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                        .REM    &
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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

THIS PROGRAM IS INTENDED AS A BRUTE FORCE ROUTINE TO EXECUTE AN OPERATION OR SERIES OF OPERATIONS, 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

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

2.2 STORAGE

THIS PROGRAM REQUIRES AT LEAST 2K OF CORE

3.0 LOADING PROCEDURE

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 ERR	AC LOW	INT DON	SID RDY	CRC	
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 BIT8=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
;  :  :    :    :    HAL
;  :  :    :    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
                        ;-------------------------------------------------------------------------
                        000760                  .=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
```

```
 634  001416  042701  177761                    BIC     #177761,R1      ;MASK ALL BUT FUNCTION
 635  001422  022701  000002           IFB0:    CMP     #2,R1           ;IF FUNCTION IS (FW BITS#3,2,1)
 636  001426  001023                            BNE     ELB0            ;"EMPTY BUFFER" (       0,0,1)
 637  001430  016701  000372                    MOV     CSWD,R1         ;THEN MOVE CS WORD TO R1
 638  001434  032701  004000           IFC0:    BIT     #4000,R1        ;IF DEVICE IS
 639  001440  001016                            BNE     ELB0            ;RX01  (RXCS BIT#11=0)
 640  001442  012767  000064  000316            MOV     #64,TR          ;THEN SET TYPE TRANSFER
 641  001450  016767  000312  000320            MOV     TR,TYIN         ;INPUT TRANSFER          (PASS TO 1.0)
 642  001456  012767  000000  000334            MOV     #0,DNWD         ;SET DONE BIT TO ZERO    (PASS TO 1.0)
 643  001464  016767  177112  000300            MOV     DBAD,ADIN       ;ADDRESS OF INPUT        (PASS TO 1.0)
 644  001472  004767  000350                    JSR     PC,INPUT        ;INPUT RX01 "EMPTY BUFF" DO 1.0
 645  001476  016767  000262  000326  ELB0.    MOV     TE,MULTE        ;SET UP TABLE ENTRY
 646  001504  006367  000322                    ASL     MULTE           ;MULTIPLY TABLE ENTRY (*2)
 647  001510  012767  003700  000316            MOV     #ETBA,ETAD      ;SET UP ERROR TABLE BASE ADDRESS
 648  001516  066767  000310  000310            ADD     MULTE,ETAD      ;CALCULATE ERROR TABLE ADDRESS
 649  001524  012767  000040  000270            MOV     #40,RDYWD       ;SET DONE BIT TEST    (PASS TO 1/3.1)
 650  001532  004767  001512                    JSR     PC,DELAY        ;DELAY FOR DONE        DO 1/3.1
 651  001536  032767  000001  001344  IFD0:    BIT     #1,ERSTAT       ;IF ERROR STATUS
 652  001544  001401                            BEQ     ELD0            ;EQUALS 1 THEN
 653  001546  000417                            BR      EID0            ;PROCEED TO END IF 'D'
 654  001550  012767  000001  000220  ELD0:    MOV     #1,TYIN         ;SET INPUT TYPE -SINGLE WD (PASS TO 1.0)
 655  001556  012767  000040  000234            MOV     #40,DNWD        ;SET DONE BIT -COMPARE WD  (PASS TO 1.0)
 656  001564  016767  177010  000200            MOV     CSAD,ADIN       ;SET ADRESS OF INPUT WD    (PASS TO 1.0)
 657  001572  004767  000250                    JSR     PC,INPUT        ;GET DEVICE STATUS WD       DO 1.0
 658  001576  032767  100000  000170  IFE0:    BIT     #100000,WDIN    ;IF DEVICE ERROR BIT (RXCS BIT#15 1)
 659  001604  001422                            BEQ     ELE0            ;EQUALS 1
 660  001606  012767  000001  000162  EID0:    MOV     #1,TYIN         ;SET INPUT TYPE -SINGLE WD (PASS TO 1.0)
 661  001614  016767  176762  000150            MOV     DBAD,ADIN       ;SET ADDRESS OF INPUT WD   (PASS TO 1.0)
 662  001622  012767  000040  000170            MOV     #40,DNWD        ;SET DONE BIT -COMPARE WD  (PASS TO 1.0)
 663  001630  004767  000212                    JSR     PC,INPUT        ;GET DEVICE ERROR WD (RXES) DO 1.0
 664  001634  016767  000134  000176            MOV     WDIN,ERWD       ;SAVE ERROR WD
 665  001642  016777  000172  000164            MOV     ERWD,@ETAD      ;STORE ERROR WORD IN TABLE
 666  001650  000405                            BR      EIE0            ;PROCEED TO END IF 'E'
 667  001652  012777  000000  000154  ELE0:    MOV     #0,@ETAD        ;ZERO ERROR TABLE LOCATION
 668  001660  005067  001224                    CLR     ERSTAT          ;CLEAR ERROR STATUS (SET BY 3.0)
 669  001664  005267  000074           EIE0:    INC     TE              ;INCREMENT TABLE ENTRY
 670  001670  032767  100000  000132  IFF0:    BIT     #100000,SWWD    ;IF SR BIT#15 IS
 671  001676  001411                            BEQ     IFH0            ;EQUAL TO ONE
 672  001700  000000                            HALT                    ;THEN HALT
 673  001702  026767  177002  000054  IFG0:    CMP     TL,TE           ;IF      (TL-TE)
 674  001710  001003                            BNE     EIG0            ;TE-TL
 675  001712  012767  000000  000044            MOV     #0,TE           ;THEN SET TE-0
 676  001720  000415                    EIG0:   BR      EIF0
 677  001722  026767  176762  000034  IFH0:    CMP     TL,TE           ;IF      (TL-TE)
 678  001730  001010                            BNE     EIH0            ;TE TL
 679  001732  032767  040000  000070  IFI0:    BIT     #40000,SWWD     ;THEN IF SR BIT#14 IS
 680  001740  001401                            BEQ     EII0            ;EQUAL TO ONE
 681  001742  000000                            HALT                    ;THEN HALT
 682  001744  012767  000000  000012  EII0:    MOV     #0,TE           ;SET TABLE ENTRY TO ZERO
 683  001752  000240                    EIH0:   NOP
 684  001754  000240                    EIF0:   NOP
 685  001756  000167  177232                    JMP     D00             ;GET NEXT TABLE ENTRY
 686                                    ;-----------------------------------------------------------------------
```

```
                                    ;MODULE 0.0 - REGISTERS AND PARAMETERS ---------------------------------
            000606                     SWAD SWR                 ;EXTERNAL, SWITCH REG ADDRESS
            000600                     CSAD=RXCS                ;EXTERNAL, RXCS ADDRESS
            000602                     DBAD=RXDB                ;EXTERNAL, RXDB ADDRESS
            000710                       TL=OPNUM               ;EXTERNAL,SET FUNCTION TABLE LENGTH
            000702                       WC=WRDCNT              ;EXTERNAL, WORD COUNT
            000700                   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  177464  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     IFF3            ;''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.
```

```
 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
                                        ;-------------------------------------------------------------------
                                        DELAY:  NOP
003250  000240                          IFA13:  CMP     RDYWD,#0        ;IF READY WORD
003252  026727  176544  000000                  BEQ     EIA13           ;EQUALS ZERO THEN BRANCH TO ENDIF 'A'
003260  001423                                  MOV     RYDX,R4         ;SET READY DELAY MULT
003262  016704  175420                          MOV     RYDLY,R3        ;SET READY DELAY
003266  016703  175412                  BDA13:  BIT     RDYWD,@CSAD     ;IF READY
003272  036777  176524  175300          BDB13:  BNE     EIB13           ;EQUAL TO ONE THEN BRANCH TO ENDIF 'B'
003300  001012                                  DEC     R3              ;ELSE DECREMENT DELAY
003302  005303                                  MOV     R3,@DISPLY      ;DISPLAY R3
003304  010377  000022                          MOV     R3,@DISPLY      ;DISPLAY R3
003310  010377  000016                          MOV     R3,@DISPLY      ;DISPLAY R3
003314  010377  000012                          BNE     BDB13           ;DOUNTIL R3 0
003320  001364                                  DEC     R4              ;DECREMENT DELAY MULT.
003322  005304                                  BNE     BDA13           ;DOUNTIL R4=0
003324  001360                          EIB13:  NOP
003326  000240                          EIA13:  RTS     PC              ;RETURN TO CALLING MODULE
003330  000207                          ;MODULE 1/3.1 REGISTERS ---------------------------------------------
                                        
                                          RYDX RDYDX                    ;EXTERNAL, READY MULTIPLIER
000706                                   RYDLY-RDYDLY                   ;EXTERNAL, READY DELAY
000704                                  DISPLY: 762                     ;INTERNAL, ADDRESS OF LIGHTS
003332  000762                          ;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
                                        ;-------------------------------------------------------------------
```

```
1006                                    .SBTTL  DATA TABLES
1007                                    ;-----------------------------------------------------------------
1008            003700                          .-3700                  ;ERROR TABLE (CODE=5 OR RXES IF ERR OCCURRED)
1009            000020                          .REPT 16.
1010                                            .WORD 0
1011                                            .ENDR
1012
1013                                    ;-----------------------------------------------------------------
1014            004000                          .=4000                  ;INPUT TABLE -- RX TO TABLE
1015            000400                          .REPT   256.
1016                                            .BYTE   0
1017                                            .ENDR
1018
1019                                    ;-----------------------------------------------------------------
1020            004400                          .=4400                  ;EXTENDED ERROR CODE TABLE (CODE=7)
1021            000200                          .REPT 128.
1022                                            .WORD 0
1023                                            .ENDR
1024
1025                                    ;-----------------------------------------------------------------
1026            005000                          .-5000                  ;OUTPUT TABLE -- TABLE TO RX
1027            000400                          .REPT   256.
1028                                            .BYTE   377
1029                                            .ENDR
1030                                    ;-----------------------------------------------------------------
1031   005400   000000                  PATCH:  0                       ;PATCH AREA
1032            006000                          . 6000
1033                                    ;-----------------------------------------------------------------
1034
1035                                    ;---------- BOOT RX01 ------------------------------------------------
1036   006000   005000                  BOOTRX: CLR     R0
1037   006002   012701   177170                 MOV     #177170,R1      ;LOAD RXCS ADR
1038   006006   105711           1$:    TSTB    (R1)                    ;TEST RXCS
1039   006010   001776                  BEQ     1$
1040   006012   012711   000003                 MOV     #3,(R1)         ;SEND COMMAND
1041   006016   005711           2$:    TST     (R1)                    ;TEST RXCS
1042   006020   001776                  BEQ     2$                      ;WAIT FOR TR, DONE, OR ERROR
1043   006022   100405                  BMI     3$                      ;ERROR - HALT.
1044   006024   105711                  TSTB    (R1)                    ;SEE IF 'TR'
1045   006026   100004                  BPL     4$                      ;NOT 'TR', BUT 'DONE'
1046   006030   116120   000002                 MOVB    2(R1),(R0)+     ;MOVE BYTE
1047   006034   000770                  BR      2$                      ;NEXT
1048   006036   000000           3$:    HALT
1049   006040   005000           4$:    CLR     R0
1050   006042   000110                  JMP     (R0)
1051   006044   000000                  HALT
1052   006046   000000                  HALT
1053   006050   000000                  HALT
1054                                    ;-----------------------------------------------------------------
1055
1056
1057            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*  918   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#
EID0     001606            653   660#
EIE0     001664            666   669#
EIF0     001754            676   684#
EIG0     001720            674   676#
EIH0     001752            678   683#
EIH3     002662            825   846#
EII0     001744            680   682#
EII3     002520            820   825#
EIK3     002430            812   814#
ELA1     002106            732   739#
ELA3     002320            796   798#
ELB0     001476            636   639   645#
ELD0     001550            652   654#
ELE0     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#
OPNL*   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     947
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#
STARTO  001050  589   591#
STARTI  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)
```