altair 680b
SYSTEM MONITOR MANUAL

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I ABSTRACT

This document describes the functions and operating procedures of the Altair 680b PROM Monitor, a system program which allows the user to examine and change the contents of memory locations, load formatted object tapes into memory, start program execution at a specified address, and debug user programs. A source listing of the PROM Monitor is included so that its I/O and hexadecimal conversion routines may be utilized by user programs.

II NOTES ON THE FORMAT OF THIS MANUAL

1) All numbers used in this document are hexadecimal (base 16) unless otherwise indicated.

2) In the examples provided in this document, underscoring is used to indicate user typed information.

3) The symbol <CR> is used to represent a carriage return.

4) There are two versions of the PROM Monitor, one which supports the use of the ACIA chip, and one for use with a Baudot Teletype. All information in this manual applies to both versions of the Monitor, except where otherwise noted.

5) Symbolic addresses which are referenced but not defined in the examples, such as OUTCH and OUT2H, are entry points in the PROM Monitor. Refer to appropriate source listing (Section IX for the ACIA version and Section X for the Baudot version) for detailed information on these routines.

6) Assembly code examples follow the conventions of the 680B Resident Assembler.

III STARTING UP THE PROM MONITOR

A) Power up sequence

1) Strap the appropriate bits at location FØØ2 to indicate the presence of a terminal, the type of terminal, and the number of stop bits to be used. (See the 680B Operator's Manual.)

2) Turn the Altair[T.M.] computer on.

3) Turn the terminal on.

4) Switch the Halt-Run switch to the Halt position.

5) Actuate the Reset switch.

6) Switch the Halt-Run switch to the Run position.

7) The PROM Monitor will respond by sending a carriage return and line feed to the terminal and printing a ".". The "." is the Monitor's prompt character which indicates that the Monitor is ready to accept a command.

> NOTE
>
> Use steps 4 through 7 to start the Monitor if the system is already powered up.

B) Entering the PROM Monitor from a User Program

There are three methods of entering the Monitor from a user program. The first method is to include the following instructions at the appropriate place in the program.

```
LDX $FFFE  RESTART VECTOR TO X REGISTER
```

JMP X JUMP TO RESTART ADDRESS

This has the same effect as doing a Reset from the front panel. The Monitor is entered at its reset entry point, causing the stack pointer and all system parameters to be initialized.

> NOTE
>
> If the user program is outputting to the terminal just prior to the execution of these instructions, the last character sent to the terminal may be lost when the Monitor initializes the terminal control register.

The second method of entering the Monitor from a user program is to include the following instruction at the appropriate place in the program.

JMP CRLF

The symbol CRLF must be correctly defined in the user program for the version of the Monitor being used (ACIA or Baudot). The Monitor is entered, the stack pointer is loaded from SAVSTK (ØØF6 and ØØF7), and a carriage return, line feed, and the Monitor's prompt character are sent to the terminal.

The third method of entering the Monitor from a user program is to place a SWI (software interrupt) instruction at the appropriate place in the program. This method is generally used for program debugging and therefore discussion of this feature is delayed until section V.

IV DESCRIPTION OF MONITOR COMMANDS

M - Memory Examine and Deposit Command

Purpose - To examine and optionally modify the contents of a single memory byte.

Usage -

1) Type M in response to the Monitor's ".".
2) A space will be printed.
3) Type the four digit hexadecimal address of the byte to be examined.
4) The two digit hexadecimal contents of the specified byte will be printed, preceded by and followed by a space.
5) To change the contents of the specified byte, enter the new contents by typing two hexadecimal digits.
6) To leave the contents of the specified byte unaltered, type a carriage return (or any other non-hexadecimal character).

Examples -

1) To examine and leave unaltered the contents of ØØA2, the following command is used:

.M ØØA2 FF <CR>

2) To deposit a Ø9 in location ØØ72, the following command is used:

.M ØØ72 E1 Ø9

(Note that a carriage return is not used.)

NOTE
The contents of the specified byte are not changed until two valid hexadecimal digits are entered. Therefore, if an invalid digit is typed, the contents of the location will remain unchanged.

N - Memory Deposit and Examine Next Command

Purpose - Used after an M command to examine and optionally modify the contents of the next sequential memory byte.

Usage -

1) Type N in response to the Monitor's ".".

2) The Monitor will type the next sequential memory address, preceded by and followed by a space. The contents of the byte will be printed, followed by a space.

3) To change the contents of the specified byte, enter the new contents by typing two hexadecimal digits.

4) To leave the contents of the specified byte unaltered, type a carriage return (or any other non-hexadecimal character).

Examples -

1) To load a string of ASCII characters into successive memory bytes starting at location 0050, use the following commands:

```
.M 0050 00 4D
.N 0051 00 49
.N 0052 00 54
.N 0053 00 53
```

2) To check and correct a sequence of instructions located at 0015 through 0018, the following commands are used:

```
.M 0015 4C <CR>
.N 0016 5C <CR>
.N 0017 36 32
.N 0018 37 <CR>
```

J - Jump to Specified Address Command

Purpose - To start program execution at a specified address.

Usage -

1) Type J in response to the Monitor's ".".

2) A space will be printed.

3) Type the four digit hexadecimal address at which execution is to begin.

4) The processor will jump to the specified location and start execution of the program stored there.

Example -

To start execution of a program which starts at Ø2F3, the following command is used:

.J Ø2F3

L - Load Paper Tape Command

Purpose - To load formatted object tapes into memory. (See Section VI for paper tape format.)

Usage -

1) Type L in response to the Monitor's ".".

2) Place the paper tape in the reader and start the reader.

Loading begins with the first data record (type S1). Any information preceding the first data record, including the header record (type SØ) is ignored.

Normal termination of the load occurs when an end of file record (type S9) is encountered. Control returns to the Monitor's command decoding section and any information following the S9 on the tape is interpreted as Monitor commands. Therefore, the paper tape reader should be turned off as soon as the S9 is printed on the terminal.

If a checksum error occurs while the tape is being read, control is returned to the Monitor's command decoding section and the rest of the information on the tape is interpreted as Monitor commands. If this occurs, the paper tape reader should be turned off and the paper tape should be reloaded from its beginning.

Suppressing Teletype Echo

> NOTE
>
> This information applies only to the ACIA version of the PROM Monitor.

While loading a paper tape, Teletype echo can be suppressed by one of two methods. The first method is to use the Monitor's M command to store an FF into the Monitor's echo flag (location 00F3). The command

M 00F3 03 FF

turns off Teletype echoing. The L command can then be used to load the paper tape. (The L will not be echoed!) When the load is completed, the command

M 00F3 FF 00

is used to restore Teletype echoing. (Only the FF, which is printed by the Monitor, will appear on the terminal!)

> NOTE
>
> Only the most significant bit of the echo flag affects Teletype echoing. Therefore, any number loaded into 00F3 which has bit 7 set will suppress echoing, and any number loaded into 00F3 which has bit 7 clear will restore echoing.

The second method of suppressing Teletype echo is to have the first data block of the paper tape load an FF into location 00F3 and to have the last data block load a 00 into location 00F3. This can be accomplished by including the following mnemonics in an assembly code program.

```
NAM EXAMPL
ORG $00F3
FCB $FF          TURN OFF ECHO FOR LOAD

(PROGRAM STATEMENTS)

ORG $00F3
FCB 0            RESTORE TTY ECHO
END
```

This is the method used on all MITS supplied paper tapes. When using this method, a typical load looks like:

```
.L S00B00004D454D5445535420B5
S10400F3FF08
S9
.
```

If a checksum error occurs, Teletype echoing will remain off. The command

```
.M 00F3  FF 00
```

can be used to restore echoing. (Only the FF will appear on the terminal!)

P - Proceed From Program Breakpoint Command

Purpose - To proceed from a program breakpoint.

Usage -

1) Type P in response to the Monitor's ".".

2) Program execution will be resumed.

NOTE
A discussion of program breakpoints is included in Section V.

V USER PROGRAM DEBUGGING WITH THE PROM MONITOR

Setting Program Breakpoints

When a program is not performing properly, it is often helpful to stop program execution at strategic points for the purpose of displaying and/or modifying the contents of the processor registers and memory locations. This is known as setting program breakpoints.

The PROM Monitor allows a program breakpoint to be set by insertion of a SWI (software interrupt) instruction at the point in the program where the break is to occur. When the SWI instruction is executed, the status of the processor is pushed onto the stack according to the format shown in Table 5-1. The PROM Monitor gains control of the processor and may be used to examine and/or modify the contents of the registers and memory locations.

Stack Pointer >	
SP+1	> Condition Codes
SP+2	> Accumulator B
SP+3	> Accumulator A
SP+4	> Index Reg (High Order Byte)
SP+5	> Index Reg (Low Order Byte)
SP+6	> Program Counter (High Order Byte)
SP+7	> Program Counter (Low Order Byte)

TABLE 5-1

When the Monitor is entered at a program breakpoint, the stack pointer is saved in locations ØØFA and ØØFB. When an N command is executed, the contents of ØØFA and ØØFB are incremented by one and then used as the address of the next memory byte to be examined. Therefore, if an N command is issued directly after entering the Monitor at a breakpoint, the address displayed will be SP+1 (see Table 5-1) and the contents displayed will be the contents of the condition codes register. Further N commands will display the contents of the remaining processor registers in the order shown in Table 5-1.

Alternatively, the contents of the stack pointer can be determined by using the M and N commands to examine locations ØØF6 and ØØF7, where the Monitor stores the high and low bytes of the stack pointer, respectively. Once the contents of the stack pointer have been determined, the M and N commands can be used in conjunction with Table 5-1 to examine and/or modify the contents of the processor registers.

The P command is used to continue program execution after a breakpoint. The P command causes the stack pointer to be loaded from locations ØØF6 and ØØF7 and the other processor registers to be pulled from the stack. Program execution is resumed at the address of the SWI instruction that caused the break, plus one.

> NOTE
>
> The contents of the stack pointer may be changed by modifying the contents of locations ØØF6 and ØØF7. However, great caution should be exercised when so doing since the P command causes the processor registers to be pulled from the stack.

Any number of breakpoints may be present in a program at one time. It should be clear that insertion of a SWI instruction may make re-assembly of the program necessary. A breakpoint can be removed by replacing the SWI instruction with a NOP or by deleting the SWI instruction and re-assembling the program.

Breakpoint Routines

Whenever the PROM Monitor is entered at a program breakpoint, the flag BRKADR (location F2) is checked. If the most significant bit (bit 7) of BRKADR is clear (=Ø) then the Monitor assumes processor control. (This is the normal course of events since the Monitor initializes BRKADR to Ø3 whenever the Reset function is performed.) However, if the most significant bit of BRKADR is set (=1), which can be accomplished by using the command

M ØØF2 Ø3 FF

or including the instruction

```
COM     $F2     SET BRKADR FLAG
```

in a program, then control is transferred to location ØØØØ when a program breakpoint occurs. This feature can be used to perform special functions when program breakpoints occcur. Two examples of the use of this feature are given below.

1) This example illustrates the use of a breakpoint routine to print the contents of the processor's registers and continue program execution each time a program breakpoint occurs.

```
            ORG     Ø       BREAKPOINT ROUTINE ADDRESS
            LDA B   #@15    SEND CR AND LF
            JSR     OUTCH   TO TERMINAL
            LDA B   #@12
            JSR     OUTCH
            TSX             X POINTS TO PROCESSOR STATUS
            LDA B   #7      INITIALIZE COUNTER
LOOP        LDA A   X       BYTE OF STATUS TO A REG
            PSH B           OUT2H & OUTS CLOBBER B REG
            JSR     OUT2H   PRINT OUT BYTE OF STATUS
            JSR     OUTS    SPACE OVER
            PUL B           RESTORE B REG
            INX             BUMP POINTER
            DEC B           DECREMENT COUNTER
            BNE     LOOP    IF NOT DONE, KEEP PRINTING
            RTI             CONTINUE PROGRAM EXECUTION
```

2) This example illustrates the use of a breakpoint routine to examine the contents of the A register and transfer control to the Monitor if A is clear (contains all zeroes). If A is not clear, program execution continues. This type of routine is used to implement "conditional breakpoints".

```
            ORG     Ø
            JMP     $Ø3ØØ   THIS BREAKPOINT ROUTINE
            ORG     $Ø3ØØ   STARTS AT Ø3ØØ
            TST A           TEST CONTENTS OF A REG
            BNE     CONTIN  A ALL ZEROES?
            JMP     CRLF    YES, JUMP TO MONITOR
CONTIN      RTI             NO, CONTINUE PROG EXEC
```

VI PAPER TAPE FORMAT

The PROM Monitor supports the paper tape format established by Motorola.

The first character of a record is an S. The digit following the S defines the type of record.

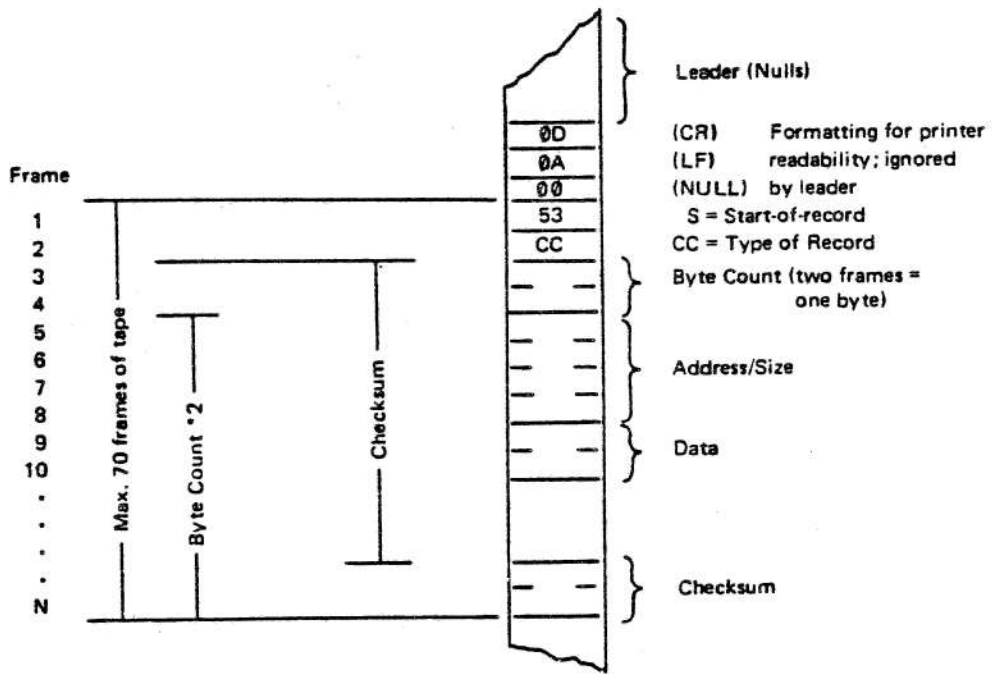
S0 = Header Record
S1 = Data Record
S9 = End of File Record

Header records (type S0) contain the program name, and are ignored by the PROM Monitor. The end of file record (type S9) causes the Monitor to terminate the loading process. Data records (type S1) contain the actual data to be loaded and are of the form:

S1NNAAAADDDDDDDDDD.....DDCC

where S1 specifies that the record is a data record, NN is a two digit hexadecimal byte count specifying the number of remaining bytes in the record (1 byte = 2 frames of tape), AAAA is the 4 digit hexadecimal starting address of the data block, each DD pair consists of two hexadecimal digits which are combined to form a byte, and CC is the checksum of all preceding frames (excluding the S and 1). The checksum is the one's complement of the binary sum of the byte count, the address, and the data bytes.

Further information concerning the paper tape format is given in Figure 6-1.



Frames 3 through N are hexadecimal digits (in 7-bit ASCII) which are converted to BCD. Two BCD digits are combined to make one 8-bit byte.

The checksum is the one's complement of the summation of 8-bit bytes.

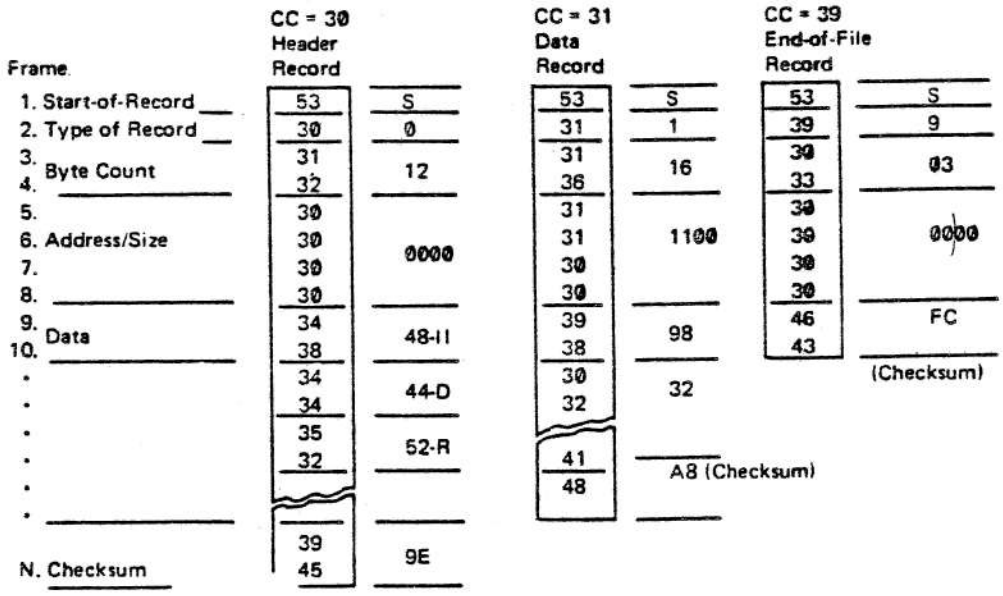


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FIGURE 6-1. Paper Tape Format

VII PROM MONITOR MEMORY USE INFORMATION

Monitor Memory Location

The ACIA version of the PROM Monitor is 256 bytes long and resides in locations FF00 through FFFF. The Baudot version of the Monitor is 512 bytes long and resides in locations FE00 through FFFF.

Monitor Stack

The stack pointer is initialized to 00F1 whenever the Monitor is entered at its reset entry point. The stack pointer can be changed by using the Monitor's M and N commands to alter the contents of SAVSTK (see Monitor flags below)

> NOTE
>
> The contents of SAVSTK should generally not be changed when the Monitor is entered at a program breakpoint as this will cause the P command to operate improperly.

Monitor Flags

Locations 00F2 through 00FF are reserved for use by the Monitor. These locations are assigned as described below. With the exceptions of BRKADR, ECHO, and SAVSTK, these locations should generally not be tampered with.

BRKADR (00F2) - BREAKPOINT ADDRESS FLAG

If bit 7 of BRKADR is clear (=0) the Monitor gains processor control when a program breakpoint occurs. If bit 7 is set, control is transferred to location 0000 when a breakpoint occurs. See Section V for further information.

ECHO (00F3) - TELETYPE ECHO FLAG

(Applies to ACIA version only)

If bit 7 of ECHO is clear, Teletype input is echoed. If bit 7 is set, Teletype echo is suppressed. See Page 9 for further information.

EXTFLG (00F4) - EXTENDED CHARACTER FLAG

(Applies to Baudot version only)

EXTFLG is set when the Baudot character input routine receives the extend character and cleared after the extended character is received. See Section VIII for information on the Baudot version of the Monitor.

BUFULL (00F5) - BUFFER FULL FLAG

(Applies to Baudot version only)

If BUFULL is clear then the contents of the character buffer are not current. If BUFULL is set (any bits high) then the contents of the character buffer are current.

SAVSTK (00F6-00F7)

SAVSTK is used to save and restore the contents of the stack pointer.

TEMP (00F8)

TEMP is used for temporary storage during computation of paper tape checksums.

BYTECT (00F9) - BYTE COUNT

BYTECT contains the byte count during paper tape loading.

XHI (ØØFA)

XHI stores the high order byte of the index register.

XLO (ØØFB)

XLO stores the low order byte of the index register.

> NOTE
>
> XHI and XLO are also used to store the stack pointer when the Monitor is entered at a program breakpoint. This allows the N command to be used to examine the processor status. (See Section V for further information.)

SHIFT (ØØFC)

(Applies to Baudot version only)

SHIFT is set whenever the Baudot Teletype is in the upper case mode. SHIFT is clear whenever the Baudot Teletype is in the lower case mode.

SAVEX (ØØFD-OOFE)

(Applies to Baudot version only)

SAVEX is used by the Baudot output character routine to save and restore the contents of the index register.

BUFFER (ØØFF)

(Applies to Baudot version only)

BUFFER is the character buffer used by the Baudot input character routine.

Interrupt Vectors

The non-maskable interrupt vector points to location 0104.

The maskable interrupt vector points to location 0100 in the ACIA version of the Monitor. See Section VIII for information concerning the maskable interrupt vector in the Baudot version.)

VII BAUDOT TELETYPE OPTION INFORMATION

The Baudot version of the PROM Monitor is a 512 byte, 2 PROM chip version of the Monitor, which contains the necessary software to support a Baudot Teletype (using bit banger I/O) and convert between Baudot (5 level code) and 7 bit ASCII.

> NOTE
>
> The Monitor supports Baudot Teletypes wired for half duplex only.

Baudot Input

Input from the Baudot Teletype is handled by using the maskable interrupt feature of the 6800 MPU. Therefore, the interrupt mask (bit 4 in the processor condition codes register) must be clear (=0) to enable input from the Baudot Teletype.

The maskable interrupt vector points to location FE00. When a maskable interrupt request is acknowledged, the Monitor checks to see if the the interrupt request was originated by the Baudot Teletype. If so, the character code is clocked in. If the request was originated by a device other than the Baudot Teletype, control is transferred to location 0104.

The Baudot input routine converts from Baudot to ASCII and then stores the ASCII character into a 1 byte buffer. Therefore, one character type ahead is possible.

> NOTE
>
> The Baudot output character routine masks out interrupts and therefore a character typed while output is occurring is likely to be either misread or lost entirely.

Baudot < > ASCII Conversion

Figure 8-1 shows the Baudot keyboard which the Monitor's Baudot < > ASCII conversion is based on. The Baudot character set contains 55 (decimal) useable codes. For most computer applications this is an insufficient number of character codes, and therefore the PROM Monitor supports an extended Baudot character set. Table 8-2 shows the characters supported by the Baudot version of the Monitor.

The following is a list of conventions used for Baudot < > ASCII conversion.

1) Extended characters are formed by combining an & (the extend character) with another upper case character. For example, an "=" sign is represented by "&;" .

2) On output, if an ASCII code cannot be matched with a Baudot code, the extend character is printed, followed by a blank.

3) On input, control characters are formed by combining an & (the extend character) with the appropriate lower case character. For example, to send a control-A, the extend character must be typed, followed by a letters shift, followed by an A.

4) On input, any upper case extended character which is not explicitly defined in Table 8-2 is matched to the ASCII control character of its associated lower case. For example, an extended ":" (&:) is matched to a control-C.

5) On input, the codes for null, line feed, and carriage return are unaffected by case. For example, a lower case line feed, an upper case line feed, and an extended line feed are all matched to an ASCII 12 (octal).

6) The letters and figures shift codes are not matched to ASCII codes. They serve only to change the character case.

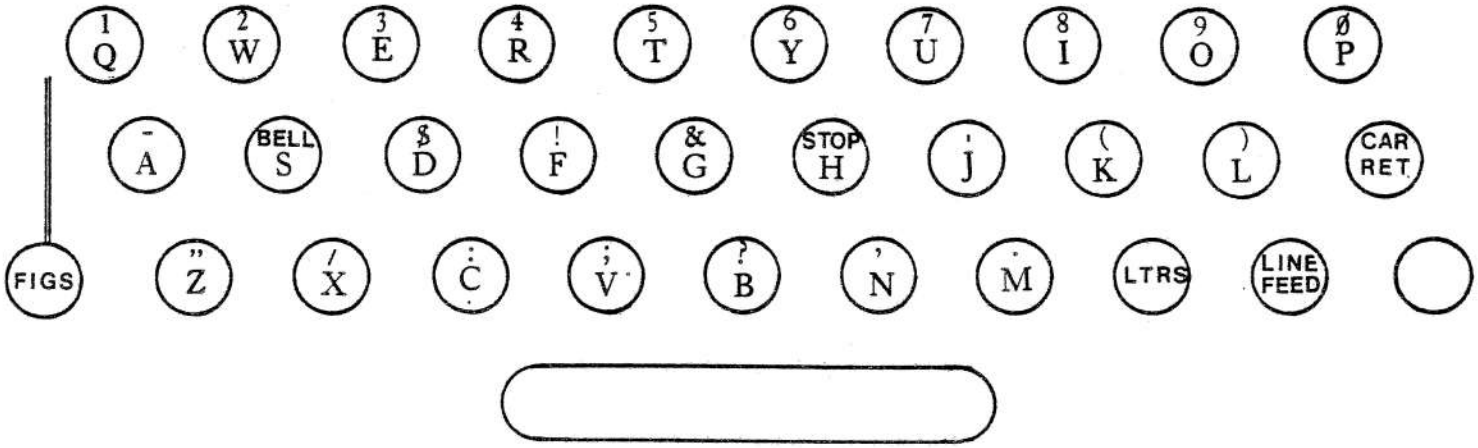

Figure 8-1. Baudot Keyboard

BAUDOT (OCTAL)	LOWER CASE	UPPER CASE	EXTENDED CASE
0	NULL	NULL	
1	E	3	
2	LINE FEED	LINE FEED	
3	A	-	SEE *2 BELOW
4	BLANK	BLANK	
5	S	CONTROL-G	
6	I	8	
7	U	7	
10	CAR RETURN	CAR RETURN	
11	D	$	ESCAPE
12	R	4	
13	J	'	
14	N	,	@
15	F	!	^
16	C	:	
17	K	(	<
20	T	5	
21	Z	"	#
22	L	)	>
23	W	2	
24	H	SEE *1 BELOW	
25	Y	6	
26	P	0	
27	Q	1	
30	O	9	
31	B	?	%
32	G	& (EXT CHAR)	+
33	FIG SHIFT	FIG SHIFT	
34	M	.	*
35	X	/	
36	V	;	=
37	LTR SHIFT	LTR SHIFT	

*1 ON INPUT A STOP IS MATCHED TO A NULL. THERE IS NO ASCII CODE WHICH WILL OUTPUT A STOP.

*2 THIS CHARACTER IS PRINTED AS A BACK ARROW ON TELETYPE MODEL 33.

TABLE 8-2 Baudot <>ASCII Conversion

PAGE 001 PROM MON IX PROM MONITOR SOURCE LISTING (ACIA VERSION)

```
00001                           NAM     PROM    MONITOR
00002                   **
00003                   ** ALTAIR 680B PROM MONITOR
00004                   ** ACIA VERSION 1.0
00005                   **
00006                           OPT     S       PRINT SYMBOL TABLE
00007                           OPT     PAGE    PAGINATED LISTING
00008   0100    MIVEC   EQU     $100
00009   0104    NMIVEC  EQU     $104
00010   F002    STRAPS  EQU     $F002
00011   0000    NOTERM  EQU     0
00012   F000    ACIACS  EQU     $F000
00013   F001    ACIADA  EQU     $F001
00014                   **
00015                   * MONITOR STACK AND FLAGS
00016                   **
00017 00F1              ORG     $F1
00018 00F1 0001 STACK   RMB     1       BOTTOM OF MONITOR'S STACK
00019 00F2 0001 BRKADR  RMB     1       BREAKPOINT ADDRESS FLAG
00020 00F3 0001 ECHO    RMB     1       TTY ECHO FLAG
00021 00F4 0001 EXTFLG  RMB     1       EXTENDED CHARACTER FLAG
00022 00F5 0001 BUFULL  RMB     1       BUFFER FULL FLAG
00023 00F6 0002 SAVSTK  RMB     2       TEMP FOR STACK POINTER
00024 00F8 0001 TEMP    RMB     1       TEMPORARY STORAGE
00025 00F9 0001 BYTECT  RMB     1       BYTE CGUNT
00026 00FA 0001 XHI     RMB     1       XREG HIGH
00027 00FB 0001 XLOW    RMB     1       XREG LOW
00028 00FC 0001 SHIFT   RMB     1       BAUDOT SHIFT FLAG
00029 00FD 0002 SAVEX   RMB     2       TEMP FOR INDEX RG
00030 00FF 0001 BUFFER  RMB     1       BAUDOT CHARACTER BUFFER
00031                   **
00032                   * START OF PROM
00033                   *
00034 FF00              ORG     $FF00
00035                   **
00036                   * INPUT ONE CHAR INTO A-REGISTER
00037                   * ECHO CHAR IF BIT 7 OF ECHO FLAG IS CLEAR
00038                   **
00040 FF00 8D 22 INCH   BSR     POLCAT  ACIA STATUS TO A REG
00041 FF02 24 FC        BCC     INCH    RECEIVE NOT READY
00042 FF04 C6 7F        LDA B   #$7F    MASK FOR PARITY REMOVAL
00043 FF06 D1 F3        CMP B   ECHO    CHECK ECHO FLAG
00044 FF08 F4 F001      AND B   ACIADA  GET CHARACTER
00045 FF0B 24 74        BCC     OUTCH   ECHO
00046 FF0D 39           RTS             NO ECHO
00048                   **
00049                   * THE FOLLOWING NOP LINES UP THE ENTRY
00050                   * POINTS TO POLCAT IN THE TWO VERSIONS
00051                   * OF THE MONITOR
00052                   **
00054 FF0E 01           NOP
```

```
---
PAGE  002   PROM MON


00059                    **
00060                    * INPUT ONE HEX DIGIT INTO B REG
00061                    * RETURN TO CALLING PROGRAM IF
00062                    * CHARACTER RECEIVED IS A HEX
00063                    * DIGIT.  IF NOT HEX, GO TO CRLF
00064                    **
00065 FF0F 8D EF    INHEX  BSR         INCH      GET A CHARACTER
00066 FF11 C0 30           SUB B      #'0
00067 FF13 2B 3C           BMI        C1        NOT HEX
00068 FF15 C1 09           CMP B      #$9
00069 FF17 2F 0A           BLE        IN1HG     NOT HEX
00070 FF19 C1 11           CMP B      #$11
00071 FF1B 2B 34           BMI        C1        NOT HEX
00072 FF1D C1 16           CMP B      #$16
00073 FF1F 2E 30           BGT        C1        NOT HEX
00074 FF21 C0 07           SUB B      #7        IT'S A LETTER-GET BCD
00075 FF23 39        IN1HG  RTS                  RETURN
00077                    * *
00078                    * POLE FOR CHARACTER
00079                    * SETS CARRY IF CHARACTER IS IN BUFFER
00080                    * CLOBBERS B REG
00081                    **
00082 FF24 F6 F000   POLCAT LDA B      ACIACS    ACIA STATUS TO B
00083 FF27 57              ASR B                 ROTATE RDRF BIT INTO CARRY
00084 FF28 39              RTS                   RETURN
00088                    **
00089                    * LOAD PAPER TAPE
00090                    * LOAD ONLY S1 TYPE RECORDS
00091                    * TERMINATE ON S9 OR CHECKSUM ERROR
00092                    **
00093 FF29 8D D5     LOAD   BSR         INCH      READ FRAME
00094 FF2B C0 53           SUB B      #'S
00095 FF2D 26 FA           BNE        LOAD      FIRST CHAR NOT (S)
00096 FF2F 8D CF           BSR        INCH      READ FRAME
00097 FF31 C1 39           CMP B      #'9
00098 FF33 27 1C           BEQ        C1        S9 END OF FILE
00099 FF35 C1 31           CMP B      #'1
00100 FF37 26 F0           BNE        LOAD      SECOND CHAR NOT (1)
00101 FF39 4F              CLR A                ZERO THE CHECKSUM
00102 FF3A 8D 17           BSR        BYTE      READ BYTE
00103 FF3C C0 02           SUB B      #2
00104 FF3E D7 F9           STA B      BYTECT    BYTE COUNT
00105 FF40 8D 20           BSR        BADDR     GET ADDRESS OF BLOCK
00106 FF42 8D 0F     LOAD11 BSR       BYTE      GET DATA BYTE
00107 FF44 7A 00F9         DEC        BYTECT    DECREMENT BYTE COUNT
00108 FF47 27 05           BEQ        LOAD15    DONE WITH THIS BLOCK
00109 FF49 E7 00           STA B      X         STORE DATA
00110 FF4B 08              INX                  BUMP POINTER
00111 FF4C 20 F4           BRA        LOAD11    GO BACK FOR MORE
00112 FF4E 4C        LOAD15 INC A                INCREMENT CHECKSUM
00113 FF4F 27 D8     LLOAD  BEQ       LOAD      ALL OK - IT'S ZERO
00114 FF51 20 58     C1     BRA       CRLF      CHECKSUM ERROR - QUIT
```

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PAGE  003   PROM MON


00117                       **
00118                       * READ BYTE (2 HEX DIGITS)
00119                       * INTO B REG
00120                       * A IS USED FOR PAPER TAPE CHECKSUM
00121                       **
00122 FF53 8D BA    BYTE    BSR         INHEX     GET FIRST HEX DIG
00123 FF55 58               ASL B                 SHIFT TO HIGH ORDER 4 BITS
00124 FF56 58               ASL B
00125 FF57 58               ASL B
00126 FF58 58               ASL B
00127 FF59 1B               ABA                   ADD TO CHEKSUM
00128 FF5A D7 F8            STA B       TEMP      STORE DIGIT
00129 FF5C 8D B1            BSR         INHEX     GET 2ND HEX DIG
00130 FF5E 1B               ABA                   ADD TO CHECKSUM
00131 FF5F DB F8            ADD B       TEMP      COMBINE DIGITS TO GET BYTE
00132 FF61 39               RTS                   RETURN
00133                       **
00134                       * READ 16 BIT ADDRESS INTO X
00135                       * STORE SAME ADDRESS IN XHI & XLO
00136                       * CLOBBERS B REG
00137                       **
00138 FF62 8D EF    BADDR   BSR         BYTE      GET HIGH ORDER ADDRESS
00139 FF64 D7 FA            STA B       XHI       STORE IT
00140 FF66 8D EB            BSR         BYTE      GET LOW ORDER ADDRESS
00141 FF68 D7 FB            STA B       XLOW      STORE IT
00142 FF6A DE FA            LDX         XHI       LOAD X WITH ADDRESS BUILT
00143 FF6C 39               RTS                   RETURN
00147                       **
00148                       * PRINT BYTE IN A REG
00149                       * CLOBBERS B REG
00150                       **
00151 FF6D 16       OUT2H   TAB                   COPY BYTE TO B
00152 FF6E 54               LSR B                 SHIFT TO RIGHT
00153 FF6F 54               LSR B
00154 FF70 54               LSR B
00155 FF71 54               LSR B
00156 FF72 8D 01            BSR         OUTHR     OUTPUT FIRST DIGIT
00157 FF74 16               TAB                   BYTE INTO B AGAIN
00160 FF75 C4 0F    OUTHR   AND B       #$F       GET RID OF LEFT DIG
00161 FF77 CB 30            ADD B       #$30      GET ASCII
00162 FF79 C1 39            CMP B       #$39
00163 FF7B 23 04            BLS         OUTCH
00164 FF7D CB 07            ADD B       #7        IF IT'S A LETTER ADD 7
00165 FF7F 01               NOP                   LINE UP OUTCH ENTRY POINTS
00166 FF80 01               NOP
```

PAGE 004 PROM MON

```
00167 FF81 8C       OUTCH  FCB        $8C       USE CPX SKIP TRICK
00168 FF82 C6 20    OUTS   LDA B      #$20      OUTS PRINTS A SPACE
00171                      **
00172                      * OUTCH OUTPUTS CHARACTER IN B
00173                      **
00174 FF84 37              PSH B                SAVE CHAR
00175 FF85 8D 9D    OUTC1  BSR        POLCAT    ACIA STATUS TO B REG
00176 FF87 57              ASR B
00177 FF88 24 FB           BCC        OUTC1     XMIT NOT READY
00178 FF8A 33              PUL B                CHAR BACK TO B REG
00179 FF8B F7 F001         STA B      ACIADA    OUTPUT CHARACTER
00180 FF8E 39              RTS
00183                      **
00184                      * EXAMINE AND DEPOSIT NEXT
00185                      * USES CONTENTS OF XHI & XLO AS POINTER
00186                      **
00187 FF8F DE FA    NCHANG LDX        XHI       INCREMENT POINTER
00188 FF91 08              INX
00189 FF92 DF FA           STX        XHI
00190 FF94 96 FA           LDA A      XHI
00191 FF96 8D D5           BSR        OUT2H     PRINT OUT ADDRESS
00192 FF98 96 FB           LDA A      XLOW
00193 FF9A 8D D1           BSR        OUT2H
00194 FF9C 8C              FCB        $8C       USE CPX SKIP TRICK
00195                      **
00196                      * EXAMINE & DEPOSIT
00197                      **
00198 FF9D 8D C3    CHANGE BSR        BADDR     BUILD ADDRESS
00199 FF9F 8D E1           BSR        OUTS      PRINT SPACE
00200 FFA1 A6 00           LDA A      X         BYTE INTO A
00201 FFA3 8D C8           BSR        OUT2H     PRINT BYTE
00202 FFA5 8D DB           BSR        OUTS      PRINT SPACE
00203 FFA7 8D AA           BSR        BYTE      GET NEW BYTE
00204 FFA9 E7 00           STA B      X         STORE NEW BYTE
00206                      **
00207                      * COMMAND DECODING SECTION
00208                      **
00209 FFAB 9E F6    CRLF   LDS        SAVSTK
00210 FFAD C6 0D           LDA B      #$D       CARRIAGE RETURN
00211 FFAF 8D D0           BSR        OUTCH
00212 FFB1 C6 0A           LDA B      #$A       LINE FEED
00213 FFB3 8D CC           BSR        OUTCH
00214 FFB5 C6 2E           LDA B      #'.       PROMPT CHARACTER
00215 FFB7 8D C8           BSR        OUTCH
00216 FFB9 BD FF00         JSR        INCH      READ CHARACTER
00217 FFBC 17              TBA                  MAKE A COPY
00218 FFBD 8D C3           BSR        OUTS      PRINT SPACE
00219 FFBF 81 4C           CMP A      #'L
00220 FFC1 27 8C           BEQ        LLOAD     LOAD PAPER TAPE
```

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PAGE  005   PROM MON


00221 FFC3 81 4A          CMP A     #'J
00222 FFC5 26 04          BNE       NOTJ
00223 FFC7 8D 99          BSR       BADDR     GET ADDRESS TO JUMP TO
00224 FFC9 6E 00          JMP       X         JUMP TO IT
00225 FFCB 81 4D   NOTJ   CMP A     #'M
00226 FFCD 27 CE          BEQ       CHANGE    EXAMINE & DEPOSIT
00227 FFCF 81 4E          CMP A     #'N
00228 FFD1 27 BC          BEQ       NCHANG    E & D NEXT
00229 FFD3 81 50          CMP A     #'P
00230 FFD5 26 D4          BNE       CRLF
00231 FFD7 3B             RTI                 PROCEDE FROM BREAKPOINT
00233                     **
00234                     * RESET ENTRY POINT
00235                     **
00236 FFD8 8E 00F3 RESET  LDS       #ECHO     INITIALIZE STACK POINTER
00237 FFDB C6 03          LDA B     #3        INIT ECHO AND BRKADR FLAGS
00238 FFDD 37             PSH B
00239 FFDE 37             PSH B
00240 FFDF F7 F000        STA B     ACIACS    MASTER RESET ACIA
00241 FFE2 F6 F002        LDA B     STRAPS    LOOK AT STRAPS
00242 FFE5 2B 19          BMI       NOTERM    NO TERM - JUMP TO 0
00243 FFE7 C4 04          AND B     #4        GET # OF STOP BITS
00244 FFE9 CA D1          ORA B     #$D1
00245 FFEB F7 F000        STA B     ACIACS    INIT ACIA PORT
00246                     **
00247                     * SOFTWARE INTERRUPT ENTRY POINT
00248                     **
00249 FFEE 9F F6   INTRPT STS       SAVSTK    SAVE STACK POINTER
00250 FFF0 9F FA          STS       XHI       SAVE SP FOR N COMMAND
00251 FFF2 D6 F2          LDA B     BRKADR    IF BIT 7 OF BRKADR IS SET
00252 FFF4 2B 0A          BMI       NOTERM    JUMP TO 0
00253 FFF6 20 B3          BRA       CRLF      GOTO COMMAND DECODER
00256                     **
00257                     * NOW COME THE INTERRUPT VECTORS
00258                     **
00260 FFF8                ORG       $FFF8
00263 FFF8 0100           FDB       MIVEC     MI VECTOR
00264 FFFA FFEE           FDB       INTRPT    SWI VECTOR
00265 FFFC 0104           FDB       NMIVEC    NMI VECTOR
00266 FFFE FFD8           FDB       RESET     RESET VECTOR
00268                     END
```

PAGE 006 PROM MON

```
MIVEC  0100
NMIVEC 0104
STRAPS F002
NOTERM 0000
ACIACS F000
ACIADA F001
STACK  00F1
BRKADR 00F2
ECHO   00F3
EXTFLG 00F4
BUFULL 00F5
SAVSTK 00F6
TEMP   00F8
BYTECT 00F9
XHI    00FA
XLOW   00FB
SHIFT  00FC
SAVEX  00FD
BUFFER 00FF
INCH   FF00
INHEX  FF0F
IN1HG  FF23
POLCAT FF24
LOAD   FF29
LOAD11 FF42
LOAD15 FF4E
LLOAD  FF4F
C1     FF51
BYTE   FF53
BADDR  FF62
OUT2H  FF6D
OUTHR  FF75
OUTCH  FF81
OUTS   FF82
OUTC1  FF85
NCHANG FF8F
CHANGE FF9D
CRLF   FFAB
NOTJ   FFCB
RESET  FFD8
INTRPT FFEE


TOTAL ERRORS 00000
```

PAGE 001 PROM MON X **PROM MONITOR SOURCE LISTING (BAUDOT VERSION)**

```
00001                           NAM     PROM    MONITOR
00002                   **
00003                   ** ALTAIR 680B PROM MONITOR
00004                   ** BAUDOT VERSION 1.0
00005                   **
00006                           OPT     S       PRINT SYMBOL TABLE
00007                           OPT     PAGE    PAGINATED LISTING
00008       FE00        MIVEC   EQU     $FE00
00009       0104        NMIVEC  EQU     $104
00010       0100        CRAZY   EQU     $100
00011       F002        STRAPS  EQU     $F002
00012       0000        NOTERM  EQU     0
00013       F000        ACIACS  EQU     $F000
00014       F001        ACIADA  EQU     $F001
00015 00F1                      ORG     $F1
00016 00F1  0001        STACK   RMB     1       BOTTOM OF MONITOR'S STACK
00017 00F2  0001        BRKADR  RMB     1       BREAKPOINT ADDRESS FLAG
00018 00F3  0001        ECHO    RMB     1       TTY ECHO FLAG
00019 00F4  0001        EXTFLG  RMB     1       EXTENDED CHARACTER FLAG
00020 00F5  0001        BUFULL  RMB     1       BUFFER FULL FLAG
00021 00F6  0002        SAVSTK  RMB     2       TEMP FOR STACK POINTER
00022 00F8  0001        TEMP    RMB     1       TEMPORARY STORAGE
00023 00F9  0001        BYTECT  RMB     1       BYTE COUNT
00024 00FA  0001        XHI     RMB     1       XREG HIGH
00025 00FB  0001        XLOW    RMB     1       XREG LOW
00026 00FC  0001        SHIFT   RMB     1       BAUDOT SHIFT FLAG
00027 00FD  0002        SAVEX   RMB     2       TEMP FOR INDEX REG
00028 00FF  0001        BUFFER  RMB     1       BAUDOT CHARACTER BUFFER
00029                   **
00030                   * START OF PROM
00031                   **
00032 FE00                      ORG     $FE00
00033                   **
00034                   * MASKABLE INTERRRUPT VECTOR POINTS TO GET
00035                   **
00036 FE00 86 40        GET     LDA A   #$40    THIS BIT ROTATES INTO CARRY
00037                   *                         TO SIGNAL STOP BIT ARRIVAL
00038 FE02 F6 F002              LDA B   STRAPS  IF BIT 0 OF F002 IS LOW
00039 FE05 56                   ROR B           THEN INTERRUPT CAME FROM BAUDOT
00040 FE06 24 21                BCC     GETBIT  SO CLOCK IN CHAR CODE
00041 FE08 7E                   FCB     $7E     IF BIT 0 IS HIGH
00042 FE09 01                   FCB     001     JUMP TO 0100 (HEX)
00043                   **
00044                   * THIS IS THE UPPPER CASE CONVERSION TABLE
00045                   **
00046 FE0A 00           UPCAS   FCB     0       NULL
00047 FE0B 33                   FCC     /3/
00048 FE0C 0A                   FCB     $A      LINE FEED
00049 FE0D 2D                   FCC     /-/
00050 FE0E 20                   FCB     $20     BLANK
00051 FE0F 07                   FCB     7       CONTROL G (BELL)
00052 FE10 38                   FCC     /87/
      FE11 37
00053 FE12 0D                   FCB     $D      CARRIAGE RETURN
```

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PAGE  002   PROM MON


00054 FE13 24              FCC       /$4'/
      FE14 34
      FE15 27
00055 FE16 2C              FCC       /,/
00056 FE17 21              FCC       /!:(5/
      FE18 3A
      FE19 28
      FE1A 35
00057 FE1B 22              FCC       /"/
00058 FE1C 29              FCC       /)/
00059 FE1D 32              FCC       /2/
00060 FE1E 00              FCB       0           SLOT FOR STOP
00061 FE1F 36              FCC       /6019?/
      FE20 30
      FE21 31
      FE22 39
      FE23 3F
00062 FE24 00              FCB       0           SLOT FOR &
00063 FE25 00              FCB       0           SLOT FOR FIGURES SHIFT
00064 FE26 2E              FCC       /./
00065 FE27 2F              FCC       !/!
00066 FE28 3B              FCC       /;/
00067                 **
00068                 * END OF UPPER CASE TABLE
00069                 **
00070 FE29 8D 3D    GETBIT BSR       WAIT11      WAIT HALF A BIT TIME
00071 FE2B F6 F002         LDA B     STRAPS
00072 FE2E 56              ROR B                 PUT DATA BIT INTO CARRY
00073 FE2F 8D 37           BSR       WAIT11      FINISH UP BIT TIME
00074 FE31 46              ROR A                 COLLECT CODE IN A
00075 FE32 24 F5           BCC       GETBIT      IF MORE TO COME GO GET EM
00076 FE34 48              ASL A                 GET RID OF STOP BIT
00077 FE35 44              LSR A                 RIGHT JUSTIFY CODE
00078 FE36 44              LSR A
00079 FE37 44              LSR A
00080                 **
00081                 * WE HAVE THE CODE IN A NOW
00082                 **
00083 FE38 81 1B           CMP A     #$1B        IF IT'S AN UPSHIFT
00084 FE3A 26 03           BNE       NTUP        SET THE SHIFT FLAG
00085 FE3C D7 FC    CLRSF  STA B     SHIFT       AND RETURN FROM INTERRUPT
00086 FE3E 3B              RTI
00088 FE3F 5F       NTUP   CLR B
00089 FE40 81 1F           CMP A     #$1F        IF IT'S A DOWNSHIFT
00090 FE42 27 F8           BEQ       CLRSF       CLEAR THE SHIFT FLAG
00092 FE44 D1 F4           CMP B     EXTFLG      IF EXTENDED CHARACTER
00093 FE46 2B 31           BMI       EXTCAR      IS SET GO TO EXT
00094                 *                           CHARACTER SEARCH
00095 FE48 CE FEE2         LDX       #LOWCAS-2
00096                 * SET POINTER TO LOWER CASE
00097 FE4B D1 FC           CMP B     SHIFT       IF SHIFT FLAG IS SET
00098 FE4D 2B 20           BMI       UPCAR       THEN INDEX INTO UPPER CASE TABLE
```

PAGE 003 PROM MON

```
00099 FE4F 08       ADDAX   INX              ADD A REG TO X REG
00100 FE50 4A               DEC A
00101 FE51 2A FC            BPL     ADDAX
00102 FE53 53       DONE    COM B            FORM MASK
00103 FE54 D7 F5            STA B   BUFULL   SET BUFFER FULL FLAG
00104 FE56 E4 01            AND B   1,X      MASK OFF LOW 6 OR ALL 8
00105 FE58 D7 FF            STA B   BUFFER   STORE CHAR INTO BUFFER
00106 FE5A 3B               RTI              RETURN FROM THE INTERRUPT
00107                       **
00108                       * PUT CLOCKS OUT THE CHARACTER CODE
00109                       **
00110 FE5B 48       PUT     ASL A            ROTATE IN START BIT
00111 FE5C 8A 40            ORA A   #$40     OR IN STOP BIT
00112 FE5E B7 F002  NXTBIT  STA A   $F002    SEND A BIT
00113 FE61 8D 05            BSR     WAIT11
00114 FE63 8D 03            BSR     WAIT11   WAIT AROUND FOR 22 MIL SECS
00115 FE65 44               LSR A            SHIFT TO NEXT BIT
00116 FE66 26 F6            BNE     NXTBIT   IF MORE TO SEND THEN DO SO
00118 FE68 CE 02AF  WAIT11  LDX     #687     11 MIL SEC DELAY
00119 FE6B 09       WAIT    DEX
00120 FE6C 26 FD            BNE     WAIT
00121 FE6E 39               RTS
00123 FE6F CE FE08  UPCAR   LDX     #UPCAS-2 POINT TO UPPER CASE TABLE
00124 FE72 81 1A            CMP A   #$1A     IF IT'S THE EXTEND CHAR THEN
00125 FE74 26 D9            BNE     ADDAX    SET THE EXTENDED CHAR FLAG
00126 FE76 97 F4            STA A   EXTFLG   AND RETURN FROM INTERRUPT
00127 FE78 3B               RTI
00129 FE79 CE FFE0  EXTCAR  LDX     #EXTEND-2 POINT TO EXTENDED CHAR TABLE
00130 FE7C D7 F4            STA B   EXTFLG   CLEAR THE EXTEND FLAG
00131 FE7E 08       CHKNXT  INX
00132 FE7F 08               INX
00133 FE80 A1 00            CMP A   X        SEARCH THE EXTENDED CHAR TABLE
00134 FE82 27 CF            BEQ     DONE     IF MATCH FOUND THEN WE ARE DONE
00135 FE84 6D 00            TST     X        IF MINUS ENCOUNTERED THEN CODE NOT
00136 FE86 2A F6            BPL     CHKNXT   IN TABLE SO MAKE INTO CONTROL CHAR
00137 FE88 CE FEE2          LDX     #LOWCAS-2 BY TAKING LOWER CASE ASCII AND
00138 FE8B C6 C0            LDA B   #$C0     SETTING MASK TO GET RIG OF HI
00139 FE8D 20 C0            BRA     ADDAX    ORDER 2 BITS
00140 FE8F 96 FC    CHKUP   LDA A   SHIFT    BEFORE CHECKING UPPPER CASE TABLE
00141 FE91 26 06            BNE     OKUP     CHECK THE SHIFT FLAG
00142 FE93 86 1B            LDA A   #$1B     SEND OUT FIGURES SHIFT AND SET
00143 FE95 97 FC            STA A   SHIFT    SHIFT FLAG AS NECESSARY
00144 FE97 8D C2            BSR     PUT
00145 FE99 CE FE0A  OKUP    LDX     #UPCAS   SET POINTER TO UPPER CASE TABLE
00146 FE9C 8D 39            BSR     SEARCH   CALL SEARCH ROUTINE
00147 FE9E 2A 2F            BPL     RESTR    IF POSITIVE, SEARCH WAS SUCCESSFUL
00148 FEA0 86 1A            LDA A   #$1A     SEARCH FAILED SO OUTPUT EXTEND
00149 FEA2 8D B7            BSR     PUT      CHARACTER
00150 FEA4 CE FFE0          LDX     #EXTEND-2
00151 FEA7 E1 01    NXT     CMP B   1,X      SEARCH THROUGH EXTENDED CHAR
00152 FEA9 27 24            BEQ     RESTR    TABLE
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PAGE  004   PROM MON


00153 FEAB 08            INX
00154 FEAC 08            INX                        BUMP POINTER TWICE
00155 FEAD A6 00         LDA A       X              LOAD THE BAUDOT CODE INTO B
00156 FEAF 2A F6         BPL         NXT            IF MINUS - END OF TABLE
00157 FEB1 C6 20         LDA B       #$20           NO MATCH FOUND - OUTPUT BLANK
00158 FEB3 8D 04         BSR         BOUT2
00159 FEB5 20 1A         BRA         REST2
00160                    **
00161                    * BOUTCH IS THE OUTPUT CHARACTER ROUTINE
00162                    **
00163 FEB7 DF FD    BOUTCH STX       SAVEX          SAVE X,A,&B
00164 FEB9 0F       BOUT2  SEI                      DISENABLE INTERRUPTS
00165 FEBA 36            PSH A
00166 FEBB 37            PSH B
00167 FEBC CE FEE4       LDX         #LOWCAS        SET POINTER TO LOWER CASE
00168 FEBF 8D 16         BSR         SEARCH         TABLE AND CALL SEARCH ROUTINE
00169 FEC1 2B CC         BMI         CHKUP          IF MINUS, THEN SEARCH FAILED
00170 FEC3 D6 FC         LDA B       SHIFT          CHECK THE SHIFT FLAG
00171 FEC5 27 08         BEQ         RESTR
00172 FEC7 36            PSH A                      IF FLAG IS SET THEN SEND OUT
00173 FEC8 86 1F         LDA A       #$1F           LETTERS SHIFT AND CLEAR FLAG
00174 FECA 8D 8F         BSR         PUT
00175 FECC 97 FC         STA A       SHIFT          A IS CLEAR ON RETURN FROM PUT
00176 FECE 32            PUL A
00177 FECF 8D 8A    RESTR  BSR       PUT
00178 FED1 33       REST2  PUL B                    RESTORE B
00179 FED2 32              PUL A                    RESTORE A REG
00180 FED3 DE FD           LDX       SAVEX          RESTORE X REG
00181 FED5 0E              CLI                      ENABLE INTERRUPTS
00182 FED6 39       RET    RTS                      RETURN
00183                    **
00184                    * SUBROUTINE TO SEARCH CONVERSION TABLES
00185                    * RETURNS WITH CODE IN A IF FOUND
00186                    * RETURNS WITH N BIT SET IF NOT FOUND
00187                    **
00188 FED7 4F       SEARCH CLR A
00189 FED8 6D 00    NXTCHK TST       X
00190 FEDA 2B FA           BMI       RET            IF MINUS - END OF TABLE
00191 FEDC E1 00           CMP B     X
00192 FEDE 27 F6           BEQ       RET            MATCH - RETURN
00193 FEE0 08              INX                      INCREMENT POINTER
00194 FEE1 4C              INC A                    INCREMENT OUTPUT CODE
00195 FEE2 20 F4           BRA       NXTCHK         CONTINUE SEARCH
00196                    **
00197                    * LOWER CASE CONVERSION TABLE
00198                    **
00199 FEE4 00       LOWCAS FCB       0              NULL
00200 FEE5 45              FCC       /E/
00201 FEE6 0A              FCB       $A             LINE FEED
00202 FEE7 41              FCC       /A/
00203 FEE8 20              FCB       $20            BLANK
00204 FEE9 53              FCC       /SIU/
      FEEA 49
      FEEB 55

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00205 FEEC 0D              FCB       $D       CARRIAGE RETURN
00206 FEED 44              FCC       /DRJNFCKTZLWHYPQOBG/
      FEEE 52
      FEEF 4A
      FEF0 4E
      FEF1 46
      FEF2 43
      FEF3 4B
      FEF4 54
      FEF5 5A
      FEF6 4C
      FEF7 57
      FEF8 48
      FEF9 59
      FEFA 50
      FEFB 51
      FEFC 4F
      FEFD 42
      FEFE 47
00207 FEFF 00              FCB       0        SLOT FOR FIGURES SHIFT
00208                 **
00209                 * INCH ENTRY POINT MUST BE AT START OF SECOND PROM
00210                 **
00211 FF00 4D       INCH   FCC       /MXV/
      FF01 58
      FF02 56
00213 FF03 8D 1F    HANG   BSR       POLCAT   IF BUFFER IS EMPTY
00214 FF05 24 FC           BCC       HANG     HANG AROUND FOR INTERRUPT
00215 FF07 7F 00F5         CLR       BUFULL   CLEAR THE BUFFER FULL FLAG
00216 FF0A D6 FF           LDA B     BUFFER   PUT CHAR INTO B
00217 FF0C 39              RTS                RETURN
00218                 **
00219                 * INPUT ONE HEX DIGIT INTO B REG
00220                 * RETURN TO CALLING PROGRAM IF
00221                 * CHARACTER RECEIVED IS A HEX
00222                 * DIGIT.  IF NOT HEX, GO TO CRLF
00223                 **
00224 FF0D 8D F1    INHEX  BSR       INCH     GET A CHARACTER
00225 FF0F C0 30           SUB B     #'0
00226 FF11 2B 3D           BMI       C1       NOT HEX
00227 FF13 C1 09           CMP B     #$9
00228 FF15 2F 0A           BLE       IN1HG    NOT HEX
00229 FF17 C1 11           CMP B     #$11
00230 FF19 2B 35           BMI       C1       NOT HEX
00231 FF1B C1 16           CMP B     #$16
00232 FF1D 2E 31           BGT       C1       NOT HEX
00233 FF1F C0 07           SUB B     #7       IT'S A LETTER-GET BCD
00234 FF21 39       IN1HG  RTS               RETURN
00235                 **
00236                 * THIS HELPS LINE UP ENTRY POINTS
00237                 **
00238 FF22 20 93    BBOUTC BRA       BOUTCH
00239                 **
```

PAGE 006 PROM MON

```
00240                   * POLE FOR CHARACTER
00241                   * SET CARRY IF CHAR IN BUFFER IS CURRENT
00242                   * CLEAR CARRY IF NOT CURRENT
00243                   **
00244 FF24 D6 F5        POLCAT LDA B    BUFULL
00245 FF26 57                  ASR B
00246 FF27 39                  RTS
00247                   **
00248                   * LOAD PAPER TAPE
00249                   * LOAD ONLY S1 TYPE RECORDS
00250                   * TERMINATE ON S9 OR CHECKSUM ERROR
00251                   **
00252 FF28 8D D6        LOAD    BSR     INCH    READ FRAME
00253 FF2A C0 53                SUB B   #'S
00254 FF2C 26 FA                BNE     LOAD    FIRST CHAR NOT (S)
00255 FF2E 8D D0                BSR     INCH    READ FRAME
00256 FF30 C1 39                CMP B   #'9
00257 FF32 27 1C                BEQ     C1      S9 END OF FILE
00258 FF34 C1 31                CMP B   #'1
00259 FF36 26 F0                BNE     LOAD    SECOND CHAR NOT (1)
00260 FF38 4F                   CLR A           ZERO THE CHECKSUM
00261 FF39 8D 17                BSR     BYTE    READ BYTE
00262 FF3B C0 02                SUB B   #2
00263 FF3D D7 F9                STA B   BYTECT  BYTE COUNT
00264 FF3F 8D 20                BSR     BADDR   GET ADDRESS OF BLOCK
00265 FF41 8D 0F        LOAD11  BSR     BYTE    GET DATA BYTE
00266 FF43 7A 00F9              DEC     BYTECT  DECREMENT BYTE COUNT
00267 FF46 27 05                BEQ     LOAD15  DONE WITH THIS BLOCK
00268 FF48 E7 00                STA B   X       STORE DATA
00269 FF4A 08                   INX             BUMP POINTER
00270 FF4B 20 F4                BRA     LOAD11  GO BACK FOR MORE
00271 FF4D 4C           LOAD15  INC A           INCREMENT CHECKSUM
00272 FF4E 27 D8        LLOAD   BEQ     LOAD    ALL OK - IT'S ZERO
00273 FF50 20 4D        C1      BRA     CRLF    CHECKSUM ERROR - QUIT
00274                   **
00275                   * READ BYTE (2 HEX DIGITS)
00276                   * INTO B REG
00277                   * A IS USED FOR PAPER TAPE CHECKSUM
00278                   **
00279 FF52 8D B9        BYTE    BSR     INHEX   GET FIRST HEX DIG
00280 FF54 58                   ASL B           SHIFT TO HIGH ORDER 4 BITS
00281 FF55 58                   ASL B
00282 FF56 58                   ASL B
00283 FF57 58                   ASL B
00284 FF58 1B                   ABA             ADD TO CHEKSUM
00285 FF59 D7 F8                STA B   TEMP    STORE DIGIT
00286 FF5B 8D B0                BSR     INHEX   GET 2ND HEX DIG
00287 FF5D 1B                   ABA             ADD TO CHECKSUM
00288 FF5E DB F8                ADD B   TEMP    COMBINE DIGITS TO GET BYTE
00289 FF60 39                   RTS             RETURN
00290                   **
00291                   * READ 16 BIT ADDRESS INTO X
00292                   * STORE SAME ADDRESS IN XHI & XLO
00293                   * CLOBBERS B REG
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PAGE  007   PROM MON


00294                       **
00295 FF61 8D EF    BADDR   BSR         BYTE      GET HIGH ORDER ADDRESS
00296 FF63 D7 FA            STA B       XHI       STORE IT
00297 FF65 8D EB            BSR         BYTE      GET LOW ORDER ADDRESS
00298 FF67 D7 FB            STA B       XLOW      STORE IT
00299 FF69 DE FA            LDX         XHI       LOAD X WITH ADDRESS BUILT
00300 FF6B 39               RTS                   RETURN
00301                       **
00302                       * PRINT BYTE IN A REG
00303                       * CLOBBERS B REG
00304                       **
00305 FF6C 16       OUT2H   TAB                   COPY BYTE TO B
00306 FF6D 54               LSR B                 SHIFT TO RIGHT
00307 FF6E 54               LSR B
00308 FF6F 54               LSR B
00309 FF70 54               LSR B
00310 FF71 8D 01            BSR         OUTHR     OUTPUT FIRST DIGIT
00311 FF73 16               TAB                   BYTE INTO B AGAIN
00312 FF74 C4 0F    OUTHR   AND B       #$F       GET RID OF LEFT DIG
00313 FF76 CB 30            ADD B       #$30      GET ASCII
00314 FF78 C1 39            CMP B       #$39
00315 FF7A 23 05            BLS         OUTCH
00316 FF7C CB 07            ADD B       #7        IF IT'S A LETTER ADD 7
00317 FF7E 8C               FCB         $8C
00318 FF7F C6 20    OUTS    LDA B       #$20      OUTS PRINTS A SPACE
00319                       **
00320                       * OUTCH OUTPUTS CHAR IN B
00321                       **
00322 FF81 20 9F    OUTCH   BRA         BBOUTC
00323                       **
00324                       * EXAMINE AND DEPOSIT NEXT
00325                       * USES CONTENTS OF XHI & XLO AS POINTER
00326                       **
00327 FF83 DE FA    NCHANG  LDX         XHI       INCREMENT POINTER
00328 FF85 08               INX
00329 FF86 DF FA            STX         XHI
00330 FF88 96 FA            LDA A       XHI
00331 FF8A 8D E0            BSR         OUT2H     PRINT OUT ADDRESS
00332 FF8C 96 FB            LDA A       XLOW
00333 FF8E 8D DC            BSR         OUT2H
00334 FF90 8C               FCB         $8C
00335                       **
00336                       * EXAMINE & DEPOSIT
00337                       **
00338 FF91 8D CE    CHANGE  BSR         BADDR     BUILD ADDRESS
00339 FF93 8D EA            BSR         OUTS      PRINT SPACE
00340 FF95 A6 00            LDA A       X         BYTE INTO A
00341 FF97 8D D3            BSR         OUT2H     PRINT BYTE
00342 FF99 8D E4            BSR         OUTS      PRINT SPACE
00343 FF9B 8D B5            BSR         BYTE      GET NEW BYTE
00344 FF9D E7 00            STA B       X         STORE NEW BYTE
00345                       **
00346                       * COMMAND DECODING SECTION
00347                       **
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PAGE  008   PROM MON


00348 FF9F 9E F6   CRLF   LDS         SAVSTK
00349 FFA1 C6 0D          LDA B       #$D       CARRIAGE RETURN
00350 FFA3 8D DC          BSR         OUTCH
00351 FFA5 C6 0A          LDA B       #$A       LINE FEED
00352 FFA7 8D D8          BSR         OUTCH
00353 FFA9 C6 2E          LDA B       #'.       PROMPT CHARACTER
00354 FFAB 8D D4          BSR         OUTCH
00355 FFAD BD FF00        JSR         INCH      READ CHARACTER
00356 FFB0 17             TBA                   MAKE A COPY
00357 FFB1 8D CC          BSR         OUTS      PRINT SPACE
00358 FFB3 81 4C          CMP A       #'L
00359 FFB5 27 97          BEQ         LLOAD     LOAD PAPER TAPE
00360 FFB7 81 4A          CMP A       #'J
00361 FFB9 26 04          BNE         NOTJ
00362 FFBB 8D A4          BSR         BADDR     GET ADDRESS TO JUMP TO
00363 FFBD 6E 00          JMP         X         JUMP TO IT
00364 FFBF 81 4D   NOTJ   CMP A       #'M
00365 FFC1 27 CE          BEQ         CHANGE    EXAMINE & DEPOSIT
00366 FFC3 81 4E          CMP A       #'N
00367 FFC5 27 BC          BEQ         NCHANG    E & D NEXT
00368 FFC7 81 50          CMP A       #'P
00369 FFC9 26 D4          BNE         CRLF
00370 FFCB 3B             RTI                   PROCEDE FROM BREAKPOINT
00371 FFCC 8E 00F5 RESET  LDS         #BUFULL   INIT STACK POINTER
00372 FFCF 4F             CLR A
00373 FFD0 36             PSH A                 INIT BUFFER FULL FLAG
00374 FFD1 36             PSH A                 INIT EXT CHAR FLAG
00375 FFD2 36             PSH A                 INIT ECHO FLAG
00376 FFD3 36             PSH A                 INIT BRKADR FLAG
00377                **
00378                * SOFTWARE INTERRUPT ENTRY POINT
00379                **
00380 FFD4 9F F6   INTRPT STS         SAVSTK    SAVE STACK POINTER
00381 FFD6 9F FA          STS         XHI       SAVE SP FOR N COMMAND
00382 FFD8 0E             CLI                   ENABLE INTERRUPTS
00383 FFD9 B6 F002        LDA A       STRAPS    IF NO TERMINAL BIT IS SET
00384 FFDC 9A F2          ORA A       BRKADR    OR BIT 7 OF BRKADR IS SET
00385 FFDE 2B 20          BMI         NOTERM    JUMP TO 0
00386 FFE0 20 BD          BRA         CRLF      TO COMMAND DECODER
00387                **
00388                * EXTENDED CHARACTER TABLE
00389                **
00390 FFE2 03      EXTEND FCB         3
00391 FFE3 5F             FCC         / /
00392 FFE4 1E             FCB         $1E
00393 FFE5 3D             FCC         /=/
00394 FFE6 09             FCB         $9
00395 FFE7 1B             FCB         $1B       ESCAPE CHARACTER
00396 FFE8 0D             FCB         $D
00397 FFE9 5E             FCC         / /
00398 FFEA 1A             FCB         $1A
00399 FFEB 2B             FCC         /+/
00400 FFEC 0F             FCB         $F
```

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PAGE  009   PROM MON


00401 FFED 3C              FCC         /</
00402 FFEE 12              FCB         $12
00403 FFEF 3E              FCC         />/
00404 FFF0 1C              FCB         $1C
00405 FFF1 2A              FCC         /*/
00406 FFF2 11              FCB         $11
00407 FFF3 23              FCC         /#/
00408 FFF4 19              FCB         $19
00409 FFF5 25              FCC         /%/
00410 FFF6 0C              FCB         $C
00411 FFF7 40              FCC         /@/
00412                 **
00413                 * NOW COME THE INTERRUPT VECTORS
00414                 **
00415 FFF8                 ORG         $FFF8
00416 FFF8 FE00            FDB         MIVEC     MI VECTOR
00417 FFFA FFD4            FDB         INTRPT    SWI VECTOR
00418 FFFC 0104            FDB         NMIVEC    NMI VECTOR
00419 FFFE FFCC            FDB         RESET     RESET VECTOR
00420                      END


MIVEC   FE00
NMIVEC  0104
CRAZY   0100
STRAPS  F002
NOTERM  0000
ACIACS  F000
ACIADA  F001
STACK   00F1
BRKADR  00F2
ECHO    00F3
EXTFLG  00F4
BUFULL  00F5
SAVSTK  00F6
TEMP    00F8
BYTECT  00F9
XHI     00FA
XLOW    00FB
SHIFT   00FC
SAVEX   00FD
BUFFER  00FF
GET     FE00
UPCAS   FE0A
GETBIT  FE29
CLRSF   FE3C
NTUP    FE3F
ADDAX   FE4F
DONE    FE53
PUT     FE5B
NXTBIT  FE5E
WAIT11  FE68
WAIT    FE6B
UPCAR   FE6F
EXTCAR  FE79
CHKNXT  FE7E
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```
CHKUP   FE8F
OKUP    FE99
NXT     FEA7
BOUTCH  FEB7
BOUT2   FEB9
RESTR   FECF
REST2   FED1
RET     FED6
SEARCH  FED7
NXTCHK  FED8
LOWCAS  FEE4
INCH    FF00
HANG    FF03
INHEX   FF0D
IN1HG   FF21
BBOUTC  FF22
POLCAT  FF24
LOAD    FF28
LOAD11  FF41
LOAD15  FF4D
LLOAD   FF4E
C1      FF50
BYTE    FF52
BADDR   FF61
OUT2H   FF6C
OUTHR   FF74
OUTS    FF7F
OUTCH   FF81
NCHANG  FF83
CHANGE  FF91
CRLF    FF9F
NOTJ    FFBF
RESET   FFCC
INTRPT  FFD4
EXTEND  FFE2
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TOTAL ERRORS 00000

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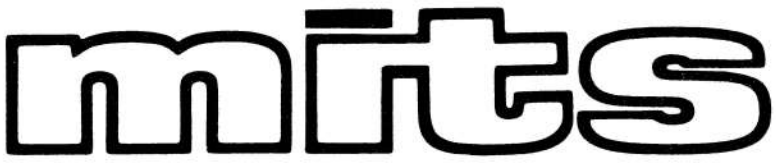

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