SET: DRV#,SIDE#,DENSITY BIT,INTERRUPT
000702  000001          WRDCNT: 1               ;WORD COUNT-FOR FILL OR EMPTY BUFFER OPERATIONS
000704  100000          RDYDLY: 100000          ;READY DELAY            : TIME OUT
000706  000001          RDYDX:  1               ;READY MULTIPLIER       :      DELAYS
000710  000001          OPNUM:  1               ;NUMBER OF OPERATIONS (1 TO 15 DECIMAL)
                        ;-------------------------------------------------------------------
                        ;
                        ;       ***** FUNCTION TABLE *****
                        ;
                        ;ENTER FUNCTIONS IN SEQUENCE DESIRED.  MUST HAVE AT LEAST 1 FUNCTION
                        ;ENTERED, AND MAY HAVE UP TO 16 OPERATIONS.  SET THE OPERATION COUNTER
                        ;(OPNUM) ABOVE EQUAL TO THE NUMBER OF FUNCTIONS IN THE SEQUENCE.
                        ;
                        ;       CODE        FUNCTION
                        ;       ----        --------
                        ;        0       FILL BUFFER
                        ;        1       EMPTY BUFFER
                        ;        2       WRITE SECTOR
                        ;        3       READ SECTOR
                        ;        4       SET DENSITY (RX02,XX) ** BE CAREFUL  TAKES 15 SECONDS **
                        ;        5   -   READ MAINTENANCE STATUS  ** MAINTENANCE MODE **
                        ;        6   -   WRITE SECTOR WITH DELETED DATA
                        ;        7       READ ERROR CODE
                        ;-------------------------------------------------------------------
                        ;       .--< FILL WITH SEQUENCE OF FUNCTIONS
                        ;       .
                        ;       .       ETAD            XETAD (RX02,XX ONLY)
                        ;               ----            -----
000712  000000  FUNTAB: 0   ;   3700            4400
000714  000000          0   ;   3702            4420
000716  000000          0   ;   3704            4440
000720  000000          0   ;   3706            4460
000722  000000          0   ;   3710            4500
000724  000000          0   ;   3712            4520
000726  000000          0   ;   3714            4540
000730  000000          0   ;   3716            4560
000732  000000          0   ;   3720            4600
000734  000000          0   ;   3722            4620
000736  000000          0   ;   3724            4640
000740  000000          0   ;   3726            4660
000742  000000          0   ;   3730            4700
000744  000000          0   ;   3732            4720
000746  000000          0   ;   3734            4740
000750  000000          0   ;   3736            4760
                        ;-------------------------------------------------------------------
                          INTAB=4000                    ;ADDRESS OF INPUT TABLE, RX TO TABLE
                          OUTAB 5000                    ;ADDRESS OF OUTPUT TABLE, TABLE TO RX
                           ETBA=3700                    ;ADDRESS OF ERROR TABLE (16 WORDS)
                          XETBA 4400                    ;ADDRESS OF EXTENDED ERROR CODE TABLE
                        ;-------------------------------------------------------------------
                                .=760
000760  000000  SOFTSR: 0                       ;SOFTWARE SWITCH REG
                        ;-------------------------------------------------------------------
```

```
                    001000                          .=1000
                                                    ;START OF PROGRAM
                                                .SBTTL  MODULE 0.0 - CONTROL
                                                ;-----------------------------------------------------------------------

001000  012706  000500          START:  MOV     #500,SP         ;INTIALIZE STACK PIONTER
001004  012777  001042  177602          MOV     #SSWTRP,@BTRP   ;SET BUS TRAP FOR SWITCHLESS ADR TRAP
001012  012777  000200  177576          MOV     #200,@BTRP2     ;SET PROCESSOR PRI FOR TRAP
001020  005777  177564                  TST     @HDSWR          ;CAUSE SWITCHLESS PROCESSOR TRAP
001024  016767  177560  177554          MOV     HDSWR,SWR       ;SET UP FOR HARDWARE SWITCH REG.
001032  016767  177552  002272          MOV     HDSWR,DISPLY    ;SET DISPLAY REG
001040  000403                          BR      START0          ;NO SWITCHLESS PROCESSOR TRAP BRANCH
001042  016767  177544  177536  SSWTRP: MOV     SFSWR,SWR       ;SET UP SOFTWARE SWITCH REG.
001050  012777  001074  177536  START0: MOV     #LSITRP,@BTRP   ;SET BUS TRAP FOR LSI TRAP
001056  012777  000200  177532          MOV     #200,@BTRP2     ;SET PROCESS
001064  012777  000340  177512          MOV     #340,@PSW       ;CAUSE LSI TRAP
001072  000405                          BR      START1          ;BR IF NO TRAP
001074  012767  000001  000740  LSITRP: MOV     #1,LSIFLG       ;SET SWITCHLESS PROCESSOR FLAG
001102  106427  000200                  MTPS    #200            ;SET LSI PRIORITY
001106  005077  177502          START1: CLR     @BTRP           ;RESET BUS TRAP
001112  005077  177500                  CLR     @BTRP2          ;RESET BUS TRAP
001116  012767  000001  000642          MOV     #1,TR           ;INTIALIZE INPUT TYPE
001124  012767  000000  000632          MOV     #0,TE           ;INTIALIZE TABLE ENTRY
001132  012767  000000  000660          MOV     #0,DNWD         ;SET DONE BIT TO ZERO
001140  016767  177434  000636          MOV     CSAD,ADOT       ;ADDRESS OF OUTPUT WORD  (PASS TO 3.0)
001146  016767  000652  000632          MOV     INTWD,WDOT      ;INTIALIZE WORD          (PASS TO 3.0)
001154  004767  001076                  JSR     PC,OUTPUT       ;INTIALIZE DEVICE        DO 3.0
001160  012767  000040  000632          MOV     #40,DNWD        ;SET DONE BIT TO ONE
001166  016767  177406  000576          MOV     CSAD,ADIN       ;ADDRESS OF INPUT WORD   (PASS TO 1.0)
001174  016767  000566  000574          MOV     TR,TYIN         ;INPUT TYPE              (PASS TO 1.0)
001202  004767  000640                  JSR     PC,INPUT        ;INPUT DEVICE CS REG     DO 1.0
001206  016767  000562  000612          MOV     WDIN,CSWD       ;SAVE DEVICE CS REG      (FROM  1.0)
001214  016767  177366  000550  DO0:    MOV     SWR,ADIN        ;ADDRESS OF WORD INPUT   (PASS TO 1.0)
001222  012767  000000  000570          MOV     #0,DNWD         ;SET DONE BIT TO ZERO    (PASS TO 1.0)
001230  012767  000001  000530          MOV     #1,TR           ;SET INPUT TYPE          (PASS TO 1.0)
001236  016767  000524  000532          MOV     TR,TYIN         ;INPUT TYPE              (PASS TO 1.0)
001244  004767  000576                  JSR     PC,INPUT        ;INPUT SWITCH REG        DO 1.0
001250  016767  000520  000552          MOV     WDIN,SWWD       ;SAVE SWITCH REG         (FROM    1.0)
001256  016767  000502  000514          MOV     TE,TABENT       ;TABLE ENTRY             (PASS TO 2.0)
001264  016767  177410  000524          MOV     SETFW,STWD      ;SET FUNCTION WORD       (PASS TO 2.0)
001272  004767  000706                  JSR     PC,PROCES       ;PROCESS TABLE ENTRY     DO 2.0
001276  016767  000500  000456          MOV     FNWD,FW         ;SAVE FUNCTION WORD      (FROM 2.0)
001304  032767  020000  000516  IFA0:   BIT     #20000,SWWD     ;IF SR BIT#13
001312  001413                          BEQ     EA10            ;EQUALS ONE, THEN
001314  012767  000040  000476          MOV     #40,DNWD        ;SET DONE BIT                    (PASS TO 3.0)
001322  016767  177252  000454          MOV     CSAD,ADOT       ;AND SET ADDRESS OF OUTPUT       (PASS TO 3.0)
001330  016767  000470  000450          MOV     INTWD,WDOT      ;AND SET INTIALIZE WORD          (PASS TO 3.0)
001336  004767  000714                  JSR     PC,OUTPUT       ;AND INTIALIZE DEVICE             DO 3.0
001342  012767  000040  000450  EA10.   MOV     #40,DNWD        ;SET DONE BIT TO ONE              (PASS TO 3.0)
001350  016767  000410  000460          MOV     TE,TBEN         ;TABLE ENTRY                      (PASS TO 3.0)
001356  016767  000400  000422          MOV     FW,WDOT         ;FUNCTION WORD FOR OUTPUT         (PASS TO 3.0)
001364  016767  000436  000376          MOV     CSWD,STATWD     ;DEVICE STATUS WORD               (PASS TO 3.0)
001372  016767  177304  000410          MOV     WC,WDCT         ;BUFFER WORD COUNT (RX02)         (PASS TO 3.0)
001400  016767  000424  000404          MOV     SWWD,TASA       ;TA AND SA (IN SWITCH WORD)       (PASS TO 3.0)
001406  004767  000644                  JSR     PC,OUTPUT       ;OUTPUT FUNCTION WORD              DO 3.0
001412  016701  000344                  MOV     FW,R1           ;MOVE FUNCTION WORD TO R1
```

```
001416 042701 177761                BIC   #177761,R1       ;MASK ALL BUT FUNCTION
001422 022701 000002         IFB0:  CMP   #2,R1            ;IF FUNCTION IS (FW BITS#3,2,1)
001426 001023                       BNE   ELB0             ;'EMPTY BUFFER' (         0,0,1)
001430 016701 000372                MOV   CSWD,R1          ;THEN MOVE CS WORD TO R1
001434 032701 004000         IFC0:  BIT   #4000,R1         ;IF DEVICE IS
001440 001016                       BNE   ELB0             ;RX01  (RXCS BIT#11=0)
001442 012767 000064 000316         MOV   #64,TR           ;THEN SET TYPE TRANSFER
001450 016767 000312 000320         MOV   TR,TYIN          ;INPUT TRANSFER          (PASS TO 1.0)
001456 012767 000000 000334         MOV   #0,DNWD          ;SET DONE BIT TO ZERO    (PASS TO 1.0)
001464 016767 177112 000300         MOV   DBAD,ADIN        ;ADDRESS OF INPUT        (PASS TO 1.0)
001472 004767 000350                JSR   PC,INPUT         ;INPUT RX01 'EMPTY BUFF' DO 1.0
001476 016767 000262 000326  ELB0.  MOV   TE,MULTE         ;SET UP TABLE ENTRY
001504 006367 000322                ASL   MULTE            ;MULTIPLY TABLE ENTRY (*2)
001510 012767 003700 000316         MOV   #ETBA,ETAD       ;SET UP ERROR TABLE BASE ADDRESS
001516 066767 000310 000310         ADD   MULTE,ETAD       ;CALCULATE ERROR TABLE ADDRESS
001524 012767 000040 000270         MOV   #40,RDYWD        ;SET DONE BIT TEST   (PASS TO 1/3.1)
001532 004767 001512                JSR   PC,DELAY         ;DELAY FOR DONE       DO 1/3.1
001536 032767 000001 001344  IFD0:  BIT   #1,ERSTAT        ;IF ERROR STATUS
001544 001401                       BEQ   ELD0             ;EQUALS 1 THEN
001546 000417                       BR    EID0             ;PROCEED TO END IF 'D'
001550 012767 000001 000220  ELD0:  MOV   #1,TYIN          ;SET INPUT TYPE -SINGLE WD (PASS TO 1.0)
001556 012767 000040 000234         MOV   #40,DNWD         ;SET DONE BIT -COMPARE WD  (PASS TO 1.0)
001564 016767 177010 000200         MOV   CSAD,ADIN        ;SET ADRESS OF INPUT WD    (PASS TO 1.0)
001572 004767 000250                JSR   PC,INPUT         ;GET DEVICE STATUS WD       DO 1.0
001576 032767 100000 000170  IFE0:  BIT   #100000,WDIN     ;IF DEVICE ERROR BIT (RXCS BIT#15 1)
001604 001422                       BEQ   ELE0             ;EQUALS 1
001606 012767 000001 000162  EID0:  MOV   #1,TYIN          ;SET INPUT TYPE -SINGLE WD (PASS TO 1.0)
001614 016767 176762 000150         MOV   DBAD,ADIN        ;SET ADDRESS OF INPUT WD   (PASS TO 1.0)
001622 012767 000040 000170         MOV   #40,DNWD         ;SET DONE BIT -COMPARE WD  (PASS TO 1.0)
001630 004767 000212                JSR   PC,INPUT         ;GET DEVICE ERROR WD (RXES) DO 1.0
001634 016767 000134 000176         MOV   WDIN,ERWD        ;SAVE ERROR WD
001642 016777 000172 000164         MOV   ERWD,@ETAD       ;STORE ERROR WORD IN TABLE
001650 000405                       BR    EIE0             ;PROCEED TO END IF 'E'
001652 012777 000000 000154  ELE0:  MOV   #0,@ETAD         ;ZERO ERROR TABLE LOCATION
001660 005067 001224                CLR   ERSTAT           ;CLEAR ERROR STATUS (SET BY 3.0)
001664 005267 000074         EIE0:  INC   TE               ;INCREMENT TABLE ENTRY
001670 032767 100000 000132  IFF0:  BIT   #100000,SWWD     ;IF SR BIT#15 IS
001676 001411                       BEQ   IFH0             ;EQUAL TO ONE
001700 000000                       HALT                   ;THEN HALT
001702 026767 177002 000054  IFG0:  CMP   TL,TE            ;IF      (TL-TE)
001710 001003                       BNE   EIG0             ;TE-TL
001712 012767 000000 000044         MOV   #0,TE            ;THEN SET TE-0
001720 000415                EIG0:  BR    EIF0
001722 026767 176762 000034  IFH0:  CMP   TL,TE            ;IF      (TL-TE)
001730 001010                       BNE   EIH0             ;TE TL
001732 032767 040000 000070  IFI0:  BIT   #40000,SWWD      ;THEN IF SR BIT#14 IS
001740 001401                       BEQ   EII0             ;EQUAL TO ONE
001742 000000                       HALT                   ;THEN HALT
001744 012767 000000 000012  EII0:  MOV   #0,TE            ;SET TABLE ENTRY TO ZERO
001752 000240                EIH0:  NOP
001754 000240                EIF0:  NOP
001756 000167 177232                JMP   D00              ;GET NEXT TABLE ENTRY
                             ;-------------------------------------------------------------------
```

```
                                ;MODULE 0.0 - REGISTERS AND PARAMETERS ---------------------------------
                                   SWAD SWR                    ;EXTERNAL, SWITCH REG ADDRESS
                                   CSAD-RXCS                   ;EXTERNAL, RXCS ADDRESS
                                   DBAD=RXDB                   ;EXTERNAL, RXDB ADDRESS
                                     TL=OPNUM                  ;EXTERNAL,SET FUNCTION TABLE LENGTH
                                     WC=WRDCNT                 ;EXTERNAL, WORD COUNT
                                 SETFW-SETCS                   ;EXTERNAL, SET PART OF FUNCTION WORD
001762  000000                  FW:      0                    ;INTERNAL, FUNCTION WORD
001764  000000                  TE:      0                    ;INTERNAL, TABLE ENTRY
001766  000000                  TR:      0                    ;INTERNAL, TRANSFER TYPE
001770  000000                  STATWD:  0                    ;MODULE  .0 DEVICE STATUS WORD
001772  000000                  ADIN:    0                    ;MODULE 1.0 INPUT ADDRESS
001774  000000                  WDIN:    0                    ;MODULE 1.0 INPUT WORD
001776  000000                  TYIN:    0                    ;MODULE 1.0 TYPE TRANSFER
002000  000000                  TABENT:  0                    ;MODULE 2.0 TABLE ENTRY
002002  000000                  FNWD:    0                    ;MODULE 2.0 FUNCTION WORD
002004  000000                  ADOT:    0                    ;MODULE 3.0 OUTPUT ADDRESS
002006  000000                  WDOT:    0                    ;MODULE 3.0 OUTPUT WORD
002010  000000                  WDCT:    0                    ;MODULE 3.0 WORD COUNT (RX02)
002012  000000                  TASA:    0                    ;MODULE 3.0 TRACK AND SECTOR ADDRESS
002014  000000                  DATAD:   0                    ;MODULE 3.0 DATA ADDRESS
002016  000000                  STWD:    0                    ;MODULE 2.0 PRESET FUNCTION WORD
002020  000000                  DNWD:    0                    ;MODULE 0.0 DONE READY TEST WORD
002022  000000                  RDYWD:   0                    ;MODULE 1/3.1 READY WORD
002024  040000                  INTWD:   40000                ;INTERNAL,INITIALIZE DEVICE WORD
002026  000000                  CSWD:    0                    ;INTERNAL,DEVICE CS REG
002030  000000                  SWWD:    0                    ;INTERNAL,SWITCH REG WORD
002032  000000                  MULTE:   0                    ;INTERNAL,MULTIPLY TABLE ENTRY PARAM.
002034  000000                  ETAD:    0                    ;INTERNAL,ADDRESS OF ERROR WORD
002036  000000                  TBEN:    0                    ;MODULE 3.0 CURRENT TABLE ENTRY
002040  000000                  ERWD:    0                    ;INTERNAL, TEMP STORAGE ERROR WORD
002042  000000                  LSIFLG:  0                    ;EXTERNAL, LSI PROCESSOR/SWITCHLESS PROCESSOR FLAG
0020--  000000                  INTRFG:  0                    ;EXTERNAL, INTERRUPT FLAG

                                ;MODULE 0.0 ----- END MODULE -----------------------------------------
```

```
                                                    .SBTTL  MODULE 1.0 - INPUT
                                                    ;-------------------------------------------------------------------

002046  000240                                      INPUT:  NOP
002050  032767  000001  177720                      IFA':   BIT     #1,TYIN         ;IF WORD TRANSFER
002056  001413                                              BEQ     ELA1            ;EQUALS ONE
002060  016767  177734  177734                              MOV     DNWD,RDYWD      ;SET READY WORD (PASS TO 1/3.1)
002066  004767  001156                                      JSR     PC,DELAY        ;DELAY FOR READY   DO 1/3.1
002072  000240                                              NOP
002074  017767  177672  177672                              MOV     @ADIN,WDIN      ;THEN TRANSFER WORD (PASS TO 0.0)
002102  000240                                              NOP
002104  000431                                              BR      EIA1            ;BRANCH TO ENDIF 'A'
002106  012767  000000  000062                      ELA1:   MOV     #0,BYCNT        ;INTIALIZE BYTE COUNT
002114  016701  000056                              BDA1:   MOV     BYCNT,R1        ;MOVE BYTE COUNT
002120  062701  004000                                      ADD     #BAINTB,R1      ;ADD DATA BASE ADDRESS TO BYTE COUNT
002124  010167  000050                                      MOV     R1,DAINAD       ;MOVE RESULT TO DATA ADDRESS
002130  016767  000046  177664                              MOV     INTR,RDYWD      ;SET READY WORD  (PASS TO 1/3.1)
002136  004767  001106                                      JSR     PC,DELAY        ;DELAY FOR READY  DO 1/3.1
002142  117777  177624  000030                              MOVB    @ADIN,@DAINAD   ;MOV DATA BYTE TO INPUT DATA TABLE
002150  005267  000022                                      INC     BYCNT           ;INCREMENT BYTE COUNT
002154  000240                                              NOP
002156  000240                                              NOP
002160  032767  000200  000010                              BIT     #200,BYCNT      ;TEST BYCNT
002166  001752                                      DUA3:   BEQ     BDA1            ;DOUNTIL BYCNT 128 BYTES
002170  000240                                      EIA1:   NOP
002172  000240                                              NOP
002174  000207                                              RTS     PC              ;RETURN TO MOD 0.0


                                                    ;MODULE 1.0 REGISTERS ----------------------------------------------

002176  000000                                      BYCNT:  0                       ;INTERNAL, BYTE COUNTER
002200  000000                                      DAINAD: 0                       ;INTERNAL, CURRENT ADDRESS DATA INPUT TABLE
002202  000200                                      INTR:   200                     ;INTERNAL, TRANSFER READY, INPUT
        004000                                       BAINTB INTAB                   ;EXTERNAL, INPUT DATA TABLE BEGIN ADDRESS
                                                    ;MODULE 1.0 ----- END MODULE ---------------------------------------
```

```
                                    .SBTTL  MODULE 2.0 - PROCESS
                                    ;-------------------------------------------------------------------------

002204  000240                      PROCES: NOP
002206  006167  177566                      ROL     TABENT          ;DOUBLE ENTRY FOR TABLE ADDRESS
002212  016705  177562                      MOV     TABENT,R5       ;ENTRY FUNCTION CODE TABLE
002216  012704  000712                      MOV     #TBA,R4         ;BASE ADDRESS FUNCTION CODE TABLE
002222  060405                              ADD     R4,R5           ;FORM ADDRESS OR FUNCTION CODE
002224  010567  000024                      MOV     R5,FUNCAD       ;SAVE ADDRESS OF FUNCTION CODE
002230  011501                              MOV     (R5),R1         ;GET FUNCTION CODE
002232  000261                              SEC                     ;SET CARRY BIT
002234  006101                              ROL     R1              ;FORMAT FUNCTION CODE + GO BIT
002236  016702  177554                      MOV     STWD,R2         ;GET SET FUNCTION WORD
002242  050102                              BIS     R1,R2           ;MASK FUNCTION CODE ONTO SET FUNCTION WORD
002244  010267  177532                      MOV     R2,FNWD         ;FUNCTION WORD  (PASS TO 0.0)
002250  000240                              NOP
002252  000207                              RTS     PC              ;RETURN TO MOD 0.0
                                    ;MODULE 2.0 REGISTERS ---------------------------------------------------

        000712                          TBA=FUNTAB                  ;BEGIN ADDRESS FUNCTION CODE TABLE
002254  000000                      FUNCAD: 0                       ;CURRENT FUNCTION CODE ADDRESS
                                    ;MODULE 2.0 ----- END MODULE ---------------------------------------------
```

```
                                        .SBTTL  MODULE 3.0 - OUTPUT
                                        ;-------------------------------------------------------------------
                                        
002256  000240                  OUTPUT: NOP
002260  016767  177534  177534        MOV     DNWD,RDYWD      ;READY TEST WD          (PASS TO 3.1)
002266  016767  177514  000604        MOV     WDOT,WRDS       ;WORD FOR OUTPUT        (PASS TO 3.1)
002274  016767  176300  000600        MOV     CSADR,ADRS      ;ADDRESS OF OUTPUT      (PASS TO 3.1)
002302  004767  000614                JSR     PC,OUTSWD       ;OUTPUT FUNCTION WD (FW) DO 3.1
002306  032767  040000  177472  IFA3: BIT     #40000,WDOT     ;IF FUNCTION IS
002314  001001                        BNE     ELA3            ;NOT AN ''INTIALIZE'' (FW BIT#14=0)
002316  000402                        BR      THA3            ;THEN 'A'
002320  000167  000520          ELA3: JMP     END3            ;ENDIF 'A' -DONE
002324  032767  000010  177454  THA3: BIT     #10,WDOT        ;THEN, IF FUNCTION IS
002332  001073                        BNE     IFC3            ;'READ,WRITE,FILL,EMPTY'' (FW BIT#3=0)
002334  032767  000004  177444  IFH3: BIT     #4,WDOT         ;AND THEN IF FUNCTION IS
002342  001077                        BNE     ELH3            ;'EMPTY,FILL''  (FW BIT#2=0)
002344  032767  004000  177416  .FI3: BIT     #4000,STATWD    ;THEN IF DEVICE IS
002352  001443                        BEQ     IFJ3            ;RX02     (RXCS BIT#11=1)
002354  016767  000516  177440        MOV     OTTR,RDYWD      ;THEN SET OUTPUT READY TEST WORD (PASS TO 3.1)
002362  016767  177422  000510        MOV     WDCT,WRDS       ;AND SET WORD FOR OUTPUT        (PASS TO 3.1)
002370  016767  176206  000504        MOV     DBADR,ADRS      ;AND SET ADDRESS OF OUTPUT      (PASS TO 3.1)
002376  004767  000520                JSR     PC,OUTSWD       ;OUTPUT WORD  COUNT  WORD        DO 3.1
002402  032767  000002  177376  IFK3: BIT     #2,WDOT         ;IF FUNCTION IS
002410  001004                        BNE     ELK3            ;'FILL BUFFER''      (FW BIT#1 0)
002412  012767  005000  000474        MOV     #BAOUTB,BA      ;SET BASE ADDRESS FOR FILL
002420  000403                        BR      EIK3            ;BRANCH TO ENDIF 'K'
002422  012767  004000  000464  ELK3: MOV     #BAINTB,BA      ;SET BASE ADDRESS FOR EMPTY
002430  016767  000442  177364  EIK3: MOV     OTTR,RDYWD      ;SET OUTPUT READY TEST WORD  (PASS TO 3.1)
002436  016767  000452  000434        MOV     BA,WRDS         ;WORD FOR OUTPUT             (PASS TO 3.1)
002444  016767  176132  000430        MOV     DBADR,ADRS      ;ADDRESS OF OUTPUT           (PASS TO 3.1)
002452  004767  000444                JSR     PC,OUTSWD       ;OUTPUT BASE ADDRESS WORD     DO 3.1
002456  000167  000362                JMP     END3            ;DONE
002462  032767  000002  177316  IFJ3: BIT     #2,WDOT         ;IF FUNCTION IS
002470  001013                        BNE     EII3            ;'FILL BUFFER -RX01'' (FW BIT#1-0)
002472  016767  000400  177322        MOV     OTTR,RDYWD      ;THEN SET OUTPUT READY TEST WORD (PASS TO 3.2)
002500  016767  002274  000376        MOV     BAOUTB,WRDM     ;WORD TABLE FOR OUTPUT           (PASS TO 3.2)
002506  016767  176070  000372        MOV     DBAD,ADRM       ;ADDRESS OF OUTPUT               (PASS TO 3.2)
002514  004767  000432                JSR     PC,OUTMWD       ;OUTPUT WORD TABLE                DO 3.2
002520  000460                  EII3: BR      EIH3            ;BRANCH TO ENDIF 'H'
002522  032767  000004  177256  IFC3: BIT     #4,WDOT         ;IF FUNCTION WORD IS
002530  001516                        BEQ     IFE3            ;'WRITE D.D.'' OR 'READ E.C.''(FW BIT#2-1)
002532  032767  000002  177246  IFD3: BIT     #2,WDOT         ;THEN, IF FUNCTION IS
002540  001051                        BNE     IFF3            ;'WRITE D.D.'', THEN          (FW BIT#1 0)
002542  016767  000330  177252  ELH3: MOV     OTTR,RDYWD      ;SET OUTPUT READY TEST WORD     (PASS TO 3.1)
002550  016767  177236  000322        MOV     TASA,WRDS       ;MOVE TRACK AND SECTOR ADDRESS  (PASS TO 3.1)
002556  042767  177700  000314        BIC     #177700,WRDS    ;FORMAT TO SECTOR ADDRESS       (PASS TO 3.1)
002564  016767  176012  000310        MOV     DBAD,ADRS       ;ADDRESS OF OUTPUT              (PASS TO 3.1)
002572  004767  000324                JSR     PC,OUTSWD       ;OUTPUT SECTOR ADDRESS           DO 3.1
002576  016767  177210  000274        MOV     TASA,WRDS       ;MOVE TRACK AND SECTOR ADDRESS
002604  006067  000270                ROR     WRDS            ;FORMAT
002610  006067  000264                ROR     WRDS            ;FORMAT
002614  006067  000260                ROR     WRDS            ;FORMAT
002620  006067  000254                ROR     WRDS            ;FORMAT
002624  006067  000250                ROR     WRDS            ;FORMAT
002630  006067  000244                ROR     WRDS            ;FORMAT
002634  042767  177600  000236        BIC     #177600,WRDS    ;FORMAT TRACK ADDRE             PASS TO 3.1
```

```
 843  002642  016767  000230  177152          MOV     OTTR,RDYWD      ;SET OUTPUT READY TEST WORD (PASS TO 3.1)
 844  002650  016767  175726  000224          MOV     DBADR,ADRS      ;ADDRESS OF OUTPUT           (PASS TO 3.1)
 845  002656  004767  000240                  JSR     PC,OUTSWD       ;OUTPUT TRACK ADDRESS         DO 3.1
 846  002662  000470                  EIH3:   BR      END3            ;ENDIF H -DONE
 847  002664  032767  004000  177076  IFF3:   BIT     #4000,STATWD    ;IF DEVICE IS
 848  002672  001441                          BEQ     THE3            ;RX02, THEN          (RXCS BIT#11-1)
 849  002674  016767  177136  000214          MOV     TBEN,MULT       ;SET UP TABLE ENTRY FOR MULT.
 850  002702  006367  000210                  ASL     MULT            ;-MULTIPLY
 851  002706  006367  000204                  ASL     MULT            ; TABLE ENTRY (TE)
 852  002712  006367  000200                  ASL     MULT            ; BY
 853  002716  006367  000174                  ASL     MULT            ; 20(8)
 854  002722  012767  004400  000170          MOV     #XETBA,XETAD    ;SET UP TO CAL. ADDRESS
 855  002730  066767  000162  000162          ADD     MULT,XETAD      ;EXTENDED ERROR TABLE ADDRESS
 856  002736  016767  000134  177056          MOV     OTTR,RDYWD      ;SET READY WD TO TR MODE      (PASS TO 3.1)
 857  002744  016767  000150  000126          MOV     XETAD,WRDS      ;EXT ERR. CODE TABLE ADD      (PASS TO 3.1)
 858  002752  016767  175624  000122          MOV     DBAD,ADRS       ;ADDRESS OF OUTPUT, RXDB      (PASS TO 3.1)
 859  002760  004767  000136                  JSR     PC,OUTSWD       ;O/P BASE ADD FOR ERR. CODE    DO 3.1
 860  002764  000427                          BR      END3            ;DONE
 861  002766  032767  000002  177012  IFE3:   BIT     #2,WDOT         ;IF FUNCTION IS
 862  002774  001404                          BEQ     ELE3            ;'READ STATUS'          (FW BIT#1 1)
 863  002776  012767  000001  000104  THE3:   MOV     #1,ERSTAT       ;THEN-SET ERR STATUS FLAG  (CLEAR BY 0.0)
 864  003004  000417                          BR      END3            ;DONE
 865  003006  032767  004000  176754  ELE3:   BIT     #4000,STATWD    ;IF DEVICE IS
 866  003014  001413                          BEQ     END3            ;RX02, THEN                   (RXCS BIT#11 1)
 867  003016  016767  000054  176776          MOV     OTTR,RDYWD      ;SET  OUTPUT READY TEST WD (PASS TO 3.1)
 868  003024  016767  000062  000046          MOV     VALWD,WRDS      ;VALIDATION WORD           (PASS TO 3.1)
 869  003032  016767  175544  000042          MOV     DBAD,ADRS       ;ADDRESS OF OUTPUT ,RXDB   (PASS TO 3.1)
 870  003040  004767  000056                  JSR     PC,OUTSWD       ;OUTPUT VALIDATION WORD      DO 3.1
 871  003044  032767  000100  176734  END3:   BIT     #100,WDOT       ;IF INTERRUPT BIT
 872  003052  001403                          BEQ     1$              ;IS SET, THEN
 873  003054  004767  000254                  CALL    WATCH           ;CALL MOD U.2 - WATCH DOG
 874  003060  000405                          BR      2$              ;BR TO END
 875  003062  012767  000040  176732  1$:     MOV     #40,RDYWD       ;SET DELAY FOR DONE
 876  003070  004767  000154                  JSR     PC,DELAY        ;DELAY FOR DONE BIT
 877  003074  000207                  2$:     RTS     PC              ;RETURN TO MOD 0.0
 878                                  ;MODULE 3.0 REGISTERS ----------------------------------------------------
 879
 880  003076  000200                  OTTR:   200                     ;MODULE 1/3.1 TRANSFER READY, OUTPUT
 881  003100  000000                  WRDS:   0                       ;MODULE 3.1 OUTPUT WORD
 882  003102  000000                  ADRS:   0                       ;MODULE 3.1 OUTPUT ADDRESS
 883  003104  000000                  WRDM:   0                       ;MODULE 3.2 OUTPUT WORD
 884  003106  000000                  ADRM:   0                       ;MODULE 3.2 OUTPUT ADDRESS
 885  003110  000000                  ERSTAT: 0                       ;MODULE 0.0 ERR STATUS READ FLAG
 886  003112  000111                  VALWD:  111                     ;EXTERNAL, VALIDATION WD (SET DENS.) ASCII "I"
 887  003114  000000                  BA:     0                       ;INTERNAL, TEMP BASE ADDRESS
 888  003116  000000                  MULT:   0                       ;INTERNAL, MULTIPLY PARAMETER
 889  003120  000000                  XETAD:  0                       ;MODULE 3.1 EXT. ERR. TABLE ADDR.
 890          000602                    DBADR DBAD                    ;MODULE 0.0 RX DATA BUFFER ADDRESS
 891          000600                    CSADR CSAD                    ;MODULE 0.0 RX CONT/STATUS ADDRESS
 892          005000                   BAOUTB-OUTAB                   ;EXTERNAL, BASE ADDRESS OUTPUT TABLE
 893                                  ;MODULE 3.0 ----- END MODULE ----------------------------------------------
```

```
                                        .SBTTL  MODULE 3.1 - OUTPUT SINGLE WORD
                                        ;-------------------------------------------------------------
                                        ;
003122  000240                  OUTSWD: NOP
003124  016767  176672  176670         MOV     RDYWD,RDYWD     ;OUTPUT READY WORD      (PASS TO 1/3.1)
003132  004767  000112                 JSR     PC,DELAY        ;DELAY FOR READY        DO 1/3.1
003136  000240                         NOP
003140  016777  177734  177734         MOV     WRDS,@ADRS      ;MOVE WORD TO ADDRESS
003146  000240                         NOP
003150  000207                         RTS     PC              ;RETURN TO MOD 3.0
                                    ;MODULE 3.1 ----- END MODULE ----------------------------------------
                                        .SBTTL  MODULE 3.2 - OUTPUT MULTIPLE WORDS
                                        ;-------------------------------------------------------------
                                        ;
003152  000240                  OUTMWD: NOP
003154  012767  000000  000062         MOV     #0,BTCNT        ;INTIALIZE BYTE COUNT
003162  016767  176634  176632  BDA32: MOV     RDYWD,RDYWD     ;OUTPUT READY WORD      (PASS TO 1/3.1)
003170  004767  000054                 JSR     PC,DELAY        ;DELAY FOR READY        DO 1/3.1
003174  000240                         NOP
003176  016701  000042                 MOV     BTCNT,R1        ;MOVE BYTE COUNT
003202  062701  005000                 ADD     #BAOUTB,R1      ;ADD DATA BASS ADDRESS TO BYTE COUNT
003206  010167  000034                 MOV     R1,DAOTAD       ;MOV RESULT TO OUTPUT DATA ADDRESS
003212  117777  000030  177666         MOVB    @DAOTAD,@ADRM   ;MOV DATA BYTE TO OUTPUT
003220  000240                         NOP
003222  005267  000016                 INC     BTCNT           ;INCREMENT BYTE COUNT
003226  000240                         NOP
003230  032767  000200  000006  DUA32: BIT     #200,BTCNT      ;TEST BYCNT
003236  001751                         BEQ     BDA32           ;DO UNTIL BTCNT-128 BYTES
003240  000240                         NOP
003242  000207                         RTS     PC              ;RETURN TO MOD 3.0
                                    ;MODULE 3.2 REGISTERS -----------------------------------------------

003244  000000                  BTCNT:  0                       ;INTERNAL, BYTE COUNTER
        005000                   BAOUTB-OUTAB                   ;EXTERNAL, BASE ADDRESS OF OUTPUT TABLE
003246  000000                  DAOTAD: 0                       ;INTERNAL, CURRENT ADDRESS IN OUTPUT TABLE
                                    ;MODULE 3.2 ----- END MODULE  -----------------------------------------
```

```
                                        .SBTTL  MODULE 1/3.1 - DELAY
                                        ;-------------------------------------------------------------
                                        ;
003250  000240                  DELAY:  NOP
003252  026727  176544  000000  IFA13:  CMP     RDYWD,#0        ;IF READY WORD
003260  001423                          BEQ     EIA13           ;EQUALS ZERO THEN BRANCH TO ENDIF 'A'
003262  016704  175420                  MOV     RYDX,R4         ;SET READY DELAY MULT
003266  016703  175412          BDA13:  MOV     RYDLY,R3        ;SET READY DELAY
003272  036777  176524  175300  BDB13:  BIT     RDYWD,@CSAD     ;IF READY
003300  001012                          BNE     EIB13           ;EQUAL TO ONE THEN BRANCH TO ENDIF 'B'
003302  005303                          DEC     R3              ;ELSE DECREMENT DELAY
003304  010377  000022                  MOV     R3,@DISPLY      ;DISPLAY R3
003310  010377  000016                  MOV     R3,@DISPLY      ;DISPLAY R3
003314  010377  000012                  MOV     R3,@DISPLY      ;DISPLAY R3
003320  001364                          BNE     BDB13           ;DOUNTIL R3 0
003322  005304                          DEC     R4              ;DECREMENT DELAY MULT.
003324  001360                          BNE     BDA13           ;DOUNTIL R4=0
003326  000240                  EIB13:  NOP
003330  000207                  EIA13:  RTS     PC              ;RETURN TO CALLING MODULE
                                        ;MODULE 1/3.1 REGISTERS ---------------------------------------
                                        
                                          RYDX RDYDX                    ;EXTERNAL, READY MULTIPLIER
000704                                   RYDLY=RDYDLY                   ;EXTERNAL, READY DELAY
003332  000762                  DISPLY: 762                             ;INTERNAL, ADDRESS OF LIGHTS
                                        ;MODULE 1/3.1 ----- END MODULE -------------------------------
```

```
                                        .SBTTL  MOD U.2.1  - WATCH DOG TIMER
                                        ;-------------------------------------------------------------------
003334  000240                  WATCH:  NOP                     ;
003336  012767  000000  000104          MOV     #PR0,NEWPRI     ;SET PROCESSOR PRI-0
003344  004767  000054                  JSP     PC,SETPRI       ;SET PROCESSOR PRI
003350  016704  000044                  MOV     DX,R4           ;SET DELAY MULT
003354  016703  000042          BDAU21: MOV     DLY,R3          ;SET DELAY
003360  005767  176460          BDBU21: TST     INTRFG          ;IF INTERRUPT FLAG
003364  001007                          BNE     ENDU21          ;EQUALS ZERO, THEN
003366  005303                          DEC     R3              ;DECREMENT DELAY CNT
003370  001373                          BNE     BDBU21          ;IF IT EQUALS ZERO
003372  005304                          DEC     R4              ;THEN DECREMENT DELAY MULT
003374  001367                          BNE     BDAU21          ;IF IT EQUALS ZERO, THEN
003376  052767  000001  177504          BIS     #1,ERSTAT       ;SET ERROR
003404  012767  000340  000036  ENDU21: MOV     #PR7,NEWPRI     ;SET PROCESSOR PRI-7
003412  004767  000006                  JSR     PC,SETPRI       ;SET PROCESSOR PRI
003416  000207                          RTS     PC              ;RETURN TO MOD 2.3.4
                                        ;-------------------------------------------------------------------
000000                          PR0=0                           ;PRIORITY 0
000340                          PR7=340                         ;PRIORITY 7
003420  000010                  DX:     10                      ;DELAY MULT
003422  100000                  DLY:    100000                  ;DELAY
                                        ;MOD U.2.1 ---- END MODULE ----------------------------------------
                                        .SBTTL  SET PROCESSOR PRI
                                        ;-------------------------------------------------------------------
003424  005767  176412          SETPRI: TST     LSIFLG          ;IF PROCESSOR IS
003430  001403                          BEQ     1$              ;LSI, THEN
003432  106467  000012                  MTPS    NEWPRI          ;SET PROCESSOR PRI
003436  000403                          BR      SETPIX          ;BR TO END
003440  016777  000004  175136  1$:     MOV     NEWPRI,@PSW     ;SET PROCESSOR PRI
003446  000207                  SETPIX: RTS     PC              ;RETURN
                                        ;-------------------------------------------------------------------
003450  000000                  NEWPRI: 0                       ;NEW PROCESSOR PRIORITY
                                        ;-------------------------------------------------------------------
                                        .SBTTL  RX INTERRUPT HANDLER
                                        ;-------------------------------------------------------------------
003452  000240                  RXINTR: NOP                     ;
003454  005267  176364                  INC     INTRFG          ;INCREMENT INTERRUPT FLAG
003460  000240                          NOP                     ;
003462  000002                          RTI                     ;RETURN TO PROGRAM
                                        ;-------------------------------------------------------------------
```

```
                                .SBTTL  DATA TABLES
                                ;-------------------------------------------------------------------------
            003700                      .-3700                  ;ERROR TABLE (CODE=5 OR RXES IF ERR OCCURRED)
            000020                      .REPT 16.
                                        .WORD 0
                                        .ENDR

                                ;-------------------------------------------------------------------------
            004000                      .=4000                  ;INPUT TABLE -- RX TO TABLE
            000400                      .REPT   256.
                                        .BYTE   0
                                        .ENDR

                                ;-------------------------------------------------------------------------
            004400                      .=4400                  ;EXTENDED ERROR CODE TABLE (CODE=7)
            000200                      .REPT 128.
                                        .WORD 0
                                        .ENDR

                                ;-------------------------------------------------------------------------
            005000                      .-5000                  ;OUTPUT TABLE -- TABLE TO RX
            000400                      .REPT   256.
                                        .BYTE   377
                                        .ENDR
                                ;-------------------------------------------------------------------------
005400      000000              PATCH:  0                       ;PATCH AREA
            006000                      . 6000
                                ;-------------------------------------------------------------------------
                                ;
                                ;---------- BOOT RX01 ----------------------------------------------------
006000  005000              BOOTRX: CLR     R0
006002  012701  177170              MOV     #177170,R1          ;LOAD RXCS ADR
006006  105711              1$:     TSTB    (R1)                ;TEST RXCS
006010  001776                      BEQ     1$
006012  012711  000003              MOV     #3,(R1)             ;SEND COMMAND
006016  005711              2$:     TST     (R1)                ;TEST RXCS
006020  001776                      BEQ     2$                  ;WAIT FOR TR, DONE, OR ERROR
006022  100405                      BMI     3$                  ;ERROR - HALT.
006024  105711                      TSTB    (R1)                ;SEE IF 'TR'
006026  100004                      BPL     4$                  ;NOT 'TR', BUT 'DONE'
006030  116120  000002              MOVB    2(R1),(R0)+         ;MOVE BYTE
006034  000770                      BR      2$                  ;NEXT
006036  000000              3$:     HALT
006040  005000              4$:     CLR     R0
006042  000110                      JMP     (R0)
006044  000000                      HALT
006046  000000                      HALT
006050  000000                      HALT
                                ;-------------------------------------------------------------------------


            000001                      .END
```

```
ADIN    001772  606* 610* 643* 656* 661* 699# 736  745
ADOT    002004  602* 623* 704#
ADRM    003106  823* 884# 918*
ADRS    003102  793* 807* 816* 833* 844* 858* 869* 882# 902*
BA      003114  811* 813* 815  887#
BAINTB= 004000  741  761# 813
BAOUTB= 005000  811  822  892# 916  929#
BDAU21  003354  966# 972
BDA1    002114  740# 750
BDA13   003266  940# 949
BDA32   003162  912# 923
BDBU21  003360  967# 970
BDB13   003272  941# 947
BOOTRX  006000  1036#
BTCNT   003244  911* 915  920* 922  928#
BTRP    000614  518# 584* 591* 597*
BTRP2   000616  519# 585* 592* 598*
BYCNT   002176  739* 740  746* 749  758#
CSAD  = 000600  602  606  623  656  690# 891  941
CSADR = 000600  793  891#
CSWD    002026  609* 629  637  713#
DAINAD  002200  742* 745* 759#
DAOTAD  003246  917* 9'8  930#
DATAD   002014  708#
DBAD  = 000602  643  661  691# 823  833  858  869  890
DBADR = 000602  807  816  844  890#
DELAY   003250  650  734  744  876  900  913  936#
DISPLY  003332  588* 944* 945* 946* 956#
DLY     003422  966  981#
DNWD    002020  601* 605* 611* 622* 626* 642* 655* 662* 710# 733  791
DOO     001214  610# 685
DUA3    002166  750#
DUA32   003230  922#
DX      003420  965  980#
EA10    001342  621  626#
EIA1    002170  738  751#
EIA13   003330  938  951#
EIB13   003326  942  950#
EIDO    001606  653  660#
EIEO    001664  666  669#
EIFO    001754  676  684#
EIGO    001720  674  676#
EIHO    001752  678  683#
EIH3    002662  825  846#
EIIO    001744  680  682#
EII3    002520  820  825#
EIK3    002430  812  81'#
ELA1    002106  732  739#
ELA3    002320  796  798#
ELBO    001476  636  639  645#
ELDO    001550  652  654#
ELEO    001652  659  667#
ELE3    003006  862  865#
ELH3    002542  802  830#
ELK3    002422  810  813#
ENDU21  003404  968  974#
```

```
END3      003044    798    818    846    860    864    866    871#
ERSTAT    003110    651    668*   863*   885#   973*
ERWD      002040    664*   665    718#
ETAD      002034    647*   648*   665*   667*   716#
ETBA    = 003700    571#   647
FNWD      002002    619    703#   778*
FUNCAD    002254    772*   784#
FUNTAB    000712    552#   783
FW        001762    619*   628    633    695#
HDSWR     000610    516#   586    587    588
IFA0      001304    620#
IFA1      002050    731#
IFA13     003252    937#
IFA3      002306    795#
IFB0      001422    635#
IFC0      001434    638#
IFC3      002522    800    826#
IFD0      001536    651#
IFD3      002532    828#
IFE0      001576    658#
IFE3      002766    827    861#
IFF0      001670    670#
IFF3      002664    829    847#
IFG0      001702    673#
IFH0      001722    671    677#
IFH3      002334    801#
IFI0      001732    679#
IFI3      002344    803#
IFJ3      002462    804    819#
IFK3      002402    809#
INPUT     002046    608    614    644    657    663    730#
INTAB   = 004000    569#   761
INTR      002202    743    760#
INTRFG    002044    720#   967    1001*
INTWD     002024    603    624    712#
LSIFLG    002042    595*   719#   987
LSITRP    001074    591    595#
MULT      003116    849*   850*   851*   852*   853*   855    888#
MULTE     002032    645*   646*   648    715#
NEWPRI    003450    963*   974*   989*   991    994#
OPN[illegible] 000710  528#   692
OTTR      003076    805    814    821    830    843    856    867    880#
OUTAB   = 005000    570#   892    929
OUTMWD    003152    824    910#
OUTPUT    002256    604    625    632    790#
OUTSWD    003122    794    808    817    834    845    859    870    898#
PATCH     005400   1031#
PROCES    002204    618    767#
PR0     = 000000    963    978#
PR7     = 000340    974    979#
PSW       000604    511#   593*   991*
RDYDLY    000704    526#   955
RDYDX     000706    527#   954
RDYWD     002022    649*   711#   733*   743*   791*   805*   814*   821*   830*   843*   856*   867*   875*
                    899*   912*   937    94[illegible]
RXCS      000600    506#   690
```

```
RXDB    000602              507#    691
RXINTR  003452              500     1000#
RYDLY = 000704              940     955#
RYDX  = 000706              939     954#
SETCS   000700              524#    694
SETFW = 000700              617     694#
SETPIX  003446              990     992#
SETPRI  003424              964     975     987#
SFSWR   000612              517#    590
SOFTSR  000760              575#
SSWTRP  001042              584     590#
START   001000              495     583#
START0  001050              589     591#
START1  001106              594     597#
STATWD  001770              629*    698#    803     847     865
STWD    002016              617*    709#    776
SWAD  = 000606              689#
SWR     000606              512#    587*    590*    610     689
SWWD    002030              615*    620     631     670     679     714#
TABENT  002000              616*    702#    768*    769
TASA    002012              631*    707#    831     835
TBA   = 000712              770     783#
TBEN    002036              627*    717#    849
TE      001764              600*    6 6     627     645     669*    673     675*    677     682*    696#
THA3    002324              797     799#
THE3    002776              848     863#
TL    = 000710              673     677     692#
TR      001766              599*    607     612*    613     640*    641     697#
TYIN    001776              607*    613*    641*    654*    660*    701#    731
VALWD   003112              868     886#
WATCH   003334              873*    962#
WC    = 000702              630     693#
WDCT    002010              630*    706#    806
WDIN    001774              609     615     658     664     700#    736*
WDOT    002006              603*    624*    628*    705#    792     795     799     801     809     819     826     828     861
                            871
WRDCNT  000702              525#    693
WRDM    003104              822*    883#
WRDS    003100              792*    806*    815*    831*    832*    835*    836*    837*    838*    839*    840*    841*    842*
                            857*    868*    881#    902
XETAD   003120              854*    855*    857     889#
XETBA   004400              572#    854
.       006052              482#    494#    499#    503#    521#    574#    578#    1008#   1014#   1020#   1026#   1032#
```

```
.REGDE     480#
..V2..     480#


. ABS.  006052      000


 ERRORS DETECTED:  0

 CZRXCA,CZRXCA/CRF=CZRXCA.P11
 RUN-TIME:  4  2  .3 SECONDS
 RUN-TIME RATIO: 10/7-1.3
 CORE USED:  9K  (18 PAGES)
```