ZENITH data systems

MONITOR

MTR-89

595-2508

ZENITH DATA SYSTEMS
SAINT JOSEPH, MICHIGAN 49085

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INTRODUCTION

This Manual describes the functions and operation of the Z89 Monitor Program, MTR-89, that is contained in a read-only memory (ROM) in your Z89. Some of the major features of MTR-89 are:

Memory contents display and alteration.
Program execution control.
Floppy diskette boot-strap routine.

In addition, MTR-89 can be instructed (by means of a flag byte maintained in read/write memory) to bypass some or all of its normal functions. In this manner, a sophisticated user can augment or replace these functions.

THEORY OF OPERATION

This section supplements the information in the "Operations" and "Circuit Description" sections of your Z89 Operations Manual. In order to use all of the features of MTR-89, it is necessary to understand the Z80 operation codes and the circuit of your Z89. This section gives you details of the operation of MTR-89. The listing of MTR-89 is given in Appendix A.

Power Up and Reset

MTR-89 initializes the Z89 whenever you power-up or RESET. To power-up, use the switch on the back of the Z89. To RESET, simultaneously press the RESET key and the right-hand SHIFT key on the keyboard. MTR-89 sounds the electronic "bell" and resets to its normal state. During the initialization procedure, MTR-89 determines the high limit of continuous RAM in your Z89. Once this high limit has been determined, the Z80's stack pointer is set to this value. Then MTR-89 enters a loop waiting for you to enter a command.

Clock Interrupts

The Clock Interrupt is a crucial element in the operation of the Z89. It is a level one interrupt and is generated on the Z89 CPU board every 2 ms (millisecond). MTR-89 maintains "TICCNT" which counts up one every 2 ms. See the listing in Appendix A for the location of TICCNT.

Note that MTR-89 uses interrupts, so you should not disable interrupts for a long period of time. MTR-89 also requires a stack pointer at the top of memory with at least 80 bytes.

General Operations

When you RESET or power-up your Z89, MTR-89 responds by clearing the screen and displaying "H:". This tells you that it is ready to respond to your typed commands. When you type in something, MTR-89 will either accept it or give a beep, indicating an error.

If the letter you enter is the first letter of one of MTR-89's commands, it will display the remaining letters of the word. If the letter is not the start of a command, MTR-89 will sound the "bell" and ignore the letter.

The DELETE key will kill a partially entered line and cause MTR-89 to return to the "H:" prompt. You can use this to correct typing errors.

NOTE: In this manual, the symbol "△" means type a space and "㊡" means type a RETURN.

The following is a list of the acceptable MTR-89 commands. You type the first letter of the command, and MTR-89 will supply the remainder of the word. You have to press the RETURN key before MTR-89 will respond.

TABLE OF MTR-89 COMMANDS

Substitute	— Display or alter memory.
Go	— Start a program
Program Counter	— Set an address in the PC
Boot	— Boot from a diskette

These commands are described in the remainder of this Manual.

DISPLAYING AND ALTERING MEMORY

One of the major features of MTR-89 is its ability to examine the contents of any Z89 memory location and to modify the contents of that location if it is in RAM.

The Substitute command is used to display memory locations. After a memory location has been displayed, its value can be changed before you proceed to something else. There is an example showing the Substitute procedure at the end of the description. You may jump ahead to it at any time.

To start the substitution process, first type "S". MTR-89 will respond by completing the word "Substitute". You should then enter the address of the memory location you want to inspect, followed by a RETURN. This address **must** be given in split-octal. Refer to Appendix B for the definitions of octal and split-octal.

MTR-89 will respond by re-displaying the address with leading zeros. Following the address, MTR-89 will display the contents of that memory location in octal.

Once the value of the memory location has been displayed, you may change it. To change it, simply type in the new value (in octal). The new value will be inserted after you complete the next step.

NOTE: MTR-89 will use the last three digits that you enter. That is, the entry "12345" will be entered as "345". You may use this to correct errors as entries are made.

After you have inspected or changed the value of a memory location, you have three options. First, you can cause MTR-89 to advance to the next memory location and display it by pressing the Space Bar. Second, you can cause MTR-89 to retrieve the previous memory location and display it by pressing the minus key, "−". Finally, you can cause MTR-89 to return to its initial "H:" by pressing the RETURN key.

The following example shows these features. To help you follow what you enter and what the computer responds, your entries and the computer's responses are shown on different lines. If a new line is really used, the new line will start at the left of the page. Otherwise, the output is shown just down a line.

EXAMPLE

```
  H:                          computer
     S                        you
      ubstitute               computer
                2146 (CR)     you
002146 041                    computer
           △                  you
002147 011                    computer
           △                  you
002150 040                    computer
           -                  you
002147 011                    computer
            (CR)              you
  H:                          computer
     S                        you
      ubstitute               computer
                40100 (CR)    you
040100 xxx                    computer
           123 △              you
040101 xxx                    computer
           -                  you
040100 123                    computer
            (CR)              you
  H:                          computer
```

PROGRAM EXECUTION CONTROL

MTR-89 allows you to start a program that you have loaded into memory. It also offers a form of breakpointing.

The standard way of starting a program is to use the Go command. After you type in "G", MTR-89 responds "o". You should then type in the address (in split octal) where you want execution of your program to start. For example, if you have loaded a program at 040100, you can start it with:

```
H:  Go 40100 ↵
```

MTR-89 allows another method of starting programs. MTR-89 maintains in its working memory a value for the Program Counter. If you enter "G" and then a RETURN after MTR -89 prints "o", MTR-89 will use the value in the PC as the starting address of your program.

To set the value in the Program Counter, you use the "P" command. After you enter "P", MTR-89 will respond "rogram Counter" and you can then enter the value you want. For example:

```
H: Program Counter 40100↵
H: Go↵
```

Your program will now be started at 40100.

If you do not enter a value after "P", but simply press RETURN, then MTR-89 will display the current value of the PC on the next line. You can change the PC by typing in a new value or you can leave it un-altered by pressing RETURN. For example:

```
  H: Program Counter↵
277377 40100↵
```

(You type the second number.)

When you are debugging an assembly language program, you can use MTR-89 to set breakpoints at various places in the program. To set a breakpoint, use the Substitute command and put an HLT (166 octal) instruction where you want your program to stop.

When your program reaches the breakpoint HLT instruction, it will return to MTR-89, display an "H:", and then advance to a new line and display "H:". You can now use any of the MTR-89 commands.

To continue your program, you will first have to restore the byte in the location where you placed the breakpoint HLT. Since the computer had to execute the HLT instruction, the PC will point one beyond where you placed the HLT. To continue, you will have to decrease the PC value by one.

Do this by entering the "P" command and a RETURN. When the current value of the PC is shown, subtract one from it, and enter this value as the new value for the PC. Remember that you have to subtract in octal, so ten minus one is seven!

Alternatively, you can use the "Go" command to start the program from whatever address you want, including from the place where you put the HLT.

Note that if the program that you are debugging uses keyboard interrupts, MTR-89 and your program may "fight" for keyboard input! Your program will always see every character because it gets them by an interrupt. MTR-89 is continually testing if a character is available, and it will never see some of the characters that you enter.

ADVANCED CONTROL

One of the advanced features of MTR-89 is its provisions allowing sophisticated users to augment or replace MTR-89's functions. This is usually done in conjunction with assembly language programs, although it is sometimes possible to use these features in BASIC using the PEEK and POKE commands.

The following discussion refers to symbols and locations in MTR-89. In order to make the most of this information, you should refer to the listing of MTR-89 that is in Appendix A. Note that at the end of the listing the definitions of RAM locations from 40.000 to 40.077 and 41.120 to 41.125 are given. Following these is a symbol reference table that will help you find where symbols are used in the program.

The Tick Counter (TICCNT)

MTR-89 maintains in memory a 16-bit (2 byte) tick counter named TICCNT. This counter is incremented when the clock interrupts occur. As long as interrupts are enabled, this will occur every 2 ms. You may set TICCNT to any value and change it as often as you like. The low-order byte of TICCNT is in location 40.033 (8219 decimal) and the high-order byte is in 40.034.

Using Interrupts

All Z89 interrupts cause control to be transferred into the lowest 64 bytes of memory. Since MTR-89 occupies this area, it processes all interrupts first. Except for level zero interrupts (RESET function), you can supply a routine to process interrupts yourself.

Control is passed out of MTR-89 through the UIVECs (user interrupt vector) that are located at 40.037 and following. Each vector is three bytes long, and contains a JMP instruction to an interrupt processing routine. MTR-89 calls or jumps to the appropriate UIVEC, and control is passed to the processing routine. The exit from an interrupt processing routine should be the return instruction, RET.

I/O Interrupts

Interrupts numbered 3 through 7 are I/O interrupts of devices that you connect to your Z89. MTR-89 does not process these interrupts, but simply passes them on to a program in RAM by jumping to the appropriate UIVEC.

Zenith Data Systems software (except MTR-89) use interrupt 3 for input and output to and from the keyboard and screen. Additionally, interrupts 4 and 7 are reserved for certain applications. These programs set UIVEC themselves. If you want to use interrupts, your program has to place the appropriate jump in the appropriate UIVEC.

Clock Interrupts

The level one interrupt is generated by hardware in your Z89 every 2 ms. MTR-89 always processes these interrupts, but you can force it to pass control to your routine once it is done.

To do this, set the appropriate jump in the first UIVEC locations. Then set the UO.CLK bit (001) in .MFLAG (40.010). MTR-89 will then pass each clock interrupt to your routine when it finishes its own processing.

Single Instructions and Breakpoint Interrupts

Level two interrupts are generated by the single-instruction hardware contained in the Z89. When a single-instruction interrupt occurs, MTR-89 processes it, and jumps to the location specified by the second UIVEC.

If you have set up UIVEC for level two interrupts, you can use RST-2 as a breakpoint instruction. Control will be returned to the location specified by the second UIVEC.

FLOPPY BOOT

MTR-89 contains the code necessary to boot-up an operating system from a floppy disk. Two forms of "Boot" let you select the device (5-1/4" or Z47) and drive number (0-2 or 0-3). "Boot Primary" refers to the device that you will use most often. "Boot Secondary" provides you with a convenient way to boot from your alternate device, if you have one.

BOOT PRIMARY

The primary boot device is selected by switch SW501 sections 4, 1, and 0 on the CPU Logic Circuit Board. This switch is preset for 5-1/4" primary device. You may change the switch sections to select Z47 primary device.

H: Boot ⏎	Enter "B" and "RETURN"
H: Bootd ⏎	5-1/4" drive primary: Enter "B" and d(drive) = 0, 1, or 2 followed by "RETURN" OR Z47 primary: Enter "B" and d(drive) = 0, 1, 2, or 3 followed by "RETURN"

BOOT SECONDARY

`H:Boot SD` ↵	Enter "B", "S", and "RETURN"
`H:Boot SDd` ↵	5-1/4″ secondary: Enter "B" and "S" and d(drive) = 0, 1, or 2 followed by "RETURN" OR Z47 secondary: Enter "B" and "S" and d(drive) = 0, 1, 2, or 3 followed by "RETURN"

Use the "DELETE" key to abort the boot command and return to the monitor.

ERRORS

The console will display a "?" if any of the following conditions occur:

1. The boot device does not respond within 15 seconds.
2. The "DELETE" key is pressed.
3. Switch SW501 section 2 is set to "0".
4. A disk error occurs.

SWITCH SW501

The sections of SW501 (on the Z89 CPU logic circuit board) have been redefined as follows:

SWITCH SECTION 7 6 5 4 3 2 1 0	DESCRIPTION
X X X X X X 0 0	Port 174/177 = 5-1/4" drive
X X X X X X 0 1	Port 174/177 = Z47
X X X X 0 0 X X	Port 170/173 = unused
X X X X 0 1 X X	Port 170/173 = Z47
X X X 0 X X X X	Boot primary from port 174/177
X X X 1 X X X X	Boot primary from port 170/173
X X 0 X X X X X	Memory test
X X 1 X X X X X	Normal
X 0 X X X X X X	Baud = 9600
0 X X X X X X X	Normal

APPENDIX A

MTR-89 LISTING

This appendix contains a listing of MTR-89. It contains all the control for primitive keyboard input and screen output. MTR-89 needs RAM locations available in locations 40.000 to 40.077 and 41.120 to 41.125, and it also needs 80 bytes of stack area in high memory.

The first few pages of the listing show definitions that are used. The last portion of the listing contains references to the symbols that are used in MTR-89. Just before this cross reference listing is the definition of RAM locations in 40.000 through 40.077.

To allow compatibility with other hardware, the MTR-89 code is segmented throughout memory. The Memory Test entry point is 7.375 and the Floppy Speed Test (5-1/4" drive) entry point is 7.372.

```
***     MTR89 - H89 MONITOR                        ISSUE 09.01.00
*
*       MTR89 IS A MODIFICATION OF MTR88 BY REX CHEN IN MAY, 1980.
*       MTR89 IS IDENTICAL TO THE MTR88 IN THAT ALL ENTRY POINTS TO
*       THE CURRENT ROUTINES REMAIN UNCHANGED AND ALL ROUTINES
*       REMAIN UNALTERED WITH THE FOLLOWING EXCEPTIONS:
*
*         (1). ALL CODE WHICH SUPPORTS THE CASSETTE IS REMOVED.
*              THIS INCLUDES THE LOAD ('L') AND DUMP ('D') COMMANDS
*              AS WELL AS ALL OF THE DEVICE DRIVERS.
*         (2). 'TYPE SPACES TO DETERMINE BAUD RATE' MESSAGE IS REMOVED.
*         (3). THE BOOTSTRAP FOR THE Z-47 IS INSTALLED.
*         (4). 15 SECONDS TIME OUT FOR Z-87, OR H-17 AND Z-47 IS INSERTED.
*         (5). <DELETE> KEY SERVES AS AN ABORT-BOOT KEY.
*         (6). ALLOWS BOOT FROM SELECT DEVICE AND UNIT.
*
*
*       MTR88 IS AN ADAPTATION OF PAM/8 ORIGINALLY WRITTEN FOR THE
*       HEATH H8 COMPUTER BY J. G. LETWIN IN 1976 AND MODIFIED BY
*       R. N. BORCHARDT IN 1979 FOR USE IN THE HEATH H88/H89
*       COMPUTERS.
*
*       MTR88 PROVIDES COMPATABILITY WITH PAM/8 SUCH THAT ALL ROUTINES
*       HAVE RETAINED PREVIOUSLY DESCRIBED ENTRY POINTS AND ENTRY AND
*       EXIT CONDITIONS.  ROUTINES WHICH ARE NOT APPLICABLE SUCH AS
*       THOSE PERTAINING TO THE FRONT PANEL DISPLAY HAVE BEEN DELETED.
*
*
*       COPYRIGHT  05/1976, WINTEK CORPORATION
*                           902 N. 9TH ST.
*                           LAFAYETTE, IND.
*
*       COPYRIGHT  01/1979, HEATH COMPANY
*                           BENTON HARBOR, MI.
*
*       COPYRIGHT  05/1980, ZENITH DATA SYSTEMS INC.
*                           ST. JOSEPH, MI.
```

```
000.001                  42  .RAM.   EQU     1
                         43
000.001                  44          IF      .RAM.
                         54          ENDIF



                         56  ***     MTR88 - H88/H89 MONITOR.
                         57  *
                         58  *       THIS PROGRAM RESIDES (IN ROM) IN THE LOW 2048 BYTES OF THE HEATH
                         59  *       H88/H89 COMPUTERS.



                         61  ***     INTERRUPTS.
                         62  *
                         63  *       MTR88 IS THE PRIMARY PROCESSOR FOR ALL INTERRUPTS.
                         64  *       THEY ARE PROCESSED AS FOLLOWS:
                         65  *
                         66  *       RST     USE
                         67  *
                         68  *       0       MASTER CLEAR. (NEVER USED FOR I/O OR RST)
                         69  *
                         70  *       1       CLOCK INTERRUPT. NORMALLY TAKEN BY MTR88,
                         71  *               SETTING BIT *U0.CLK* IN BYTE *.MFLAG* ALLOWS
                         72  *               USER PROCESSING (VIA A JUMP THROUGH *UIVEC*).
                         73  *               UPON ENTRY OF THE USER ROUTINE, THE STACK
                         74  *               CONTAINS:
                         75  *               (STACK+0)  = RETURN ADDRESS (TO MTR88)
                         76  *               (STACK+2)  = (STACKPTR+14)
                         77  *               (STACK+4)  = (AF)
                         78  *               (STACK+6)  = (BC)
                         79  *               (STACK+8)  = (DE)
                         80  *               (STACK+10) = (HL)
                         81  *               (STACK+12) = (PC)
                         82  *               THE USER'S ROUTINE SHOULD RETURN TO MTR88 VIA
                         83  *               A *RET* WITHOUT ENABLING INTERRUPTS.
                         84  *
                         85  *       2       SINGLE STEP INTERRUPTS RECEIVED WHEN IN
                         86  *               USER MODE CAUSES A JUMP THROUGH *UIVEC*+3.
                         87  *               STACK UPON USER ROUTINE ENTRY:
                         88  *               (STACK+0)  = (STACKPTR+12)
                         89  *               (STACK+2)  = (AF)
                         90  *               (STACK+4)  = (BC)
                         91  *               (STACK+6)  = (DE)
                         92  *               (STACK+8)  = (HL)
                         93  *               (STACK+10) = (PC)
                         94  *               THE USER'S ROUTINE SHOULD HANDLE IT'S OWN RETURN
                         95  *               FROM THE INTERRUPT.
                         96  *
                         97  *
                         98  *       THE FOLLOWING INTERRUPTS ARE VECTORED DIRECTLY THROUGH *UIVEC*.
                         99  *       THE USER ROUTINE MUST HAVE SETUP A JUMP IN *UIVEC* BEFORE ANY
                        100  *       OF THESE INTERRUPTS MAY OCCUR.
                        101  *
```

```
                    102  *       3       I/O 3, CAUSES A DIRECT JUMP THROUGH *UIVEC*+6
                    103  *
                    104  *       4       I/O 4, CAUSES A DIRECT JUMP THROUGH *UIVEC*+9
                    105  *
                    106  *       5       I/O 5, CAUSES A DIRECT JUMP THROUGH *UIVEC*+12
                    107  *
                    108  *       6       I/O 6, CAUSES A DIRECT JUMP THROUGH *UIVEC*+15
                    109  *
                    110  *       7       I/O 7, CAUSES A DIRECT JUMP THROUGH *UIVEC*+18

                    112  **      ASSEMBLY CONSTANTS

000,000             114          XTEXT   MTR88           DEFINE MTR88 OLD EQUATES
```

```
                        117X **     IO PORTS
                        118X
                        119X ***    ALL REFERENCES TO THE H8 FRONT PANEL PORTS ARE TRAPPED BY THE
                        120X *      Z80 NMI OF THE H88/H89.  OP.CTL WILL STILL PERFORM AS IN AN H8
                        121X *      IN RESPECT TO THE CLOCK AND SINGLE STEP CONTROL.  FOR MORE
                        122X *      INFORMATION SEE THE NMI ROUTINE.
                        123X
000.360                 124X IP.PAD EQU     360Q            PAD INPUT PORT
000.360                 125X OP.CTL EQU     360Q            CONTROL OUTPUT PORT
000.360                 126X OP.DIG EQU     360Q            DIGIT SELECT OUTPUT PORT
000.361                 127X OP.SEG EQU     361Q            SEGMENT SELECT OUTPUT PORT
                        128X
                        129X *      H88/H89 CONTROL PORT
000.362                 130X H88.CTL EQU    362Q            H88/H89 PORT FOR CLOCK AND SINGLE STEP
000.002                 131X H88B.CK EQU    00000010B       2MS CLOCK ENABLE/DISABLE
000.001                 132X H88B.SS EQU    00000001B       SINGLE STEP ENABLE/DISABLE
                        133X
000.362                 134X H88.SW EQU     362Q            8 POSITION DIP SWITCH
000.200                 135X H88S.AT EQU    10000000B       AUTO BOOT SWITCH
000.100                 136X H88S.BR EQU    01000000B       BAUD RATE SWITCH        **/RNC/**
000.040                 137X H88S.M EQU     00100000B       MEMORY TEST/NORMAL OPERATION SWITCH
000.020                 138X H88S.DV EQU    00010000B       = 0, BOOT FROM DEVICE AT 174-177Q
                        139X *                              = 1, BOOT FROM DEVICE AT 170-173Q
000.014                 140X H88S.0 EQU     00001100B       = 00, NO DEVICE INSTALLED AT 170-173Q
                        141X *                              = 01, DEVICE AT 170-173Q = Z47
000.003                 142X H88S.4 EQU     00000011B       = 00, DEVICE AT 174-177Q = H17
                        143X *                              = 01, DEVICE AT 174-177Q = Z47


                        145X **     CASSETTE PORTS
                        146X
000.371                 147X IP.TPC EQU     371Q            TAPE CONTROL IN
000.371                 148X OP.TPC EQU     371Q            TAPE CONTROL OUT
000.370                 149X IP.TPD EQU     370Q            TAPE DATA IN
000.370                 150X OP.TPD EQU     370Q            TAPE DATA OUT


                        152X **     ASCII CHARACTERS.
                        153X
000.026                 154X A.SYN  EQU     026Q            SYNC CHARACTER
000.002                 155X A.STX  EQU     002Q            STX CHARACTER
000.007                 156X A.BEL  EQU     007Q            BELL CHARACTER
000.010                 157X A.BKS  EQU     010Q            BACKSPACE CHARACTER
000.012                 158X A.LF   EQU     012Q            LINE FEED CHARACTER
000.015                 159X A.CR   EQU     015Q            CARRIAGE RETURN CHARACTER
000.033                 160X A.ESC  EQU     033Q            ESCAPE CHARACTER
000.177                 161X A.DEL  EQU     177Q            DELETE OR RUBOUT CHARACTER
```

```
                        163X **     FRONT PANEL HARDWARE CONTROL BITS.
                        164X
    000,020             165X CB.SSI EQU     00010000B       SINGLE STEP INTERRUPT
    000.040             166X CB.MTL EQU     00100000B       MONITOR LIGHT
    000,100             167X CB.CLI EQU     01000000B       CLOCK INTERRUPT ENABLE
    000.200             168X CB.SPK EQU     10000000B       SPEAKER ENABLE


                        170X **     DISPLAY MODE FLAGS (IN *DSPMOD*)
                        171X
    000.000             172X DM.MR  EQU     0               MEMORY READ
    000,001             173X DM.MW  EQU     1               MEMORY WRITE
    000.002             174X DM.RR  EQU     2               REGISTER READ
    000,003             175X DM.RW  EQU     3               REGISTER WRITE


                        177X **     MACHINE INSTRUCTIONS.
                        178X
    000,166             179X MI.HLT EQU     01110110B       HALT
    000.311             180X MI.RET EQU     11001001B       RETURN
    000,333             181X MI.IN  EQU     11011011B       INPUT
    000.323             182X MI.OUT EQU     11010011B       OUTPUT
    000,072             183X MI.LDA EQU     00111010B       LDA
    000.346             184X MI.ANI EQU     11100110B       ANI
    000,021             185X MI.LXID EQU    00010001B       LXI D
    000.303             186X MI.JMP EQU     11000011B       JMP
    000,335             187X MI.LDXA EQU    11011101B       LD IX,  (BYTE A)
    000.041             188X MI.LDXB EQU    00100001B       LD IX,  (BYTE B)
    000,375             189X MI.LDYA EQU    11111101B       LD IY,  (BYTE A)
    000.041             190X MI.LDYB EQU    00100001B       LD IY,  (BYTE B)
    000,010             191X MI.EXAF EQU    00001000B       EX AF,AF'
    000.335             192X MI.JIXA EQU    11011101B       JP (IX)  (BYTE A)
    000,351             193X MI.JIXB EQU    11101001B       JP (IX)  (BYTE B)
    000.375             194X MI.JIYA EQU    11111101B       JP (IY)  (BYTE A)
    000,351             195X MI.JIYB EQU    11101001B       JP (IY)  (BYTE B)


                        197X **     USER OPTION BITS.
                        198X *
                        199X *      THESE BITS ARE SET IN CELL .MFLAG.
                        200X
    000,200             201X UO.HLT EQU     10000000B       DISABLE HALT PROCESSING
    000.100             202X UO.NFR EQU     CB.CLI          NO REFRESH OF FRONT PANEL
    000,002             203X UO.DDU EQU     00000010B       DISABLE DISPLAY UPDATE
    000.001             204X UO.CLK EQU     00000001B       ALLOW PRIVATE INTERRUPT PROCESSING
    000.000             205         XTEXT   Z47DEF          DEFINE Z47 EQUATES
```

```
                        208X *
                        209X **     DISK INTERFACE CONSTANTS
                        210X *
    000.170             211X D.STA  EQU     170Q                    INTERFACE STATUS PORT
    000.171             212X D.DAT  EQU     D.STA+1                 INTERFACE DATA PORT
                        213X *
    000.001             214X S.ERR  EQU     00000001B               ERROR BIT
    000.040             215X S.DON  EQU     00100000B               DONE
    000.200             216X S.DTR  EQU     10000000B               DATA TRANSFER REQUEST
                        217X *
    000.002             218X W.RES  EQU     00000010B               RESET COMMAND


                        220X **     CONTROLLER STATUS REGISTER
                        221X *
    000.200             222X CS.UNR EQU     10000000B               UNIT NOT READY
    000.100             223X CS.WPD EQU     01000000B               WRITE PROTECTED DRIVE


                        225X **     AUXILLARY STATUS REGISTER
                        226X *
    000.100             227X AS.0DD EQU     01000000B               TRACK 0 DOUBLE DENSITY
    000.040             228X AS.1DD EQU     00100000B               TRACK 1 - 76 DOUBLE DENSITY
    000.020             229X AS.S1A EQU     00010000B               SIDE 1 AVAILABLE
    000.003             230X AS.SLW EQU     00000011B               SECTOR LENGTH MASK


                        232X **     DISK COMMANDS
                        233X *
    000.000             234X DC.BOOT EQU    0                       BOOT
    000.001             235X DC.RST EQU     1                       READ CONTROLLER STATUS
    000.002             236X DC.RAS EQU     2                       READ AUX. STATUS
    000.003             237X DC.LSC EQU     3                       LOAD SECTOR COUNT
    000.004             238X DC.RAD EQU     4                       READ ADDR. OF LAST SECTOR ACCESSED
    000.005             239X DC.REA EQU     5                       READ SECTORS
    000.006             240X DC.WRI EQU     6                       WRITE SECTORS
    000.007             241X DC.REAB EQU    7                       READ SECTORS BUFFERED
    000.010             242X DC.WRIB EQU    8                       WRITE SECTORS BUFFERED
    000.011             243X DC.WRD EQU     9                       WRITE SECTORS & DELETE
    000.012             244X DC.WRDB EQU    10                      WRITE SECTORS BUFFERED & DELETE
    000.013             245X DC.CPY EQU     11                      COPY
    000.014             246X DC.FRM0 EQU    12                      FORMAT IBM SD
    000.015             247X DC.FRM1 EQU    13                      FORMAT     SD
    000.016             248X DC.FRM2 EQU    14                      FORMAT IBM DD
    000.017             249X DC.FRM3 EQU    15                      FORMAT     DD
```

```
                        251X **       USEFUL FLAGS
                        252X *
000.000                 253X UNT.0    EQU     00000000B       UNIT 0
000.040                 254X UNT.1    EQU     00100000B       UNIT 1
000.100                 255X UNT.2    EQU     01000000B       UNIT 2
000.140                 256X UNT.3    EQU     01100000B       UNIT 3
                        257X *
001.000                 258X C.256    EQU     256             SECTOR SIZE = 256 BYTES
000.200                 259X C.128    EQU     128             SECTOR SIZE
000.000                 260           XTEXT   H17DEF          EQUATES FOR H17 BOOT ROM
```

```
                        263X **     H17 CONTROL INFORMATION.
                        264X
    000,177             265X DP.DC  EQU   07FH          DISK CONTROL PORT
                        266X
    000,001             267X DF.HD  EQU   00000001B     HOLE DETECT
    000.002             268X DF.TO  EQU   00000010B     TRACK 0 DETECT
    000,004             269X DF.WP  EQU   00000100B     WRITE PROTECT
    000.010             270X DF.SD  EQU   00001000B     SYNC DETECT
                        271X
    000.001             272X DF.WG  EQU   00000001B     WRITE GATE ENABLE
    000,002             273X DF.DS0 EQU   00000010B     DRIVE SELECT 0
    000.004             274X DF.DS1 EQU   00000100B     DRIVE SELECT 1
    000,010             275X DF.DS2 EQU   00001000B     DRIVE SELECT 2
    000.020             276X DF.MO  EQU   00010000B     MOTOR ON (BOTH DRIVES)
    000,040             277X DF.DI  EQU   00100000B     DIRECTION (0=OUT)
    000.100             278X DF.ST  EQU   01000000B     STEP COMMAND (ACTIVE HIGH)
    000,200             279X DF.WR  EQU   10000000B     WRITE ENABLE RAM
                        280X
                        281X
                        282X
                        283X **     DISK UART PORTS AND CONTROL FLAGS.
                        284X
    000,174             285X UP.DP  EQU   07CH          DATA PORT
    000.175             286X UP.FC  EQU   07DH          FILL CHARACTER
    000,175             287X UP.ST  EQU   07DH          STATUS FLAGS
    000.176             288X UP.SC  EQU   07EH          SYN CHARACTER (OUTPUT)
    000,176             289X UP.SR  EQU   07EH          SYNC RESET (INPUT)
                        290X
    000,001             291X UF.RDA EQU   00000001B     RECEIVE DATA AVAILABLE
    000.002             292X UF.ROR EQU   00000010B     RECEIVER OVERRUN
    000,004             293X UF.RPE EQU   00000100B     RECEIVER PARITY ERROR
    000.100             294X UF.FCT EQU   01000000B     FILL CHAR TRANSMITTED
    000,200             295X UF.TBM EQU   10000000B     TRANSMITTER BUFFER EMPTY
                        296X
                        297X
                        298X
                        299X **     CHARACTER DEFINITIONS.
                        300X
    000,375             301X C.DSYN EQU   0FDH          PREFIX SYNC CHARACTER
    000.000             302         XTEXT HOSEQU        HDOS EQUATES
```

```
                        305X **      HDOS SYSTEM EQUIVALENCES.
                        306X *
                        307X
    024.000             308X S.GRT   EQU    24000A          SYSTEM AREA FOR GRT0
    025.000             309X S.GRT1  EQU    25000A          SYSTEM AREA FOR GRT 1
    026.000             310X SECSCR  EQU    26000A          SYSTEM 512 BYTE SCRATCH AREA
    030.000             311X ROMBOOT EQU    30000A          ROM BOOT ENTRY
                        312X
    040.100             313X         ORG    40100A          FREE SPACE FROM PAM-8
                        314X
    040.100             315X         DS     8               JUMP TO SYSTEM EXIT
    040.110             316X D.CON   DS     16              DISK CONSTANTS
    040.130             317X SYDD    EQU    *               SYSTEM DISK ENTRY POINT
    040.130             318X D.VEC   DS     24*3            SYSTEM ROM ENTRY VECTORS
    040.240             319X D.RAM   DS     31              SYSTEM ROM WORK AREA
    040.277             320X S.VAL   DS     36              SYSTEM VALUES
    040.343             321X S.INT   DS     115             SYSTEM INTERNAL WORK AREAS
    041.126             322X         DS     16
    041.146             323X S.SOVR  DS     2               STACK OVERFLOW WARNING
    041.150             324X         DS     42200A-*        SYSTEM STACK
    001.032             325X STACKL  EQU    *-S.SOVR        STACK SIZE
                        326X
    042.200             327X STACK   EQU    *               LWA+1 SYSTEM STACK
    042.200             328X USERFWA EQU    *               USER FWA
    042.200             329          XTEXT  MISC            MISCELLANEOUS EQUATES FOR H17 BOOT ROM
```

```
                        332X ** MISCELLANEOUS EQUATES FROM H17 BOOT ROM.
                        333X *  REFER TO H17 BOOT ROM IF MORE INFROMATION DESIRED
                        334X
    036.235             335X WHD      EQU     36235A          WAIT FOR HOLE ROUTINE ENTRY POINT
    036.271             336X WNH      EQU     36271A          WAIT FOR NO HOLE ROUTINE ENTRY POINT
                        337X
    000.130             338X BOOTAL   EQU     130A            NUMBER OF RAM TO CLEAR
    037.132             339X BOOTA    EQU     37132A          RAM CLEAR START LOCATION
    030.252             340X $MOVE    EQU     30252A          MOVE DATA ROUTINE
    000.037             341X D.RAML   EQU     37Q
    031.212             342X $ZERO    EQU     31212A          ZERO RAM ROUTINE
    041.061             343X AIO.UNI  EQU     41061A          DISK UNIT NUMBER STORAGE
    040.037             344X .UIVEC   EQU     40037A          USER INTERRUPT VECTOR
    034.031             345X CLOCK17  EQU     34031A          Z17 TIMER INTERRUPT HANDLER LOCATION
    033.366             346X R.ABORT  EQU     33366A          RESET Z17 ROUTINE LOCATION
    034.077             347X R.READ   EQU     34077A          READ Z17 ROUTINE LOCATION
    040.206             348X D.SDP    EQU     40206A          SET DEVICE PARAMETER RAM LOCATION
    036.073             349X SDP3     EQU     36073A          SET DEVICE PARAMETER ENTRY
    034.027             350X EIXIT    EQU     34027A          EI/RET LOCATION
    000.012             351X ERPTCNT  EQU     12Q             ERROR COUNT
    040.264             352X D.OECNT  EQU     40264A
    042.200             353           XTEXT   U8251          DEFINE 8251 USART BITS
```

```
                        356X **       8251 USART BIT DEFINITIONS.
                        357X *
                        358X
                        359X **       PORT ADDRESSES
                        360X
    000.000             361X UDR      EQU     0               DATA REGISTER IS EVEN
    000.001             362X USR      EQU     1               STATUS REGISTER IS NEXT
                        363X
    000.372             364X SC.UART  EQU     3720            CONSOLE USART ADDRESS (IFF 8251)
                        365X
                        366X
                        367X **       MODE INSTRUCTION CONTROL BITS.
                        368X
    000.100             369X UMI.1B   EQU     01000000B       1 STOP BIT
    000.200             370X UMI.HB   EQU     10000000B       1 1/2 STOP BITS
    000.300             371X UMI.2B   EQU     11000000B       2 STOP BITS
    000.040             372X UMI.PE   EQU     00100000B       EVEN PARITY
    000.020             373X UMI.PA   EQU     00010000B       USE PARITY
    000.000             374X UMI.L5   EQU     00000000B       5 BIT CHARACTERS
    000.004             375X UMI.L6   EQU     00000100B       6 BIT CHARACTERS
    000.010             376X UMI.L7   EQU     00001000B       7 BIT CHARACTERS
    000.014             377X UMI.L8   EQU     00001100B       8 BIT CHARACTERS
    000.001             378X UMI.1X   EQU     00000001B       CLOCK X 1
    000.002             379X UMI.16X  EQU     00000010B       CLOCK X 16
    000.003             380X UMI.64X  EQU     00000011B       CLOCK X 64
                        381X
                        382X **       COMMAND INSTRUCTION BITS.
                        383X
    000.100             384X UCI.IR   EQU     01000000B       INTERNAL RESET
    000.040             385X UCI.RO   EQU     00100000B       READER-ON CONTROL FLAG
    000.020             386X UCI.ER   EQU     00010000B       ERROR RESET
    000.004             387X UCI.RE   EQU     00000100B       RECEIVE ENABLE
    000.002             388X UCI.IE   EQU     00000010B       ENABLE INTERRUPTS FLAG
    000.001             389X UCI.TE   EQU     00000001B       TRANSMIT ENABLE
                        390X
                        391X **       STATUS READ COMMAND BITS.
                        392X
    000.040             393X USR.FE   EQU     00100000B       FRAMING ERROR
    000.020             394X USR.OE   EQU     00010000B       OVERRUN ERROR
    000.010             395X USR.PE   EQU     00001000B       PARITY ERROR
    000.004             396X USR.TXE  EQU     00000100B       TRANSMITTER EMPTY
    000.002             397X USR.RXR  EQU     00000010B       RECEIVER READY
    000.001             398X USR.TXR  EQU     00000001B       TRANSMITTER READY
    042.200             399           XTEXT   U8250           DEFINE 8250 ACE BITS
```

```
                        402X **      8250 UART CONTROL AND BIT DEFINITIONS.
                        403X
    000.350             404X SC.ACE  EQU     350Q            SYSTEM CONSOLE PORT IF 8250 ACE
    000.156             405X AC.DLY  EQU     110             220 MIL. SEC. DELAY FOR 8250
                        406X
    000.000             407X UR.RBR  EQU     0               RECEIVER BUFFER REGISTER (READ ONLY)
                        408X
    000.000             409X UR.THR  EQU     0               TRANSMITTER HOLDING REGISTER (WRITE ONLY)
                        410X
    000.000             411X UR.DLL  EQU     0               DIVISOR LATCH (LEAST SIGNIFICANT)
                        412X
    000.001             413X UR.DLM  EQU     1               DIVISOR LATCH (MOST SIGNIFICANT)
                        414X
    000.001             415X UR.IER  EQU     1               INTERRUPT ENABLE REGISTER
    000.001             416X UC.EDA  EQU     00000001B        ENABLE RECEIVED DATA AVAILABLE INTERRUPT
    000.002             417X UC.TRE  EQU     00000010B        ENABLE TRANSMIT HOLD REGISTER EMPTY INTERRUPT
    000.004             418X UC.RSI  EQU     00000100B        ENABLE RECEIVE STATUS INTERRUPT
    000.010             419X UC.MSI  EQU     00001000B        ENABLE MODEM STATUS INTERRUPT
                        420X
    000.002             421X UR.IIR  EQU     2               INTERRUPT IDENTIFICATION REGISTER
    000.001             422X UC.IIP  EQU     00000001B        INVERTED INTERRUPT PENDING (0 MEANS PENDING)
    000.006             423X UC.IID  EQU     00000110B        INTERRUPT ID
                        424X
    000.003             425X UR.LCR  EQU     3               LINE CONTROL REGISTER
    000.000             426X UC.5BW  EQU     00000000B        5 BIT WORDS
    000.001             427X UC.6BW  EQU     00000001B        6 BIT WORDS
    000.002             428X UC.7BW  EQU     00000010B        7 BIT WORDS
    000.003             429X UC.8BW  EQU     00000011B        8 BIT WORDS
    000.004             430X UC.2SB  EQU     00000100B        TWO STOP BITS SELECTED
    000.010             431X UC.PEN  EQU     00001000B        PARITY COMPUTATION ENABLED
    000.020             432X UC.EPS  EQU     00010000B        EVEN PARITY SELECT
    000.040             433X UC.SKP  EQU     00100000B        STICK PARITY
    000.100             434X UC.SB   EQU     01000000B        SET BREAK
    000.200             435X UC.DLA  EQU     10000000B        DIVISOR LATCH ACCESS
                        436X
    000.004             437X UR.MCR  EQU     4               MODEM CONTROL REGISTER
    000.001             438X UC.DTR  EQU     00000001B        DATA TERMINAL READY
    000.002             439X UC.RTS  EQU     00000010B        REQUEST TO SEND
    000.004             440X UC.OU1  EQU     00000100B        OUT 1
    000.010             441X UC.OU2  EQU     00001000B        OUT 2
    000.020             442X UC.LOO  EQU     00010000B        LOOP
                        443X
    000.005             444X UR.LSR  EQU     5               LINE STATUS REGISTER
    000.001             445X UC.DR   EQU     00000001B        DATA READY
    000.002             446X UC.OR   EQU     00000010B        OVERRUN
    000.004             447X UC.PE   EQU     00000100B        PARITY ERROR
    000.010             448X UC.FE   EQU     00001000B        FRAMING ERROR
    000.020             449X UC.BI   EQU     00010000B        BREAK INTERRUPT
    000.040             450X UC.THE  EQU     00100000B        TRANSMITTER HOLDING REGISTER EMPTY
    000.100             451X UC.TSE  EQU     01000000B        TRANSMITTER SHIFT REGISTER EMPTY
                        452X
    000.006             453X UR.MSR  EQU     6               MODEM STATUS REGISTER
    000.001             454X UC.DCS  EQU     00000001B        DELTA CLEAR TO SEND
    000.002             455X UC.DDR  EQU     00000010B        DELTA DATA SET READY
    000.004             456X UC.TER  EQU     00000100B        TRAILING EDGE OF RING
    000.010             457X UC.DRL  EQU     00001000B        DELTA RECEIVE LINE SIGNAL DETECT
```

```
000.020                 458X UC.CTS  EQU     00010000B       CLEAR TO SEND
000.040                 459X UC.DSR  EQU     00100000B       DATA SET READY
000.100                 460X UC.RI   EQU     01000000B       RING INDICATOR
000.200                 461X UC.RLS  EQU     10000000B       RECEIVED LINE SIGNAL DETECT
```

```
                                464  ***     INTERRUPT VECTORS.
                                465  *
                                466


                                468  **      LEVEL 0 - RESET
                                469  *
                                470  *       THIS 'INTERRUPT' MAY NOT BE PROCESSED BY A USER PROGRAM.
                                471
    000.001                     472          IF      .RAM.
                                484          ELSE
    000.000                     485          ORG     00A
                                486          ENDIF
                                487
    000.000  303 000 004        488  INIT0   JMP     INIT0X          DO H88 EXTENSION OF INITIALIZATION
    000.003  041 012 040        489  INIT0.0 LXI     H,PRSRAM+PRSL-1 (HL) = RAM DESTINATION FOR CODE
    000.006  303 073 000        490          JMP     INIT            INITIALIZE
                                491
    000.001                     492          IF      .RAM.
                                493          ELSE
    377.073                     494          ERRPL   INIT-1000A      BYTE IN WORD 10A MUST BE 0
                                495          ENDIF
                                496


                                498  **      LEVEL 1 - CLOCK
                                499
    000.001                     500          IF      .RAM.
                                502          ELSE
    000.010                     503  INT1    EQU     10Q             INTERRUPT ENTRY POINT
                                504
    000.000                     505          ERRNZ   *-11Q           INTO TAKES UP ONE BYTE
                                506          ENDIF
                                507
    000.011  315 132 000        508          CALL    SAVALL          SAVE USER REGISTERS
    000.014  026 000            509          MVI     D,0
    000.016  303 201 000        510          JMP     CLOCK           PROCESS CLOCK INTERRUPT
    000.001                     511          IF      .RAM.
                                512          ELSE
    377.201                     513          ERRPL   CLOCK-1000A     EXTRA BYTE MUST BE 0
                                514          ENDIF


                                516  **      LEVEL 2 - SINGLE STEP
                                517  *
                                518  *       IF THIS INTERRUPT IS RECEIVED WHEN NOT IN MONITOR MODE,
                                519  *       THEN IT IS ASSUMED TO BE GENERATED BY A USER PROGRAM
                                520  *       (SINGLE STEPPING OR BREAKPOINTING). IN SUCH CASE, THE
                                521  *       USER PROGRAM IS ENTERED THROUGH (UIVEC+3
                                522
    000.001                     523          IF      .RAM.
                                525          ELSE
    000.020                     526  INT2    EQU     20A             LEVEL 2 ENTRY
```

```
                                527
000.000                         528             ERRNZ   *-21A           INT1 TAKES EXTRA BYTE
                                529             ENDIF
                                530
000.021 315 132 000             531             CALL    SAVALL          SAVE REGISTERS
000.024 032                     532             LDAX    D               (A) = (CTLFLG)
040.011                         533 .           SET     CTLFLG
000.025 303 244 001             534             JMP     STPRTN          STEP RETURN


                                536 ***     I/O INTERRUPT VECTORS.
                                537 *
                                538 *       INTERRUPTS 3 THROUGH 7 ARE AVAILABLE FOR GENERAL I/O USE.
                                539 *
                                540 *       THESE INTERRUPTS ARE NOT SUPPORTED BY MTR88, AND SHOULD
                                541 *       NEVER OCCUR UNLESS THE USER HAS SUPPLIED HANDLER ROUTINES
                                542 *       (THROUGH UIVEC)
                                543
000.001                         544             IF      .RAM.
                                545             ELSE
000.030                         546             ORG     30A
                                547             ENDIF
                                548
000.030 303 045 040             549 INT3    JMP     UIVEC+6         JUMP TO USER ROUTINE
                                550
000.033 064 064 064             551             DB      '44440'         HEATH PART NUMBER 444-40


                                553
000.001                         554             IF      .RAM.
                                555             ELSE
000.040                         556             ORG     40A
                                557             ENDIF
                                558
000.040 303 050 040             559 INT4    JMP     UIVEC+9         JUMP TO USER ROUTINE
                                560
000.043 044 122 116             561             DB      44Q,122Q,116Q,102Q,44Q  SUPPORT CODE


                                563
000.001                         564             IF      .RAM.
                                565             ELSE
000.050                         566             ORG     50A
                                567             ENDIF
                                568
000.050 303 053 040             569 INT5    JMP     UIVEC+12        JUMP TO USER ROUTINE
                                570
                                571
                                572 **      DLY - DELAY TIME INTERVAL.
                                573 *
                                574 *       ENTRY   (A) = MILLISECOND DELAY COUNT/2
                                575 *       EXIT    NONE
                                576 *       USES    A,F
```

```
                                577
                                578          IF      .RAM.
                                579          ELSE
000.000                         580          ERRNZ   *-53A
                                581          ENDIF
                                582
000.053  365                    583  DLY     PUSH    PSW             SAVE COUNT
000.054  257                    584          XRA     A               DONT SOUND HORN
000.055  303 143 002            585          JMP     HRN0            PROCESS AS HORN


                                587
                                588          IF      .RAM.
                                589          ELSE
000.060                         590          ORG     60A
                                591          ENDIF
                                592
000.060  303 056 040            593  INT6    JMP     UIVEC+15        JUMP TO USER ROUTINE
                                594
                                595
000.063  076 320                596  GO.     MVI     A,CB.SSI+CB.CLI+CB.SPK  OFF MONITOR MODE LIGHT
000.065  303 235 001            597          JMP     SST1            RETURN TO USER PROGRAM


                                599
                                600          IF      .RAM.
                                601          ELSE
000.070                         602          ORG     70A
                                603          ENDIF
                                604
000.070  303 061 040            605  INT7    JMP     UIVEC+18        JUMP TO USER ROUTINE
```

```
                        608  **      INIT - INITIALIZE SYSTEM
                        609  *
                        610  *       INIT IS CALLED WHENEVER A HARDWARE MASTER-CLEAR IS INITIATED.
                        611  *
                        612  *       SETUP MTR88 CONTROL CELLS IN RAM.
                        613  *       DECODE HOW MUCH MEMORY EXISTS, SETUP STACKPOINTER, AND
                        614  *       ENTER THE MONITOR LOOP.
                        615  *
                        616  *       ENTRY   FROM MASTER CLEAR
                        617  *       EXIT    INTO MTR88 MAIN LOOP
                        618
000.001                 619          IF      .RAM.
                        620          ELSE
000.000                 621          ERRNZ   *-73Q
                        622          ENDIF
                        623
000.073  032           624  INIT    LDAX    D               COPY *PRSROM* INTO RAM
000.074  167           625          MOV     M,A             MOVE BYTE
000.075  053           626          DCX     H               DECREMENT DESTINATION
000.076  034           627          INR     E               INCREMENT SOURCE
000.077  302 073 000   628          JNZ     INIT            IF NOT DONE
                        629
004.000                 630  SINCR   EQU     4000A           SEARCH INCREMENT
                        631
000.102  026 004       632          MVI     D,SINCR/256     (DE) = SEARCH INCREMENT
000.104  041 000 034   633          LXI     H,START-SINCR   (HL) = FIRST RAM - SEARCH INCREMENT
                        634
                        635  *       DETERMINE MEMORY LIMIT.
                        636
000.107  167           637  INIT1   MOV     M,A             RESTORE VALUE READ
000.110  031           638          DAD     D               INCREMENT TRIAL ADDRESS
000.111  176           639          MOV     A,M             (A) = CURRENT MEMORY VALUE
000.112  065           640          DCR     M               TRY TO CHANGE IT
000.113  276           641          CMP     M
000.114  302 107 000   642          JNE     INIT1           IF MEMORY CHANGED
                        643
000.117  053           644  INIT2   DCX     H
                        645
000.001                 646          IF      .RAM.
                        649          ELSE
000.120  371           650          SPHL                    SET STACKPOINTER = MEMORY LIMIT -1
                        651          ENDIF
                        652
000.121  345           653          PUSH    H               SET *PC* VALUE ON STACK
000.122  041 322 000   654          LXI     H,ERROR
000.125  345           655          PUSH    H               SET 'RETURN ADDRESS'
                        656
                        657  *       CONFIGURE LOAD/DUMP UART
                        658
000.126  076 116       659          MVI     A,UMI.1B+UMI.L8+UMI.16X
000.130  323 371       660          OUT     OP.TPC          SET 8 BIT, NO PARITY, 1 STOP, X16
```

```
                        663  **      SAVALL - SAVE ALL REGISTERS ON STACK.
                        664  *
                        665  *       SAVALL IS CALLED WHEN AN INTERRUPT IS ACCEPTED, IN ORDER TO
                        666  *       SAVE THE CONTENTS OF THE REGISTERS ON THE STACK.
                        667  *
                        668  *       ENTRY   CALLED DIRECTLY FROM INTERRUPT ROUTINE.
                        669  *       EXIT    ALL REGISTERS PUSHED ON STACK,
                        670  *               IF NOT YET IN MONITOR MODE, REGPTR = ADDRESS OF REGISTERS
                        671  *               ON STACK.
                        672  *               (DE) = ADDRESS OF CTLFLG
                        673
    000.001             674          IF      .RAM.
                        675          ELSE
    000.000             676          ERRNZ   *-132A
                        677          ENDIF
                        678
    000.132  343        679  SAVALL  XTHL                    SET H,L ON STACK TOP
    000.133  325        680          PUSH    D
    000.134  305        681          PUSH    B
    000.135  365        682          PUSH    PSW
    000.136  353        683          XCHG                    (D,E) = RETURN ADDRESS
    000.137  041 012 000 684          LXI     H,10
    000.142  071        685          DAD     SP              (H,L) = ADDRESS OF USERS SP
                        686
                        687  **      REPLACE THESE INSTRUCTIONS WITH A JUMP AROUND THE NMI VECTOR JUMP
                        688  *
                        689  *       PUSH    H               SET ON STACK AS 'REGISTER'
                        690  *       PUSH    D               SET RETURN ADDRESS
                        691  *       LXI     D,CTLFLG
                        692  *       LDAX    D               (A) = CTLFLG
                        693
    000.143  303 105 004 694          JMP     SAVALLX         GO TO SAVALL EXTENSION
                        695
    000.001             696          IF      .RAM.
                        697          ELSE
                        698  **      ENTRY POINT FOR THE Z80 NMI
                        699  *
                        700
                        701
    000.000             702          ERRNZ   *-66H           Z80 NMI ADDRESS
                        703          ENDIF
                        704
    000.146  303 116 004 705  NMIENT JMP     NMI
                        706
    000.001             707          IF      .RAM.
                        708          ELSE
    000.000             709          ERRNZ   SAVALLR-151A    DO NOT CHANGE ORGANIZATION
                        710          ENDIF
                        711
    000.151             712  SAVALLR EQU     *               SAVALL EXTENSION RETURN ADDRESS
                        713
    000.151  057        714          CMA
    000.152  346 060    715          ANI     CB.MTL+CB.SSI   SAVE REGISTER ADDR IF USER OR SINGLE-STEP
    000.154  310        716          RZ                      RETURN IF WAS INTERRUPT OF MONITOR LOOP
    000.155  041 002 000 717          LXI     H,2
    000.160  071        718          DAD     SP              (H,L) = ADDRESS OF 'STACKPTR' ON STACK
```

```
000.161  042 035 040   719           SHLD    REGPTR
000.164  311           720           RET


                       722  **       CUI - CHECK FOR USER INTERRUPT PROCESSING.
                       723  *
                       724  *        CUI IS CALLED TO SEE IF THE USER HAS SPECIFIED PROCESSING
                       725  *        FOR THE CLOCK INTERRUPT.
                       726
000.001                727            IF      .RAM.
                       728            ELSE
000.000                729            ERRNZ   *-165A
                       730            ENDIF
                       731
040.010                732  .         SET     .MFLAG          REFERENCE TO MFLAG
000.165  012           733  CUI1      LDAX    B               (A) = .MFLAG
000.000                734            ERRNZ   UO.CLK-1        CODE ASSUMED = 01
000.166  017           735            RRC
000.167  334 037 040   736            CC      UIVEC           IF SPECIFIED, TRANSFER TO USER
                       737
                       738  *        RETURN TO PROGRAM FROM INTERRUPT.
                       739
000.001                740            IF      .RAM.
                       741            ELSE
000.000                742            ERRNZ   *-172A
                       743            ENDIF
                       744
000.172  361           745  INTXIT    POP     PSW             REMOVE FAKE 'STACK REGISTER'
000.173  361           746            POP     PSW
000.174  301           747            POP     B
000.175  321           748            POP     D
000.176  341           749            POP     H
000.177  373           750            EI
000.200  311           751            RET
```

```
                                754  ***     CLOCK - PROCESS CLOCK INTERRUPT
                                755  *
                                756  *       CLOCK IS ENTERED WHENEVER A MILLISECOND CLOCK INTERRUPT IS
                                757  *       PROCESSED.
                                758  *
                                759  *       TICCNT IS INCREMENTED EVERY INTERRUPT.
                                760
    000.001                     761          IF      .RAM.
                                762          ELSE
    000.000                     763          ERRNZ   *-201A
                                764          ENDIF
                                765
    000.201  052 033 040        766  CLOCK   LHLD    TICCNT
    000.204  043                767          INX     H
    000.205  042 033 040        768          SHLD    TICCNT          INCREMENT TICCOUNT
                                769
    000.210  072 011 040        770          LDA     CTLFLG          CLEAR CLOCK INTERRUPT FLIP-FLOP
    000.213  323 360            771          OUT     OP.CTL
                                772
                                773  *       EXIT CLOCK INTERRUPT.
                                774
    000.215  001 011 040        775          LXI     B,CTLFLG
    000.220  012                776          LDAX    B               (A) = CTLFLG
    000.221  346 040            777          ANI     CB.MTL
    000.223  302 172 000        778          JNZ     INTXIT          IF IN MONITOR MODE
    000.226  013                779          DCX     B
    000.000                     780          ERRNZ   CTLFLG-.MFLAG-1
    000.227  012                781          LDAX    B               (A) = .MFLAG
    000.000                     782          ERRNZ   U0.HLT-200Q     ASSUME HIGH-ORDER
    000.230  027                783          RAL
    000.231  332 270 000        784          JC      CLK4            SKIP IT
                                785
                                786  *       NOT IN MONITOR MODE, CHECK FOR HALT
                                787
    000.234  076 012            788          MVI     A,10            (A) = INDEX OF *P* REG
    000.236  315 052 003        789          CALL    LRA.            LOCATE REGISTER ADDRESS
    000.241  136                790          MOV     E,M
    000.242  043                791          INX     H
    000.243  126                792          MOV     D,M             (D,E) = PC CONTENTS
    000.244  033                793          DCX     D
    000.245  032                794          LDAX    D
    000.246  376 166            795          CPI     MI.HLT          CHECK FOR HALT
    000.250  302 165 000        796          JNZ     CUI1
    000.253  076 007            797          MVI     A,A.BEL         DING BELL
    000.255  315 302 003        798          CALL    WCC
    000.260  076 110            799          MVI     A,'H'           'H' FOR HALT
    000.262  315 302 003        800          CALL    WCC
    000.265  303 322 000        801          JMP     ERROR
                                802
                                803  ***     JE      ERROR           IF HALT, BE IN MONITOR MODE
                                804
                                805  *       NONE OF THE ABOVE, SO ALLOW USER PROCESSING OF CLOCK INTERRUPT
                                806
    000.270                     807  CLK4    EQU     *
    000.270  303 165 000        808          JMP     CUI1            ALLOW USER PROCESSING OF CLOCK
```

```
                          811  **      THIS IS ONLY A PORTION OF THE DYNAMIC RAM TEST!!
                          812  *
                          813  *       WAIT BEFORE MAKING ANOTHER LOOP
                          814
    000.273  041 000 000  815  DYMEM6  LXI     H,0
    000.276  053          816  DYMEM7  DCX     H
    000.277  174          817          MOV     A,H
    000.300  265          818          ORA     L
    000.301  302 276 000  819          JNZ     DYMEM7          IF (B,C) NOT ZERO
                          820
    000.304  303 207 007  821          JMP     DYMEM4          TRY AGAIN BY INCREMENTING ONCE MORE
                          822
                          823  **      HAVE A FAILURE PRIOR TO REACHING END OF MEMORY!
                          824  *
    000.307  353          825  DYMEM9  XCHG
    000.310  041 047 001  826          LXI     H,MSG.ERR       DISPLAY ERROR MESSAGE
                          827
                          828  *       LD      IX,DY9.3        RETURN ADDRESS
    000.313  335 041      829          DB      MI.LDXA,MI.LDXB
    000.315  315 003      830          DW      DY9.3
                          831
    000.317  303 306 007  832          JMP     DYMSG
```

```
                                835  ***     ERROR - COMMAND ERROR.
                                836  *
                                837  *       ERROR IS CALLED AS A 'BAIL-OUT' ROUTINE.
                                838  *
                                839  *       IT RESETS THE OPERATIONAL MODE, AND RESTORES THE STACKPOINTER.
                                840  *
                                841  *       ENTRY   NONE
                                842  *       EXIT    TO MTR LOOP
                                843  *               CTLFLG SET
                                844  *               .MFLAG CLEARED
                                845  *       USES    ALL
                                846
    000.001                     847          IF      .RAM.
                                848          ELSE
    000.000                     849          ERRNZ   *-322A
                                850          ENDIF
                                851
    000.322                     852  ERROR   EQU     *
    000.322  041 010 040        853          LXI     H,.MFLAG
    000.325  176                854          MOV     A,M             (A) = .MFLAG
    000.326  346 275            855          ANI     377Q-UO.DDU-UO.NFR      RE-ENABLE DISPLAYS
    000.330  167                856          MOV     M,A             REPLACE
    000.331  043                857          INX     H
    000.332  066 360            858          MVI     M,CB.SSI+CB.MTL+CB.CLI+CB.SPK   RESTORE *CTLFLG*
    000.000                     859          ERRNZ   CTLFLG-.MFLAG-1
    000.334  373                860          EI
    000.335  052 035 040        861          LHLD    REGPTR
    000.340  371                862          SPHL                    RESTORE STACK POINTER TO EMPTY STATE
    000.341  315 136 002        863          CALL    ALARM           ALARM FOR 200 MS


                                865  **      MTR - MONITOR LOOP.
                                866  *
                                867
    000.001                     868          IF      .RAM.
                                869          ELSE
    000.000                     870          ERRNZ   *-344A
                                871          ENDIF
                                872
    000.344                     873  MTR     EQU     *
    000.344  373                874          EI
                                875
    000.345                     876  MTR1    EQU     *
    000.345  041 345 000        877          LXI     H,MTR1
    000.350  345                878          PUSH    H               SET 'MTR1' AS RETURN ADDRESS
    000.351  303 113 002        879          JMP     CKAUTO          CHECK AUTO BOOT, IF NOT CONTROL BACK TO NEXT
    000.354  315 100 006        880  MTR.15  CALL    TYPMSG          PRINT 'H:'
                                881
    000.357  315 262 003        882  MTR.2   CALL    RCC             READ A CONSOLE CHARACTER
    000.362  346 137            883          ANI     01011111B       MAKE SURE ITS UPPER CASE TO MATCH TABLE
    000.364  041 025 001        884          LXI     H,MTRA          LOOK UP CHARACTER IN *MTRA*
    000.367  006 004            885          MVI     B,MTRAL         (B) = LENGTH OF TABLE
    000.371  276                886  MTR.3   CMP     M               SEE IF CHARACTER FROM CONSOLE = TABLE ENTRY
    000.372  312 014 001        887          JZ      MTR.4           IF EQUAL
```

```
000.375  043                       INX     H               POINT TO NEXT TABLE ENTRY
000.376  043                       INX     H
000.377  043                       INX     H
001.000  005                       DCR     B               SEE IF PAST END OF TABLE
001.001  302 371 000               JNZ     MTR.3           IF NOT PAST

001.004  076 007                   MVI     A,A.BEL         ELSE, DING ERROR
001.006  315 302 003               CALL    WCC
001.011  303 357 000               JMP     MTR.2           TRY AGAIN

001.014  315 302 003       MTR.4   CALL    WCC             WRITE CHARACTER BACK TO CONSOLE
001.017  043                       INX     H               GET ROUTINE ADDRESS LSB
001.020  176                       MOV     A,M
001.021  043                       INX     H               GET MSB
001.022  146                       MOV     H,M
001.023  157                       MOV     L,A             (H,L) = ROUTINE ADDRESS
001.024  351                       PCHL                    GO TO ROUTINE



001.025                    MTRA    EQU     *               JUMP TABLE
000.001                    .       SET     */256           ALL ROUTINES MUST START IN THIS PAGE
001.025  107                       DB      'G'             GO TO USER ROUTINE
001.026  146 001                   DW      GO88

001.030  123                       DB      'S'             SUBSTITUTE MEMORY MODE
001.031  370 004                   DW      SUBM

001.033  120                       DB      'P'             PROGRAM COUNTER ALTER MODE
001.034  103 001                   DW      PCA

001.036  102                       DB      'B'             BOOT H-17 OR Z-47 DRIVE
001.037  256 004                   DW      BOOT

000.004                    MTRAL   EQU     *-MTRA/3        NUMBER OF TABLE ENTRYS          /JWT 790507/


                           **      BSMSG   - BOOT SECONDARY DEVICE MESSAGE

001.041  040 123 104       BSMSG   DB      ' SD',0         'SECONDARY DEVICE'


001.045  077 000           ERRMSG  DB      '?',0           ERROR MESSAGE
```

```
001.047                     931          ORG     1047A
                            932  **      MSG.ERR - ERROR MESSAGE FOR RAM TEST
                            933  *
                            934  *       'ERROR @ '
                            935
001.047  015 012 012        936  MSG.ERR DB      A.CR,A.LF,A.LF
001.052  105 122 122        937          DB      'ERROR @ '
001.062  000                938          DB      0
```

```
                                941  **      SAE - STORE ABUSS AND EXIT.
                                942  *
                                943  *       ENTRY   (HL) = ABUSS VALUE
                                944  *       EXIT    TO (RET)
                                945  *       USES    NONE
                                946
000.001                         947           IF      .RAM.
                                948           ELSE
000.000                         949           ERRNZ   *-1063A
                                950           ENDIF
                                951
001.063  042 024 040            952  SAE      SHLD    ABUSS
001.066  311                    953           RET


                                955  **      PIN     -       PORT IN
                                956  *
                                957  *       PIN  INPUTS A BYTE FROM DISK
                                958  *
                                959  *       ENTRY:  NONE
                                960  *
                                961  *       EXIT:   (A) = INPUT BYTE FROM Z47
                                962  *
                                963  *       USE:    AF
                                964
001.067                         965  PIN      EQU     *
001.067  315 170 006            966           CALL    IN.                     GET STATUS
001.072  346 200                967           ANI     S.DTR                   CHECK FOR DATA TERMINAL REQUEST
001.074  050 371                968           JR      Z,PIN                   IF READY, WAIT
001.076  315 156 006            969           CALL    IN1,                    INPUT A BYTE FROM PORT
001.101  311                    970           RET
```

```
001.103                    973          ORG     1103A
                           974  **      PCA - PROGRAM COUNTER ALTER
                           975  *
                           976  *       PCA INPUTS AND/OR DISPLAYS THE CURRENT USER PROGRAM VALUE AND ALLOWS
                           977  *       A NEW VALUE TO BE ENTERED OR RETAINS THE CURRENT VALUE IF
                           978  *       A CR IS TYPED
                           979  *
                           980  *       ENTRY   NONE
                           981  *       EXIT    NONE
                           982  *       USES    A,D,E,H,L,F
                           983
                           984
001.103  041 214 006       985  PCA     LXI     H,MSG.PC        COMPLETE PC MESSAGE
001.106  315 100 006       986          CALL    TYPMSG
001.111  076 012           987          MVI     A,10            GET LOCATION OF USER PC
001.113  315 052 003       988          CALL    LRA.
001.116  136               989          MOV     E,M             (D,E) = USER PC VALUE
001.117  043               990          INX     H
001.120  126               991          MOV     D,M
001.121  353               992          XCHG                    (H,L) = USER PC VALUE
                           993
001.122  315 150 005       994          CALL    IROC            INPUT NEXT CHARACTER
001.125  332 137 001       995          JC      PCA1            IF FIRST CHARACTER WAS OCTAL, INPUT NEW PC
                           996
001.130  315 313 005       997          CALL    TOA             ELSE, OUTPUT CURRENT VALUE
001.133  315 150 005       998          CALL    IROC            SEE IF USER WANTS TO CHANGE IT NOW
001.136  320               999          RNC                     IF NO CHANGE, EXIT
                          1000
                          1001  *       ENTER NEW USER PC VALUE
                          1002
001.137  353              1003  PCA1    XCHG                    (H,L) = ADDRESS OF USER PC VALUE
001.140  026 015          1004          MVI     D,A.CR          END BYTE WITH A RETURN
001.142  315 062 003      1005          CALL    IOA             INPUT NEW ADDRESS
001.145  311              1006          RET                     EXIT


                          1008  **      GO88 - GO TO USER ROUTINE FROM H88 MONITOR
                          1009  *
                          1010  *       GO88 WAITS FOR A CARRIAGE RETURN OR A NEW ADDRESS TERMINATED WITH
                          1011  *       A CARRIAGE RETURN.  IF NO ADDRESS IS ENTERED, GO88 TRANSFERS
                          1012  *       CONTROL TO THE ADDRESS SPECIFIED BY THE USER PC VALUE
                          1013
                          1014
001.146  041 165 006      1015  GO88    LXI     H,MSG.GO        COMPLETE GO MESSAGE
001.151  315 100 006      1016          CALL    TYPMSG
001.154  315 150 005      1017          CALL    IROC            INPUT A RETURN OR AN OCTAL CHARACTER
001.157  322 177 001      1018          JNC     GO88.1          IF RETURN, GO TO CURRENT USER PC
                          1019
001.162  365              1020          PUSH    PSW             ELSE SAVE OCTAL CHARACTER AND FLAGS
001.163  076 012          1021          MVI     A,10            GET ADDRESS OF USER PC
001.165  315 052 003      1022          CALL    LRA.
001.170  043              1023          INX     H               POINT TO MSB
001.171  361              1024          POP     PSW             GET FIRST CHARACTER BACK
001.172  026 015          1025          MVI     D,A.CR          END ADDRESS WITH A RETURN
```

```
001.174 315 062 003  1026          CALL    IOA             INPUT NEW GO ADDRESS
001.177 315 302 003  1027  GO88.1  CALL    WCC             ECHO RETURN
001.202 076 012      1028          MVI     A,A.LF          LINE FEED
001.204 315 302 003  1029          CALL    WCC
001.207 303 222 001  1030          JMP     GO              EXECUTE USER ROUTINE



                     1032  **      AUTOBO  - AUTO BOOT
                     1033  *
                     1034  *       ENTRY:  NONE
                     1035  *
                     1036  *       EXIT:   (SEE 'DEVICE' ROUTINE)
                     1037  *
                     1038  *       USE:    ALL
                     1039
001.212 257          1040  AUTOBO  XRA     A               SET TO PRIMARY FLAG
001.213 315 301 002  1041          CALL    DEVICE          CHECK DEVICE INFROMATION
001.216 303 336 001  1042          JMP     BOOTO           GOTO BOOT IT



001.222              1044          ORG     1222A
                     1045  **      GO - RETURN TO USER MODE
                     1046  *
                     1047  *       ENTRY   NONE
                     1048
000.001              1049          IF      .RAM.
                     1050          ELSE
000.000              1051          ERRNZ   *-1222A
                     1052          ENDIF
                     1053
001.222 303 063 000  1054  GO      JMP     GO.



                     1056  **      SSTEP - SINGLE STEP INSTRUCTION.
                     1057  *
                     1058  *       ENTRY   NONE
                     1059
000.001              1060          IF      .RAM.
                     1061          ELSE
000.000              1062          ERRNZ   *-1225A
                     1063          ENDIF
                     1064
001.225              1065  SSTEP   EQU     *               SINGLE STEP
001.225 363          1066          DI                      DISABLE INTERRUPTS UNTIL THE RIGHT TIME
001.226 072 011 040  1067          LDA     CTLFLG
001.231 356 020      1068          XRI     CB.SSI          CLEAR SINGLE STEP INHIBIT
001.233 323 360      1069          OUT     OP.CTL          PRIME SINGLE STEP INTERRUPT
001.235 062 011 040  1070  SST1    STA     CTLFLG          SET NEW FLAG VALUES
001.240 341          1071          POP     H               CLEAN STACK
001.241 303 172 000  1072          JMP     INTXIT          RETURN TO USER ROUTINE FOR STEP
```

```
                        1074  **      STPRTN - SINGLE STEP RETURN
                        1075
  000.001               1076          IF      .RAM.
                        1077          ELSE
  000.000               1078          ERRNZ   *-1244A
                        1079          ENDIF
                        1080
  001.244               1081  STPRTN  EQU     *
  001.244  366 020      1082          ORI     CB.SSI          DISABLE SINGLE STEP INTERRUPTION
  001.246  323 360      1083          OUT     OP.CTL          TURN OFF SINGLE STEP ENABLE
  040.011               1084          SET     CTLFLG
  001.250  022          1085          STAX    D
  001.251  346 040      1086          ANI     CB.MTL          SEE IF IN MONITOR MODE
  001.253  302 344 000  1087          JNZ     MTR
  001.256  303 042 040  1088          JMP     UIVEC+3         TRANSFER TO USER'S ROUTINE
```

```
                        1091  **      NBOOT   -       NORMAL BOOT
                        1092  *
                        1093  *       NBOOT IS ENTERED WHEN USER TYPE 'BOOT' COMMAND FROM MONITOR,
                        1094  *       IT WILL ACCEPT THE BOOT DEVICE AS WELL AS THE UNIT NUMBER FROM
                        1095  *       CONSOLE AND GO TO THE BOOT CODE.
                        1096  *
                        1097  *       ENTRY:  NONE
                        1098  *
                        1099  *       EXIT:   (AIO,UNI) = UNIT NUMBER TO BOOT
                        1100  *               (PRIM)  = PORT ADDRESS OF THE BOOT DEVICE
                        1101  *               (TMFG)  = DEVICE TYPE, =1 IS Z47; =0 IS H17
                        1102  *
                        1103  *       USED:   ALL
                        1104
001.261  257            1105  NBOOT   XRA     A                       SET Z FLAG TO PRIMARY DEVICE
001.262  315 301 002    1106  NBOOTO  CALL    DEVICE                  READ SWITCH TO DETERMINE BOOT DEVICE
001.265  315 262 003    1107  START1  CALL    RCC                     INPUT FROM KB
001.270  376 015        1108          CPI     A,CR                    IF INPUT IS CR
001.272  050 042        1109          JR      Z,BOOT0                     THEN TAKE IT AS DRIVE 0
001.274  376 060        1110          CPI     '0'                     CHECK INPUT IS WITHIN DRIVE 0 - (B)
001.276  070 007        1111          JR      C,WRONG                 IF LESS THEN 0, WRONG INPUT
001.300  270            1112          CMP     B
001.301  070 036        1113          JR      C,BOOT5                   IF WITHIN THE RANGE, BOOT IT!
001.303  010            1114          DB      MI.EXAF                 SAVE INPUT, CHECK PRIM OR SEC?
001.304  050 010        1115          JR      Z,NB7                   IF PRIMARY, CHECK 'S'
001.306  010            1116          DB      MI.EXAF                 RESTORE (Z) FLAG
001.307                  1117  WRONG   EQU     *
001.307  076 007        1118          MVI     A,A.BEL                 NOT THE CASES, BEEP!
001.311  315 302 003    1119          CALL    WCC
001.314  030 347        1120          JR      START1                  AND TRY AGAIN
                        1121
001.316  010            1122  NB7     DB      MI.EXAF                 RESTORE INPUT & PRIM, SEC FLAG
001.317  346 137        1123          ANI     01011111B               MASK TO UPPER CASE LETTER
001.321  376 123        1124          CPI     'S'                     CHECK THE USER LIKE TO BOOT FROM
001.323  040 362        1125          JR      NZ,WRONG                BOOT SECONDARY DEVICE
                        1126
                        1127  *       USER WISHES TO BOOT FROM SECONDARY DEVICE
                        1128
001.325                 1129  BSEC    EQU     *
001.325  041 041 001    1130          LXI     H,BSMSG                 PRINT BOOT SECONDARY MESSAGE
001.330  315 100 006    1131          CALL    TYPMSG
001.333  074            1132          INR     A                       SET (Z)=0 FOR SECONDARY DEVICE
001.334  030 324        1133          JR      NBOOTO
                        1134
                        1135  *  SAVE THE AIO.UNI, CHECK IF THERE IS THE BOOT DEVICE AND GO!
                        1136
001.336  257            1137  BOOT0   XRA     A                       TAKE CR OR AUTO BOOT AS DRIVE 0
001.337  030 012        1138          JR      BOOT6
                        1139
001.341  315 302 003    1140  BOOT5   CALL    WCC                     PRINT UNIT NUMBER
001.344  326 060        1141          SUI     '0'                     MAKE IT BINARY
001.346  107            1142          MOV     B,A                     SAVE THE UNIT #
001.347  315 003 006    1143          CALL    WCR                     WAIT FOR A CR
001.352  170            1144          MOV     A,B                     GET UNIT NUMBER BACK
001.353  062 061 041    1145  BOOT6   STA     AIO.UNI                 STORE THE UNIT #
001.356  174            1146          MOV     A,H                     CHECK IF NO DEVICE AT ADDR. PORT
```

```
001.357  247          1147          ANA     A
001.360  312 171 002  1148          JZ      NODEV                   NO DEVICE
001.363  351          1149          PCHL                            JMP TO THE EXECUTION ROUTINE
```

```
                        1152  **      Z47     -       BOOT FROM Z47 DISK DRIVE
                        1153  *
                        1154  *       Z47 WILL LOAD DATA FROM DISK TRACK 0 SECTOR 1 AND 2 TO
                        1155  *       USER FIRST AVALIABLE RAM LOCATION. IF THE BOOT IS SUCCED,
                        1156  *       CONTROL PASS TO THAT LOCATION.
                        1157  *
                        1158  *       ENTRY:  (AIO.UNI) = UNIT NUMBER TO BOOT
                        1159  *
                        1160  *       EXIT:   NONE
                        1161  *
                        1162  *       USE:    ALL
                        1163
001,364                 1164  Z47     EQU     *
                        1165  *       LD      (STK),SP                SAVE STACK POINTER FOR RE-BOOT
001.364 355 163         1166          DB      355Q,163Q
001.366 124 041         1167          DW      STK
                        1168
001.370                 1169  Z47A    EQU     *
001.370 373             1170          EI                              LET THE TIMER FLY
001.371 072 061 041     1171          LDA     AIO.UNI                 GET UNIT NUMBER
001.374 007             1172          RLC                             SET TO SIDE/UNIT/SECTOR FORMAT
001.375 007             1173          RLC
001.376 007             1174          RLC
001.377 007             1175          RLC
002,000 007             1176          RLC
002.001 074             1177          INR     A                       SET TO SECTOR 1
002,002 117             1178          MOV     C,A                     SAVE SIDE/UNIT/SECTOR (SIDE=0)
002.003 076 002         1179  RESET   MVI     A,W.RES                 RESET Z47
002.005 315 063 006     1180          CALL    OUT.
                        1181
                        1182  * DETERMINE THE DISK IS SINGLE OR DOUBLE DENSITY
                        1183
002.010 076 002         1184          MVI     A,DC,RAS                SEND READ AUX. STATUS COMMAND
002.012 315 027 006     1185          CALL    COM
002.015 171             1186          MOV     A,C                     GET SIDE/UNIT/SECTOR
002.016 315 023 006     1187          CALL    DAT                     SEND SECOND COMMAND BYTE
002.021 315 067 001     1188          CALL    PIN                     GET AUX. STATUS
002.024 346 100         1189          ANI     AS.ODD                  CHECK IT IS SINGLE OR DOUBLE DENSITY
002.026 007             1190          RLC
002.027 356 200         1191          XRI     10000000B               REVERSE THEN 7TH BIT, MAKE THE SECTOR
002.031 107             1192          MOV     B,A                     # TO 128 OR 256(B=0) BYTES
                        1193
                        1194  *       READ BOOT CODE FROM Z47
                        1195
002.032 041 200 042     1196          LXI     H,USERFWA               BOOT DESTINATION
002.035 305             1197          PUSH    B                       SAVE SECTOR SIZE & SIDE/UNIT/SECTOR
002.036 315 121 006     1198          CALL    RDBLCK                  READ A SECTOR FROM DISK
002.041 301             1199          POP     B                       GET SECTOR SIZE & SUS BACK
002.042 014             1200          INR     C                       SET TO NEXT SECTOR
002.043 315 121 006     1201          CALL    RDBLCK                  READ ANOTHER SECTOR
                        1202
                        1203  *       CHECK ANY ERROR DURING BOOT
                        1204
002.046 315 170 006     1205          CALL    IN.                     GET INTERFACE STATUS
002.051 346 001         1206          ANI     S.ERR                   IS THERE ANY ERROR WHEN BOOT
002.053 040 114         1207          JR      NZ,NODEV                     THEN ABORT
```

```
002.055  062 010 040  1208          STA     .MFLAG                  STOP TIMER
002.060  303 200 042  1209          JMP     USERFWA


                      1211  **      RETRY   -       RE-BOOT Z47
                      1212  *
                      1213  *       RETRY IS ENTERED WHEN 3.5 SECONDS TIME OUT & BOOT Z47
                      1214  *       STILL NOT SUCCEED. IT RESTORE STACK & JUMP TO BOOT Z47 ROUTINE
                      1215  *
                      1216  *       ENTRY:  NONE
                      1217  *
                      1218  *       EXIT:   (HL) = (SP)
                      1219  *
                      1220  *       USE:    HL, SP
                      1221
002.063  052 124 041  1222  RETRY   LHLD    STK                     GET OLD STACK ADDRESS
002.066  371          1223          SPHL                            SET TO STACK POINTER
002.067  030 277      1224          JR      Z47A                    RE-BOOT
```

```
                                1227  **      R,SDP   - SET DEVICE PARAMETER, ALLOW TO SET DRIVE 0, 1, AND 2,
                                1228  *       (MORE INFORMATION CAN BE FOUND IN H17 ROM CODE 36062A)
                                1229
    002.071                     1230  R.SDP   EQU     *
    002.071  076 012            1231          MVI     A,ERPTCNT
    002.073  062 264 040        1232          STA     D.OECNT                 SET MAX ERROR COUNT FOR OPERATION
    002.076  072 061 041        1233          LDA     AIO.UNI                 LOAD DRIVE NUMBER
    002.101  365                1234          PUSH    PSW                     SAVE IT
    002.102  376 002            1235          CPI     2                       IS IT DRIVE 2?
    002.104  070 002            1236          JR      C,R.SDP1                IF NOT JMP TO H17 ROM ROUTINE
    002.106  076 003            1237          MVI     A,3
    002.110  303 073 036        1238  R.SDP1  JMP     SDP3


                                1240  **      CKAUTO  -       CHECK IF IT IS AUTO BOOT
                                1241  *
                                1242  *       CKAUTO IS ENTERED FROM MONITOR LOOP. IT WILL CHECK IF AUTO BOOT
                                1243  *       CONDITION IS TRUE.IF NOT, BACK TO MONITOR LOOP
                                1244  *               IF AUTO BOOT, JUMP TO BOOT DEVICE ROUTINE
                                1245  *
                                1246  *       ENTRY:  NONE
                                1247  *
                                1248  *       EXIT:   NONE
                                1249  *
                                1250  *       USE:    ALL
                                1251
    002.113                     1252  CKAUTO  EQU     *
    002.113  333 362            1253          IN      H88.SW          GET SWITCH DATA
    002.115  346 200            1254          ANI     H88S.AT         CHECK AUTO BOOT SWITCH BIT SET
    002.117  050 007            1255          JR.     Z,CHAT2         NOT SET
    002.121  041 123 041        1256          LXI     H,AUTOB         SET AUTO BOOT FLAG ADDR.
    002.124  276                1257          CMP     M               CHECK AUTO BOOT BEFORE?
    002.125  302 243 004        1258          JNZ     ATB             YES, AUTO BOOT
    002.130  041 111 006        1259  CHAT2   LXI     H,MSG.PR        LOAD 'H:' ADDR.
    002.133  303 354 000        1260          JMP     MTR,15          BACK TO MONITOR LOOP
```

```
002.136                 1263            ORG     2136A
                        1264  **        HORN - MAKE NOISE.
                        1265  *
                        1266  *         ENTRY   (A) = (MILLISECOND COUNT)/2
                        1267  *         EXIT    NONE
                        1268  *         USES    A,F
                        1269
000.001                 1270            IF      .RAM.
                        1271            ELSE
000.000                 1272            ERRNZ   *-2136A
                        1273            ENDIF
                        1274
002.136                 1275  ALARM     EQU     *
002.136  030 026        1276            JR      ALARMB          BRANCH TO A JUMP TO NOISE TO DING BELL
                        1277
000.001                 1278            IF      .RAM.
                        1279            ELSE
000.000                 1280            ERRNZ   *-2140A
                        1281            ENDIF
                        1282
002.140  365            1283  HORN      PUSH    PSW
002.141  076 200        1284            MVI     A,CB.SPK        TURN ON SPEAKER
                        1285
002.143  343            1286  HRN0      XTHL                    SAVE (HL), (H)  = COUNT
002.144  325            1287            PUSH    D               SAVE (DE)
002.145  353            1288            XCHG                    (D) = LOOP COUNT
002.146  041 011 040     1289            LXI     H,CTLFLG
002.151  256            1290            XRA     M
002.152  136            1291            MOV     E,M             (E) = OLD CTLFLG VALUE
002.153  167            1292            MOV     M,A             TURN ON HORN
002.154  056 033        1293            MVI     L,#TICCNT
                        1294
002.156  172            1295            MOV     A,D             (A) = CYCLE COUNT
002.157  206            1296            ADD     M
002.160  276            1297  HRN2      CMP     M               WAIT REQUIRED TICCOUNTS
002.161  040 375        1298            JR      NZ,HRN2
                        1299
002.163  303 045 006     1300            JMP     HRNX            JUMP TO AN EXTENSION OF HORN SO ROOM
                        1301  *                                       CAN BE MADE FOR A JUMP TO NIOSE
                        1302
                        1303
002.166  303 053 006     1304  ALARMB    JMP     NOISE           SEND A BELL TO THE CONSOLE
```

```
                        1307  **      NODEV   - NO DEVICE AT THE UNIT USER INDICATE
                        1308  *
                        1309  *       NODEV IS ENTERED WHEN:  1. 15 SECONDS TIME OUT
                        1310  *                               OR 2. NO DEVICE IS INDICATED ON SWITCH
                        1311  *                               OR 3. USER HIT <DELETE> TO ABORT BOOT
                        1312  *                               OR 4. BOOT ERROR
                        1313  *       IT WILL EXIT TO 'ERROR' ROUTINE AND MONITOR LOOP
                        1314  *
                        1315  *       ENTRY:  NONE
                        1316  *
                        1317  *       EXIT:   (A) = 0
                        1318  *
                        1319  *       USE:    AF, HL
                        1320
002.171                 1321  NODEV   EQU     *
002.171  041 045 001    1322          LXI     H,ERRMSG        PRINT ERROR MESSAGE
002.174  315 100 006    1323          CALL    TYPMSG
002.177  062 010 040    1324          STA     .MFLAG          STOP TIMER
002.202  323 177        1325          OUT     DP.DC           OFF DISK
002.204  303 322 000    1326          JMP     ERROR           BACK TO MONITOR LOOP
```

```
                        1329  **      H17     -   BOOT FROM H17 DISK SYSTEM
                        1330  *                   (THIS IS THE MODIFICATION OF THE H17 BOOT ROUTINE,
                        1331  *                    MORE INFORMATION CAN BE FOUND ON H17 BOOT ROM 30000A)
                        1332  *
                        1333  *       ENTRY:  (AIO.UNI) = THE UNIT TO BOOT
                        1334  *
                        1335  *       EXIT:   NONE
                        1336  *
                        1337  *       USE:    ALL
                        1338
002.207                 1339  H17     EQU     *
002.207  001 130 000    1340          LXI     B,BOOTAL        SET THE COUNT TO MOVE IN CONSTANTS AND VECTORS
002.212  021 132 037    1341          LXI     D,BOOTA         SET THE SOURCE ADDRESS
002.215  041 110 040    1342          LXI     H,D.CON         SET THE DESTINATION ADDRESS
002.220  315 252 030    1343          CALL    $MOVE           MOVE IT
                        1344
                        1345  **      SET ADDRESS FOR 'SET DEVICE PARAMETER' ROUTINE
                        1346  *       TO HANDLE DISK DRIVE 0, 1, AND 2.
                        1347
002.223  041 071 002    1348          LXI     H,R.SDP         SET THIS ROM ROUTINE ADDRESS
002.226  042 206 040    1349          SHLD    D,SDP           SET INTO RAM JUMP VECTOR
002.231  373            1350          EI                      RESTORE INTERRUPT
                        1351
                        1352  *       WAIT TILL USER INSERT THE DISK AND CLOSE THE DOOR
                        1353  *       (TIMER INTERRUPT IS AFFECTED NOW)
                        1354
002.232  006 012        1355          MVI     B,10            LOOK FOR SOME HOLE AND NO HOLE
002.234  315 071 002    1356          CALL    R.SDP           SELECT UNIT & MOTOR ON
002.237  315 271 036    1357  H17A    CALL    WNH             WAIT FOR NO HOLE
002.242  315 235 036    1358          CALL    WHD             WAIT FOR HOLE
002.245  020 370        1359          DJNZ    H17A
                        1360
                        1361  *       READ BOOT CODE
                        1362
002.247  315 366 033    1363          CALL    R,ABORT         RESET DISK DRIVE
002.252  021 200 042    1364          LXI     D,USERFWA       SET THE LOAD LOCATION
002.255  001 000 011    1365          LXI     B,9*256         LOAD 9 SECTORS
002.260  041 000 000    1366          LXI     H,0             LOAD FROM TRACK 0 SECTOR 1
002.263  315 077 034    1367          CALL    R,READ          READ DISK BOOT CODE
002.266  070 301        1368          JR      C,NODEV           ERROR ON BOOT, BACK TO 'H:'
                        1369
                        1370  **      SETUP CLOCK INTERRUPT  FOR H17 ONLY
                        1371
002.270  041 031 034    1372          LXI     H,CLOCK17       LOAD CLOCK ROUTINE ADDRESS
002.273  042 040 040    1373          SHLD    .UIVEC+1        SET IT INTO VECTOR LOCATION
002.276  303 200 042    1374          JMP     USERFWA         GOTO BOOT CODE
```

```
MTR89 - H89 MONITOR  #09.01.00.                                  Zenith Data Systems UNIX H8/H89 Cross Assembler  PA
GE   37
DETERMINE BOOT DEVICE                                                    15:27:38  28-MAY-80


                         1377  ***     DEVICE  -       DETERMINE BOOT WHICH DEVICE AT WHICH PORT
                         1378  *
                         1379  *       ENTRY:  Z FLAG  ( Z=1 FOR PRIMARY, Z=0 FOR SECONDARY)
                         1380  *
                         1381  *       EXIT:   HL = DEVICE BOOT EXECUTION ADDRESS
                         1382  *                    IF H=0 THEN NO DEVICE THERE
                         1383  *                    (I.E. THE EXEC. ADDR. MUST RESIDENT > 1000A)
                         1384  *               REG B = PRIMARY MAXI. DRIVE NUMBER
                         1385  *                    IF Z47, #='4'; IF H17, #='3'
                         1386  *               (PRIM) = PRIMARY DEVICE PORT ADDRESS
                         1387  *                    IF Z47 THEN THE PORT IS EITHER 170Q OR 174Q
                         1388  *                    IF H17 THEN DON'T CARE (H17 BOOT ROM TAKE CARE IT)
                         1389  *               (TMFG) = 1 IF BOOT FROM Z47, = 0 IF FROM H17
                         1390  *
                         1391  *       USE:    ALL
                         1392
    002.301              1393  DEVICE  EQU     *
    002.301  010        1394          DB      MI.EXAF         SAVE Z FLAG
                         1395
                         1396  *       INITIAL VARIABLES
                         1397
    002.302  363        1398          DI                      NO INTERRUPT
    002.303  041 240 040 1399          LXI     H,D.RAM         CLEAR H17 WORK RAM AREA
    002.306  006 037    1400          MVI     B,D.RAML        LENGTH TO CLEAR
    002.310  315 212 031 1401          CALL    $ZERO
    002.313  323 177    1402          OUT     DP.DC           OFF DISK
    002.315  062 033 040 1403          STA     TICCNT          0 TIMER COUNTER
    002.320  062 122 041 1404          STA     MYCNT           0.5 SECOND TIMER = 0
                         1405
    002.323  074        1406          INR     A               (A)=1
    002.324  062 121 041 1407          STA     TMFG            SET TIMER TO Z47 FLAG
    000.000              1408          ERRNZ   UO.CLK-1        TIMER INTERRPT MUST = 1
    002.327  062 010 040 1409          STA     .MFLAG          ALLOW TIMER INTERRUPT
    002.332  041 037 040 1410          LXI     H,.UIVEC        SET ALL VECTOR TO EI/RET PROCESS
    002.335  066 303    1411  BOOT2   MVI     M,MI.JMP
    002.337  043        1412          INX     H
    002.340  066 027    1413          MVI     M,#EIXIT        STORE LS BYTE
    002.342  043        1414          INX     H
    002.343  066 034    1415          MVI     M,EIXIT/256     STORE MS BYTE
    002.345  043        1416          INX     H
    002.346  207        1417          ADD     A
    002.347  362 335 002 1418          JP      BOOT2
                         1419
    002.352  041 302 004 1420          LXI     H,TMOUT         SET TIMER INTERRUPT VECTOR
    002.355  042 040 040 1421          SHLD    .UIVEC+1
                         1422
    002.360  076 170    1423          MVI     A,D.STA         ASSUME ALL DEVICE ARE Z47 & BOOT AT 170Q
    002.362  062 120 041 1424          STA     PRIM            SINCE H17 BOOT ROM WILL TAKE CARE OF ITS MATTER
    002.365  041 364 001 1425          LXI     H,Z47           SET Z47 BOOT ADDR.
    002.370  006 064    1426          MVI     B,'4'           SET MAX. UNIT TO 4
                         1427
                         1428  *       DETERMINE BOOT DEVICE AND ITS INFORMATION
                         1429
    002.372  333 362    1430          IN      H88.SW          READ SWITCH DATA
    002.374  365        1431          PUSH    PSW             SAVE IN STACK
    002.375  346 020    1432          ANI     H88S.DV         CHECK PRIMARY DEVICE ADDRESS
```

```
002.377  010           1433           DB      MI.EXAF         SAVE Z FLAG & GET Z' FOR PRIM. SEC. FLAG
003.000  040 005       1434           JR      NZ,SECOND       IT SECONDARY
003.002  010           1435           DB      MI.EXAF
003.003  040 033       1436           JR      NZ,B170
003.005  030 003       1437           JR      B174
003.007  010           1438  SECOND   DB      MI.EXAF
003.010  050 026       1439           JR      Z,B170          BOOT PRIMARY AT 170Q
003.012  076 174       1440  B174     MVI     A,UP.DP         PRIMARY DEVICE IS AT 174Q
003.014  062 120 041   1441           STA     PRIM
003.017  361           1442           POP     PSW             GET SWITCH DATA BACK
003.020  346 003       1443           ANI     H88S.4          CHECK THIS IS Z47 OR H17
003.022  050 004       1444           JR      Z,BH17          IT H17
003.024  075           1445           DCR     A
003.025  310           1446  DEV2     RZ                      IT IS Z47
003.026  045           1447           DCR     H               NO DEVICE THERE, Z47 LOCATION MUST ON 1***A
003.027  311           1448           RET
000.000                1449           ERRNZ   Z47/256-1
                       1450
                       1451  *        PRIMARY DEVICE IS H17
                       1452
003.030  041 207 002   1453  BH17     LXI     H,H17           SET TO H17 EXECUTION LOACTION
003.033  005           1454           DCR     B               SET TO MAX 3 DRIVE
003.034  062 121 041   1455           STA     TMFG            SET TIMER INTERRUPT = 0 FOR H17
003.037  311           1456           RET
                       1457
                       1458  **       PRIMARY DEVICE IS AT PORT 170Q
                       1459
003.040                1460  B170     EQU     *
003.040  361           1461           POP     PSW             GET SWITCH DATA
003.041  346 014       1462           ANI     H88S.0          CHECK ANY DEVICE IN 170Q
003.043  376 004       1463           CPI     00000100B       CHECK IF IT IS Z47
003.045  030 356       1464           JR      DEV2
```

```
003.047                 1467            ORG     3047A
                        1468  **        LRA - LOCATE REGISTER ADDRESS.
                        1469  *
                        1470  *         ENTRY   NONE.
                        1471  *         EXIT    (A) = REGISTER INDEX
                        1472  *                 (H,L) = STORAGE ADDRESS
                        1473  *                 (D,E) = (0,A)
                        1474  *         USES    A,D,E,H,L,F
                        1475
                        1476
000.001                 1477            IF      .RAM.
                        1478            ELSE
000.000                 1479            ERRNZ   *-3047A
                        1480            ENDIF
                        1481
003.047  072 005 040   1482  LRA       LDA     REGI
003.052  137           1483  LRA.      MOV     E,A
003.053  026 000       1484            MVI     D,0
003.055  052 035 040   1485            LHLD    REGPTR
003.060  031           1486            DAD     D               (DE) = (REGPTR)+(REGI)
003.061  311           1487            RET


                        1489  **        IOA - INPUT OCTAL ADDRESS.
                        1490  *
                        1491  *         ENTRY   (H,L) = ADDRESS OF RECEPTION DOUBLE BYTE.
                        1492  *                 (D) = TERMINATING CHARACTER
                        1493  *         EXIT    NONE
                        1494  *         USES    A,D,E,H,L,F
                        1495
                        1496
000.001                 1497            IF      .RAM.
                        1498            ELSE
000.000                 1499            ERRNZ   *-3062A
                        1500            ENDIF
                        1501
003.062  303 176 005   1502  IOA       JMP     IOA1
003.065  000           1503            NOP                     RETAIN H8 ORG


                        1505  **        IOB - INPUT OCTAL BYTE.
                        1506  *
                        1507  *         READ ONE OCTAL BYTE FROM THE KEYSET.
                        1508  *
                        1509  *         ENTRY   (H,L) = ADDRESS OF BYTE TO HOLD VALUE
                        1510  *                 'C' SET IF FIRST DIGIT IN (A)
                        1511  *         EXIT    NONE
                        1512  *         USES    A,D,E,H,L,F
                        1513
                        1514
000.001                 1515            IF      .RAM.
                        1516            ELSE
```

```
000.000                 1517            ERRNZ   *-3066A
                        1518            ENDIF
                        1519
003.066  066 000        1520  IOB       MVI     M,0             ZERO OUT OLD VALUE
003.070  324 262 003    1521  IOB1      CNC     RCC             READ CONSOLE CHARACTER
                        1522
                        1523  *         SEE IF CHARACTER IS A VALID OCTAL VALUE
                        1524  *
003.073  376 060        1525            CPI     '0'             LESS THAN ZERO?
003.075  332 135 003    1526            JC      IOB2            IF (A) < 0, SEE IF A TERMINATING CHARACTER
003.100  376 070        1527            CPI     '8'             GREATER THAN 7?
003.102  322 070 003    1528            JNC     IOB1            IF TOO LARGE, TRY AGAIN
                        1529
                        1530  *         HAVE AN OCTAL DIGIT
                        1531  *
003.105  315 302 003    1532            CALL    WCC             ECHO CHARACTER
003.110  346 007        1533            ANI     00000111B       MASK FOR BINARY VALUE
003.112  137            1534            MOV     E,A             (E) = VALUE
003.113  176            1535            MOV     A,M             GET OLD VALUE
003.114  007            1536            RLC                     SHIFT 3
003.115  007            1537            RLC
003.116  007            1538            RLC
003.117  303 126 003    1539            JMP     IOB1.5          JUMP AROUND AN H88/H89 TO H8 FAKE ROUTINE
                        1540
                        1541  **        FAKE OUT ROUTINE FOR CALLERS OF *DOD* FROM THE H8 FRONT PANEL
                        1542
                        1543
000.001                 1544            IF      .RAM.
                        1545            ELSE
000.000                 1546            ERRNZ   *-3122A
                        1547            ENDIF
                        1548
003.122  043            1549  DOD       INX     H
003.123  043            1550            INX     H
003.124  043            1551            INX     H
003.125  311            1552            RET
                        1553
                        1554
                        1555  *         CONTINUE
                        1556
003.126  346 370        1557  IOB1.5    ANI     11111000B       TOSS OLD LSB DIGIT
003.130  263            1558            ORA     E               REPLACE WITH NEW VALUE
003.131  167            1559            MOV     M,A
003.132  303 070 003    1560            JMP     IOB1            INPUT ANOTHER CHARACTER
                        1561
                        1562  *         CHECK FOR A CARRIAGE RETURN TO TERMINATE BYTE
                        1563  *
003.135  376 015        1564  IOB2      CPI     A.CR            CARRIAGE RETURN?
003.137  310            1565            RZ                      RETURN IF CARRIAGE RETURN       /JWT 790507/
003.140  257            1566            XRA     A               CLEAR CARRY                     /JWT 790507/
003.141  030 325        1567            JR      IOB1            GET A NEW CHARACTER             /JWT 790507/
```

```
                        1570  **      DYASC - DYNAMIC RAM ASCII OUTPUT TO CONSOLE
                        1571  *
                        1572  *       ENTRY   (A) = CHARACTER TO OUTPUT
                        1573  *               (IY) = RETURN ADDRESS
                        1574  *       EXIT    TO (IY)
                        1575  *       USES    A,C,F
                        1576
    003.143             1577  DYASC   EQU     *
                        1578  *       EX      AF,AF'          SAVE CHARACTER TO OUTPUT
    003.143  010       1579          DB      MI.EXAF
    003.144  333 355   1580  DYASC1  IN      SC.ACE+UR,LSR   READ LINE STATUS REGISTER
    003.146  346 040   1581          ANI     UC.THE
    003.150  312 144 003 1582         JZ      DYASC1          WAIT IF UART CAN'T HOLD ANOTHER CHARACTER
                        1583
                        1584  *       EX      AF,AF'          GET CHARACTER TO OUTPUT
    003.153  010       1585          DB      MI.EXAF
    003.154  323 350   1586          OUT     SC.ACE+UR,THR   OUTPUT TO UART
                        1587  *       JP      (IY)            RETURN TO CALLER
    003.156  375 351   1588          DB      MI.JIYA,MI.JIYB


                        1590  **      DYBYT - DYNAMIC RAM BYTE OUTPUT
                        1591  *
                        1592  *       ENTRY   (A) = BYTE TO OUTPUT AS OCTAL
                        1593  *               (IX) = RETURN ADDRESS
                        1594  *       EXIT    TO (IX)
                        1595  *       USES    A,C,IY,F
                        1596
    003.160  117       1597  DYBYT   MOV     C,A             SAVE CHARACTER
    003.161  346 300   1598          ANI     11000000B       OUTPUT FIRST CHARACTER OF OCTAL VALUE
    003.163  017       1599          RRC
    003.164  017       1600          RRC
    003.165  017       1601          RRC
    003.166  017       1602          RRC
    003.167  017       1603          RRC
    003.170  017       1604          RRC
    003.171  366 060   1605          ORI     00110000B       MAKE INTO ASCII
                        1606
                        1607  *       LD      IY,DYBYT.2
    003.173  375 041   1608          DB      MI,LDYA,MI,LDYB
    003.175  202 003   1609          DW      DYBYT.2
                        1610
    003.177  303 143 003 1611         JMP     DYASC
                        1612
    003.202  171       1613  DYBYT.2 MOV     A,C             OUTPUT SECOND CHARACTER
    003.203  346 070   1614          ANI     00111000B
    003.205  017       1615          RRC
    003.206  017       1616          RRC
    003.207  017       1617          RRC
    003.210  366 060   1618          ORI     00110000B       MAKE INTO ASCII
                        1619
                        1620  *       LD      IY,DYBYT.4      RETURN ADDRESS
    003.212  375 041   1621          DB      MI.LDYA,MI.LDYB
    003.214  221 003   1622          DW      DYBYT.4
                        1623
```

```
003.216 303 143 003  1624            JMP     DYASC
                     1625
003.221 171          1626  DYBYT.4   MOV     A,C             OUTPUT LAST CHARACTER
003.222 346 007      1627            ANI     00000111B
003.224 366 060      1628            ORI     00110000B       MAKE ASCII
                     1629
                     1630  *         LD      IY,DYBYT.6      RETURN ADDRESS
003.226 375 041      1631            DB      MI.LDYA,MI.LDYB
003.230 235 003      1632            DW      DYBYT.6
                     1633
003.232 303 143 003  1634            JMP     DYASC
                     1635
003.235              1636  DYBYT.6   EQU     *
                     1637  *         JP      (IX)            RETURN TO CALLER
003.235 335 351      1638            DB      MI.JIXA,MI.JIXB


                     1640  **        MSG.PAS - PASS MESSAGE FOR DYNAMIC RAM TEST
                     1641  *
                     1642
003.237 015 012      1643  MSG.PAS   DB      A.CR,A.LF
003.241 040 040 040  1644            DB      '     Pass =    '
003.257 000          1645            DB      0
```

```
003.260                 1648            ORG     3260A
                        1649    **      RCK - READ CONSOLE KEYPAD
                        1650    *
                        1651    *       RCK IS CALLED TO READ A KEYSTROKE FROM THE CONSOLE FRONT PANEL KEYPAD.
                        1652    *       SINCE THE H88/89 DOES NOT HAVE A FRONT PANEL, THIS ROUTINE IS PROVIDED
                        1653    *       ONLY TO MAINTAIN COMPATIBILITY WITH PAM-8.
                        1654    *       RCK WILL IMMEDIATELY RETURN WITH A VALUE OF 0 (ZERO) IN THE ACCUMULATOR.
                        1655    *
                        1656    *       ENTRY   NONE
                        1657    *       EXIT    (A) = 0
                        1658    *       USES    A,F
                        1659
                        1660    *       RCK MUST HAVE SAME ENTRY AS RCK IN PAM-8
000.000                 1661            ERRNZ   *-3260A
                        1662
003.260                 1663    RCK     EQU     *
                        1664
003.260  257           1665            XRA     A
003.261  311           1666            RET
                        1667
```

```
                        1671  **      RCC - READ CONSOLE CHARACTER.
                        1672  *
                        1673  *       RCC IS CALLED TO READ A KEYSTROKE FROM THE CONSOLE.
                        1674  *       IF A RUBOUT/DELETE IS RECEIVED, EXIT IS TO *ERROR*.
                        1675  *
                        1676  *       ENTRY   NONE
                        1677  *       EXIT    TO ERROR  - IF A DELETE OR RUBOUT IS ENCOUNTERED
                        1678  *               TO CALLER - WHEN A KEY IS HIT
                        1679  *                           (A) =  ASCII KEY VALUE
                        1680  *       USES    A,F
                        1681
                        1682
                        1683
003.262                 1684  RCC     EQU     *
                        1685
003.262  333 355       1686  RCC1    IN      SC.ACE+UR.LSR   INPUT ACE LINE STATUS REGISTER
003.264  346 001       1687          ANI     UC.DR           SEE IF THERE IS A DATA READY
003.266  050 372       1688          JR      Z,RCC1
                        1689
003.270  333 350       1690  RCC2    IN      SC.ACE+UR.RBR   ELSE, INPUT CHARACTER
003.272  346 177       1691          ANI     01111111B       TOSS ANY PARITY
003.274  376 177       1692          CPI     A.DEL
003.276  312 322 000   1693          JZ      ERROR           IF RUBOUT, EXIT TO ERROR
                        1694
003.301  311           1695          RET                     ELSE, EXIT TO CALLER


                        1697  **      WCC - WRITE CONSOLE CHARACTER
                        1698  *
                        1699  *       WRITE A CHARACTER TO THE CONSOLE UART PORT
                        1700  *
                        1701  *       ENTRY   (A) = ASCII CHARACTER TO OUTPUT
                        1702  *       EXIT    NONE
                        1703  *       USES    NONE
                        1704
                        1705
003.302  365           1706  WCC     PUSH    PSW             SAVE CHARACTER
003.303  333 355       1707  WCC1    IN      SC.ACE+UR.LSR   INPUT ACE STATUS
003.305  346 040       1708          ANI     UC.THE          SEE IF TRANSMITTER HOLDING REGISTER IS EMPTY
003.307  050 372       1709          JR      Z,WCC1
                        1710
003.311  361           1711          POP     PSW             GET CHARACTER
003.312  323 350       1712          OUT     SC.ACE+UR.THR           OUTPUT TO CONSOLE
003.314  311           1713          RET
```

```
                        1715  **      THE FOLLOWING IS ONLY A PORTION OF THE DYNAMIC RAM TEST!!!
                        1716  *
003.315  353           1717  DY9.3   XCHG
003.316  174           1718          MOV     A,H             OUTPUT MSB
                        1719
                        1720  *       LD      IX,DY9.4        RETURN ADDRESS
003.317  335 041       1721          DB      MI,LDXA,MI,LDXB
003.321  326 003       1722          DW      DY9.4
                        1723
003.323  303 160 003   1724          JMP     DYBYT
                        1725
003.326  175           1726  DY9.4   MOV     A,L             OUTPUT LSB
                        1727
                        1728  *       LD      IX,DY9.5        RETURN ADDRESS
003.327  335 041       1729          DB      MI,LDXA,MI,LDXB
003.331  335 003       1730          DW      DY9.5
                        1731
003.333  030 223       1732          JR      DYBYT
                        1733
003.335  353           1734  DY9.5   XCHG                    SAVE ERROR ADDRESS
003.336  041 362 007   1735          LXI     H,MSG.EQ        OUTPUT " = "
                        1736
                        1737  *       LD      IX,DY9.8        RETURN ADDRESS
003.341  335 041       1738          DB      MI.LDXA,MI.LDXB
003.343  350 003       1739          DW      DY9.8
                        1740
003.345  303 306 007   1741          JMP     DYMSG           OUTPUT STRING
                        1742
003.350  032           1743  DY9.8   LDAX    D               OUTPUT RAM CONTENTS
                        1744
                        1745  *       LD      IX,DYMEM10      RETURN ADDRESS
003.351  335 041       1746          DB      MI.LDXA,MI.LDXB
003.353  360 003       1747          DW      DYMEM10
                        1748
003.355  303 160 003   1749          JMP     DYBYT
                        1750
003.360  076 007       1751  DYMEM10 MVI     A,A.BEL         DING BELL
                        1752
                        1753  *       LD      IY,DY10.5       RETURN ADDRESS
003.362  375 041       1754          DB      MI.LDYA,MI.LDYB
003.364  265 007       1755          DW      DY10.5
                        1756
003.366  303 143 003   1757          JMP     DYASC
```

```
                        1760  **      IO ROUTINES TO BE COPIED INTO AND USED IN RAM.
                        1761  *
                        1762  *       MUST CONTINUE TO 3777A FOR PROPER COPY.
                        1763  *       THE TABLE MUST ALSO BE BACKWARDS TO THE FINAL RAM
                        1764
    000.001             1765          IF      .RAM.
                        1767          ELSE
    000.000             1768          ERRNZ   4000A-7-*
                        1769          ENDIF
                        1770
    003.371             1771  PRSROM  EQU     *
    003.371  001       1772          DB      1               REFIND
    003.372  000       1773          DB      0               CTLFLG
    003.373  000       1774          DB      0               .MFLAG
    003.374  000       1775          DB      0               DSPMOD
    003.375  000       1776          DB      0               DSPROT
    003.376  012       1777          DB      10              REGI
    003.377  311       1778          DB      MI.RET
                        1779
    000.001             1780          IF      .RAM.
                        1782          ELSE
    000.000             1783          ERRNZ *-4000A
                        1784          ENDIF
                        1785
```

```
                                1788  ***     INITOX          EXTENSION OF INIT0 TO SUPPORT H88
                                1789
    004,000  076 002            1790  INIT0X  MVI     A,H88B.CK               ENABLE CLOCK
    004,002  323 362            1791          OUT     H88.CTL
                                1792
                                1793  *       SET UP ACE FOR CONSOLE COMMUNICATIONS
                                1794  *
    004,004  076 200            1795          MVI     A,UC.DLA        SET DIVISOR LATCH ACCESS BIT
    004,006  323 353            1796          OUT     SC,ACE+UR.LCR
    004,010  041 101 004        1797          LXI     H,BRTAB         (H,L) = BEGINNING OF BAUD RATE TABLE
    004,013  333 362            1798          IN      H88.SW          INPUT SWITCHES FOR DESIRED BAUD RATE
    004,015  346 100            1799          ANI     H88S.BR         MASK FOR BAUD RATE SWITCHES ONLY
    004,017  017                1800          RRC                     SHIFT FOR A *2 FOR TABLE
    004,020  017                1801          RRC
    004,021  017                1802          RRC
    004,022  017                1803          RRC
    004,023  017                1804          RRC
    004,024  205                1805          ADD     L               ADD DISPLACEMENT FROM BEGINNING OF TABLE
    004,025  157                1806          MOV     L,A
    004,026  176                1807          MOV     A,M             GET MSB OF DIVISOR
    004,027  323 351            1808          OUT     SC,ACE+UR.DLM
    004,031  043                1809          INX     H               GET LSB
    004,032  176                1810          MOV     A,M
    004,033  323 350            1811          OUT     SC.ACE+UR.DLL
    004,035  076 003            1812          MVI     A,UC.8BW        SET 8 BITS, 1 STOP BIT, NO PARITY
    004,037  323 353            1813          OUT     SC.ACE+UR.LCR
    004,041  076 000            1814          MVI     A,0             SET NO INTERRUPTS
    004,043  323 351            1815          OUT     SC.ACE+UR.IER
                                1816
                                1817  *       WAIT A WHILE TO ALLOW THE CONSOLE RESET TO FINISH SO IT CAN
                                1818  *       ACCEPT THE FIRST PROMPT
                                1819  *
    004,045  001 000 065        1820          LXI     B,65000A        APPROX, 100 MS
    004,050  015                1821  INIT0X1 DCR     C
    004,051  040 375            1822          JR      NZ,INIT0X1
                                1823
    004,053  020 373            1824          DJNZ    INIT0X1
                                1825
                                1826  *       INPUT SWITCH TO SEE IF TO BEGIN OPERATION OR MEMORY TEST
                                1827  *
    004,055  333 362            1828          IN      H88.SW          GET SWITCHES
    004,057  346 040            1829          ANI     H88S.M          MASK FOR MEMORY TEST ONLY
    004,061  312 116 007        1830          JZ      DYMEM           IF TO PERFORM MEMORY TESTS
                                1831
                                1832  *       REPLACE WHAT WAS ORIGINALLY AT THE JUMP WHICH GOT US HERE
                                1833  *
    004,064  021 371 003        1834          LXI     D,PRSROM        (DE) = ROM COPY OF PRS CODE
    004,067  257                1835          XRA     A
    004,070  062 123 041        1836          STA     AUTOB           INITIAL AUTO BOOT FLAG
    004,073  062 066 040        1837          STA     DATA            INITIAL 362Q PORT DATA SAVE BYTE
    004,076  303 003 000        1838          JMP     INIT0.0         RETURN TO ORIGINAL CODE
```

```
                        1840  **      BRTAB - BAUD RATE DIVISOR TABLE
                        1841  *
    004,101             1842  BRTAB   EQU     *
                        1843
    004,101 000 014     1844  BR96    DB      0,12            9600 BAUD
    004.103 000 006     1845  BR19.2  DB      0,6           19,200 BAUD
                        1846  *BR38.4 DB       0,3           38,400 BAUD
                        1847  *BR56.0 DB       0,2           56,000 BAUD
                        1848
    000.004             1849  .       SET     */256
    000,000             1850          ERRNZ   BRTAB/256-.   TABLE MUST BE IN ONE PAGE


                        1852  ***     SAVALLX - SAVALL EXTENSION TO MAKE ROOM FOR A JUMP TO THE NMI HANDLER
                        1853
    004.105             1854  SAVALLX EQU     *             REPLACE OLD CODE
    004.105 345         1855          PUSH    H             SET ON STACK AS 'REGISTER'
    004.106 325         1856          PUSH    D             SET RETURN ADDRESS
    004.107 021 011 040 1857          LXI     D,CTLFLG
    004.112 032         1858          LDAX    D
    004.113 303 151 000 1859          JMP     SAVALLR       RETURN TO OLD CODE
```

```
                        1862  ****    NMI - NON MASKABLE INTERRUPT
                        1863  *
                        1864  *       NMI IS USED AS THE TRAP FOR ALL ILLEGAL PORT REQUESTS
                        1865  *
                        1866  *       PORT ADDRESSES TRAPPED ARE:
                        1867  *
                        1868  *                       IN 360Q FRONT PANEL KEYBOARD INPUT
                        1869  *                      OUT 360Q FRONT PANEL CONTROL
                        1870  *                      OUT 361Q FRONT PANEL DISPLAY CONTROL
                        1871  *                   IN/OUT 372Q CONSOLE DATA FOR AN 8251A
                        1872  *                      OUT 373Q CONSOLE CONTROL FOR AN 8251A
                        1873  *
                        1874  *
                        1875  *               THESE PORT REQUESTS ARE RESPONDED TO AS FOLLOWS:
                        1876  *
                        1877  *                       IN 360Q RETURNS WITH (A) = 377Q TO SHOW THAT
                        1878  *                              NO FRONT PANEL SWITCHES ARE PRESSED
                        1879  *
                        1880  *                       OUT 360Q MOVES BIT 6 (CB.CLI) TO BIT 1, AND
                        1881  *                              BIT 4 (CB.SSI) INVERTED, TO BIT 0, AND
                        1882  *                              OUTPUTS THESE BITS TO PORT 362Q TO
                        1883  *                              CONTROL THE CLOCK AND SINGLE STEP INTERRUPTS
                        1884  *
                        1885  *                       OUTPUTS TO 361Q, 372Q, AND 373Q JUST RETURN
                        1886  *
                        1887  *                       INPUTS FROM 361Q, 372Q, AND 373Q RETURN WITH (A) = 0
                        1888  *                              TO INDICATE AN EMPTY BUSS
                        1889  *
                        1890  *
                        1891  *               ENTRY   NONE
                        1892  *
                        1893  *               EXIT    NONE
                        1894  *
                        1895  *               USES    (A) ONLY IF 'FAKING' AN INPUT
                        1896
                        1897
004.116  343           1898  NMI     XTHL                    GET RETURN ADDRESS FROM STACK
004.117  042 064 040    1899          SHLD    NMIRET          SAVE FOR LATER USE
004.122  343           1900          XTHL                    PUT RETURN ADDRESS BACK ON STACK
                        1901
004.123  345           1902          PUSH    H               SAVE REGISTERS
004.124  305           1903          PUSH    B
004.125  365           1904          PUSH    PSW
004.126  107           1905          MOV     B,A             SAVE (A) PRIOR TO I/O
004.127  052 064 040    1906          LHLD    NMIRET          GET RETURN ADDRESS
004.132  053           1907          DCX     H               BACK UP TO PORT # WHICH GOT US HERE
004.133  176           1908          MOV     A,M             GET PORT #
                        1909
004.134  376 360       1910          CPI     360Q            PORT 360?
004.136  050 033       1911          JR      Z,NMI1            IF PORT WAS 360Q
                        1912
                        1913  *       PORT REFERENCED WAS 361Q, 372Q, OR 373Q
                        1914  *
004.140  376 361       1915          CPI     361Q            MAKE SURE PORT IS LEGAL
004.142  050 010       1916          JR      Z,NMI0.5          IF LEGAL
                        1917
```

```
004.144 376 372      1918          CPI     372Q
004.146 050 004      1919          JR      Z,NMI0.5
                     1920
004.150 376 373      1921          CPI     373Q
004.152 040 062      1922          JR      NZ,NMI2.5          IF NONE OF THE ABOVE, EXIT
                     1923
004.154 053          1924  NMI0.5  DCX     H                  POINT TO IN/OUT INSTRUCTION
004.155 176          1925          MOV     A,M                SEE IF INPUT OR OUTPUT
004.156 376 323      1926          CPI     MI.OUT
004.160 050 054      1927          JR      Z,NMI2.5             IF OUTPUT, JUST EXIT
                     1928
004.162 376 333      1929          CPI     MI.IN
004.164 040 050      1930          JR      NZ,NMI2.5          IF NOT INPUT EITHER, ILLEGAL SO EXIT
                     1931
004.166 361          1932          POP     PSW                RESTORE FLAGS
004.167 076 000      1933          MVI     A,0                ELSE, RETURN LIKE AN EMPTY BUSS
004.171 030 044      1934          JR      NMI3               EXIT
                     1935
004.173 053          1936  NMI1    DCX     H                  POINT TO IN/OUT INSTRUCTION
004.174 176          1937          MOV     A,M                GET I/O INSTRUCTION
004.175 376 333      1938          CPI     MI.IN              INPUT?
004.177 040 005      1939          JR      NZ,NMI1.5            IF NOT 'IN'
                     1940
004.201 361          1941          POP     PSW                RESTORE FLAGS
004.202 076 377      1942          MVI     A,11111111B        SHOW 'NO KEYS PRESSED'
004.204 030 031      1943          JR      NMI3               EXIT
                     1944
004.206 376 323      1945  NMI1.5  CPI     MI.OUT             MAKE SURE INTRUCTION IS AN 'OUT'
004.210 040 024      1946          JR      NZ,NMI2.5            IF NOT
                     1947
004.212 170          1948  NMI2    MOV     A,B                GET OUTPUT DATA AGAIN
004.213 346 120      1949          ANI     CB.CLI+CB.SSI      MOVE CLOCK INFO TO BIT 1
004.215 017          1950          RRC
004.216 017          1951          RRC
004.217 017          1952          RRC
004.220 017          1953          RRC
004.221 017          1954          RRC
004.222 070 001      1955          JR      C,NMI2.2
004.224 074          1956          INR     A
004.225 041 066 040  1957  NMI2.2  LXI     H,DATA             OR WITH THE BYTE IN RAM
004.230 266          1958          ORA     M                  BEFORE OUTPUT IT
004.231 323 362      1959          OUT     H88.CTL            SET IN HARDWARE
004.233 346 374      1960          ANI     11111100B
004.235 167          1961          MOV     M,A
                     1962
004.236 361          1963  NMI2.5  POP     PSW                RESTORE (A,F)
                     1964
004.237 301          1965  NMI3    POP     B
004.240 341          1966          POP     H
                     1967  *       RETN                       Z80 RETURN FROM NMI
004.241 355 105      1968          DB      355Q,105Q
```

```
                                1971  **      ATB     - AUTO BOOT ROUTINE CONTINUE
                                1972
004.243  167                    1973  ATB     MOV     M,A             SET AUTO BOOT FLAG
004.244  076 012                1974          MVI     A,10            SET TO AUTO BOOT ROUTINE
004.246  315 052 003            1975          CALL    LRA.
004.251  021 212 001            1976          LXI     D,AUTOBO        SET AUTO BOOT ROUTINE
004.254  030 016                1977          JR      BOOTX


004.256                         1979          ORG     4256A
                                1980  **      BOOT H-17 OR Z47 ENTRY POINT FOR H88
                                1981  *
                                1982  *       ENTRY   NONE
                                1983  *
                                1984  *       EXIT    (DE) = NORMAL BOOT ROUTINE ADDRESS
                                1985  *
                                1986  *       USES    ALL
                                1987
004.256  041 234 006            1988  BOOT    LXI     H,MSG.BT        COMPLETE BOOT MESSAGE
004.261  315 100 006            1989          CALL    TYPMSG
004.264  076 012                1990          MVI     A,10
004.266  315 052 003            1991          CALL    LRA.            GET LOCATION OF USER PC
004.271  021 261 001            1992          LXI     D,NBOOT         SET ITS VALUE TO THE NORMAL BOOT ROUTINE
004.274  163                    1993  BOOTX   MOV     M,E
004.275  043                    1994          INX     H
004.276  162                    1995          MOV     M,D
                                1996
004.277  303 063 000            1997          JMP     GO.             DO IT
```

```
                                2000  **      TMOUT   -  BOOT CODE TIME OUT ROUTINE
                                2001  *
                                2002  *       TMOUT IS ENTERED FROM TIMER INTERRUPT EVER 100 MS. AND IT WILL
                                2003  *       EXIT:   IF BOOT SUCCESS THEN TIMER OFF.
                                2004  *               IF 15 SECONDS TIME OUT AND BOOT IS NOT SUCCESS YES
                                2005  *                  THEN ABORT BOOT Z47 & TO MONITOR LOOP
                                2006  *               IF < 15S & 3.5S THEN RE-BOOT
                                2007  *
                                2008  *       ENTRY:  (TMFG)  = 1 IF THE TIME OUT IS FOR Z47
                                2009  *                       = 0 IF THE TIME OUT IS FOR H17
                                2010  *       EXIT:   NONE
                                2011  *
                                2012  *       USE:    ALL (WHEN RETURN, ALL REGISTERS ARE RESTORED)
                                2013
004.302                         2014  TMOUT   EQU     *
004.302  333 355                2015          IN      SC.ACE+UR.LSR           INPUT ACE LINE STATUS REGISTER
004.304  346 001                2016          ANI     UC.DR                   SEE IF THERE IS A DATA READY
004.306  050 011                2017          JR      Z,TMOUT4                CHECK IF IT IS <DELETE>
                                2018
004.310  333 350                2019          IN      SC.ACE+UR.RBR           INPUT DATA FROM KB
004.312  346 177                2020          ANI     01111111B               IS IT <DEL>?
004.314  376 177                2021          CPI     A.DEL
004.316  312 171 002            2022          JZ      NODEV                   IF IT, ABORT THE BOOT
                                2023  *                                       ELSE IGNORE THE INPUT
004.321  041 121 041            2024  TMOUT4  LXI     H,TMFG
004.324  176                    2025          MOV     A,M
004.325  247                    2026          ANA     A
004.326  010                    2027          DB      MI.EXAF                 SAVE Z FLAG
004.327  072 033 040            2028          LDA     TICCNT                  GET TIC
004.332  247                    2029          ANA     A                       SET ZERO FLAG
004.333  040 024                2030          JR      NZ,TMOUT2               NOT IN 0.5 SECOND
004.335  043                    2031          INX     H                       SET TO MYCNT
000.000                         2032          ERRNZ   MYCNT-TMFG-1            MYCNT MUST FOLLOW TMFG
004.336  064                    2033          INR     M                       INCREASE THE COUNT FOR 0.5 SECOND
004.337  176                    2034          MOV     A,M
004.340  376 036                2035          CPI     30                      CHECK IF MORE THAN 15 SECONDS
004.342  322 171 002            2036          JNC     NODEV                   NO DEVICE ?
004.345  336 007                2037  TMOUT1  SBI     7                       IS IT 3.5 SECONDS?
004.347  070 010                2038          JR      C,TMOUT2                IF NOT, WAIT
004.351  040 372                2039          JR      NZ,TMOUT1               CHECK MORE
004.353  010                    2040          DB      MI.EXAF
004.354  302 063 002            2041          JNZ     RETRY                   IF IT IS Z47, THEN RE-BOOT
004.357  030 002                2042          JR      TMOUT3                  IT IS H-17, CONTINUE IT CLOCK ROUTINE
004.361  010                    2043  TMOUT2  DB      MI.EXAF                 CHECK IT IS Z47 OR H17
004.362  300                    2044          RNZ                             Z47, THEN RETURN
004.363  303 031 034            2045  TMOUT3  JMP     CLOCK17                 CONTINUE H17 CLOCK ROUTINE
```

```
004.370                 2048            ORG     4370A
                        2049    **      SUBM - SUBSTITUTE MEMORY
                        2050    *
                        2051    *       SUBM INPUTS A MEMORY ADDRESS FROM THE CONSOLE AND THEN DISPLAYS
                        2052    *       THAT ADDRESS AND ITS CONTENTS.  IF A CARRIAGE RETURN IS THEN TYPED,
                        2053    *       CONTROL RETURNS TO THE MONITOR.  IF A SPACE IS TYPED, THE NEXT
                        2054    *       MEMORY LOCATION AND CONTENTS ARE DISPLAYED.  IF A MINUS SIGN IS
                        2055    *       TYPED, THE PREVIOUS MEMORY LOCATION AND CONTENTS ARE DISPLAYED.
                        2056    *       IF AN OCTAL CHARACTER IS TYPED, A BYTE IS ENTERED AN PLACED AT THE
                        2057    *       CURRENT MEMORY LOCATION.
                        2058    *
                        2059    *
                        2060    *       ENTRY   NONE
                        2061    *       EXIT    NONE
                        2062    *       USES    A,E,H,L,F
                        2063
                        2064
004.370  041 201 006   2065    SUBM    LXI     H,MSG.SUB       COMPLETE SUBSTITUTE MESSAGE
004.373  315 100 006   2066            CALL    TYPMSG
004.376  315 150 005   2067            CALL    IROC            INPUT FIRST CHARACTER
005.001  320           2068            RNC                     IF A RETURN, EXIT
                        2069
005.002  041 003 040   2070            LXI     H,IOWRK+1       ELSE, INPUT STARTING ADDRESS
005.005  026 015       2071            MVI     D,A.CR          ENDING WITH A RETURN
005.007  315 062 003   2072            CALL    IOA
005.012  353           2073            XCHG                    (H,L) = INPUT ADDRESS
                        2074
005.013  315 313 005   2075    SUBM1   CALL    TOA             TYPE CRLF, ADDRESS, AND A SPACE
005.016  176           2076            MOV     A,M             GET MEMORY CONTENTS FOR DISPLAY
005.017  315 343 005   2077            CALL    TOB
005.022  076 040       2078            MVI     A,' '           SPACE
005.024  315 302 003   2079            CALL    WCC
                        2080
005.027  315 301 005   2081    SUBM2   CALL    IOC             INPUT FIRST CHARACTER
005.032  322 075 005   2082            JNC     SUBM7           IF FIRST CHARACTER IS OCTAL
                        2083
005.035  376 040       2084            CPI     ' '             SPACE?
005.037  302 046 005   2085            JNZ     SUBM4           IF NOT A SPACE
                        2086
005.042  043           2087    SUBM3   INX     H               POINT TO NEXT ADDRESS
005.043  303 013 005   2088            JMP     SUBM1           DISPLAY NEXT
                        2089
005.046  376 055       2090    SUBM4   CPI     '-'             MINUS?
005.050  302 062 005   2091            JNZ     SUBM6           IF NOT
                        2092
005.053  315 302 003   2093    SUBM5   CALL    WCC             ECHO HYPHEN
005.056  053           2094            DCX     H               POINT TO PREVIOUS ADDRESS
005.057  303 013 005   2095            JMP     SUBM1           DISPLAY PREVIOUS
                        2096
005.062  376 015       2097    SUBM6   CPI     A.CR            RETURN?
005.064  310           2098            RZ                      IF RETURN, EXIT
                        2099
005.065  076 007       2100            MVI     A,A.BEL         ELSE, DING BELL
005.067  315 302 003   2101            CALL    WCC
005.072  303 027 005   2102            JMP     SUBM2           TRY AGAIN
                        2103
```

```
005.075 066 000       2104 SUBM7  MVI   M,0             ZERO BYTE TO BE BUILT
                      2105
005.077 315 302 003   2106 SUBM8  CALL  WCC             ECHO OCTAL CHARACTER
005.102 346 007       2107        ANI   00000111B       GET BINARY VALUE
005.104 137           2108        MOV   E,A             SAVE PARTIAL
005.105 176           2109        MOV   A,M             GET CURRENT
005.106 007           2110        RLC                   MAKE ROOM FOR NEW CHARACTER
005.107 007           2111        RLC
005.110 007           2112        RLC
005.111 346 370       2113        ANI   11111000B       TOSS PREVIOUS LSB
005.113 263           2114        ORA   E               ADD NEW
005.114 167           2115        MOV   M,A             SAVE NEW TOTAL
005.115 315 301 005   2116 SUBM9  CALL  IOC             INPUT NEXT CHARACTER
005.120 322 077 005   2117        JNC   SUBM8           IF OCTAL
                      2118
005.123 376 040       2119        CPI   ' '             SPACE?
005.125 312 042 005   2120        JZ    SUBM3           IF SPACE, DISPLAY NEXT BYTE
                      2121
005.130 376 055       2122        CPI   '-'             MINUS?
005.132 312 053 005   2123        JZ    SUBM5           IF MINUS, DISPLAY PREVIOUS
                      2124
005.135 376 015       2125        CPI   A,CR            RETURN?
005.137 310           2126        RZ                    IF RETURN, EXIT
                      2127
005.140 076 007       2128        MVI   A,A.BEL         ELSE, DING BELL
005.142 315 302 003   2129        CALL  WCC
005.145 303 115 005   2130        JMP   SUBM9           TRY AGAIN
```

```
                      2133 **     IROC - INPUT A RETURN OR AN OCTAL CHARACTER
                      2134 *
                      2135 *      IROC INPUTS A CHARACTER FROM THE CONSOLE AND WAITS UNTIL IT
                      2136 *      RECEIVES EITHER A VALID OCTAL CAHRACTER OR A CARRIAGE RETURN
                      2137 *
                      2138 *      ENTRY  NONE
                      2139 *      EXIT   (A) = INPUT CHARACTER
                      2140 *             'C' = SET IF CHARACTER IS OCTAL
                      2141 *      USES   A,F
                      2142
                      2143
005.150 315 262 003   2144 IROC   CALL  RCC             INPUT CHARACTER
005.153 376 015       2145        CPI   A,CR            RETURN?
005.155 310           2146        RZ                    IF A CR
                      2147
005.156 376 060       2148        CPI   '0'             < 0?
005.160 332 166 005   2149        JC    IROC1           IF < OCTAL
                      2150
005.163 376 070       2151        CPI   '8'             > 8?
005.165 330           2152        RC                    IF OCTAL
                      2153
005.166 076 007       2154 IROC1  MVI   A,A,BEL         ELSE, RING BELL
005.170 315 302 003   2155        CALL  WCC
005.173 303 150 005   2156        JMP   IROC            TRY AGAIN
```

```
                        2158  **      IOA1 - INPUT OCTAL ADDRESS
                        2159  *
                        2160  *       IOA1 IS A CONTINUATION OF *IOA* AND INPUTS A SPLIT OCTAL ADDRESS
                        2161  *       WITHOUT REQUIRING LEADING ZEROS
                        2162  *
                        2163  *       ENTRY   (H,L) = ADDRESS + 1 WHERE INPUT ADDRESS IS TO BE PLACED
                        2164  *               (A) = FIRST OCTAL CHARACTER IF 'C' IS SET
                        2165  *       EXIT    (D,E) = INPUT ADDRESS
                        2166  *               (A) = LAST INPUT CHARACTER
                        2167  *       USES    A,D,E,H,L,F
                        2168
                        2169
005.176  305           2170  IOA1    PUSH    B               SAVE (B,C)
005.177  102           2171          MOV     B,D             (B) = TERMINATION CHARACTER
005,200  345           2172          PUSH    H               SAVE ADDRESS WHERE INPUT IS TO BE PLACED
005.201  041 000 000    2173          LXI     H,0             SET NEW VALUE TO ZERO
005,204  324 262 003    2174  IOA2    CNC     RCC             IF CARRY SET, FIRST CHARACTER IS IN ACC
005.207  376 060        2175          CPI     '0'             MAKE SURE CHARACTER IS OCTAL
005.211  332 242 005    2176          JC      IOA3            IF < OCTAL
                        2177
005.214  376 070        2178          CPI     '8'
005.216  322 242 005    2179          JNC     IOA3            IF > OCTAL
                        2180
005.221  315 302 003    2181          CALL    WCC             ECHO OCTAL CHARACTER
005.224  346 007        2182          ANI     00000111B       GET BINARY VALUE
005.226  365           2183          PUSH    PSW             SAVE NEW CHARACTER VALUE
005.227  051           2184          DAD     H               SHIFT THREE TO MAKE ROOM FOR NEW CHARACTER
005.230  051           2185          DAD     H
005.231  051           2186          DAD     H
005.232  365           2187          PUSH    PSW             SAVE CARRY FROM DAD
005,233  321           2188          POP     D               SAVE FLAG RESULT IN E
005.234  361           2189          POP     PSW             RETURN NEW CHARACTER VALUE TO (A)
005,235  205           2190          ADD     L
005.236  157           2191          MOV     L,A
005.237  303 204 005    2192          JMP     IOA2            SEE IF MORE CHARACTERS
                        2193
005,242  270           2194  IOA3    CMP     B               TERMINATING CHARACTER?
005.243  312 260 005    2195          JZ      IOA4            IF EQUAL
                        2196
005.246  076 007        2197          MVI     A,A.BEL         ELSE, DING BELL
005,250  315 302 003    2198          CALL    WCC
005.253  067           2199          STC                     TRY AGAIN
005,254  077           2200          CMC
005.255  303 204 005    2201          JMP     IOA2
                        2202
                        2203  *       END OF INPUT, PUT VALUE IN MEMORY AND EXIT
                        2204
005.260  315 302 003    2205  IOA4    CALL    WCC             ECHO CHARACTER
005,263  127           2206          MOV     D,A             LAST CHARACTER TO D
005.264  325           2207          PUSH    D
005,265  361           2208          POP     PSW             (PSW) = RESULT OF DAD
005.266  174           2209          MOV     A,H             MAKE (H) INTO SPLIT OCTAL
005,267  037           2210          RAR
005.270  147           2211          MOV     H,A
005,271  172           2212          MOV     A,D             RESTORE LAST INPUT CHARACTER
005.272  353           2213          XCHG                    (D,E) = INPUT ADDRESS
```

```
005,273  341           2214          POP     H               (H,L) = LOCATION TO PLACE THIS ADDRESS
005.274  162           2215          MOV     M,D
005,275  053           2216          DCX     H
005.276  163           2217          MOV     M,E
005,277  301           2218          POP     B               RESTORE (B,C)
005.300  311           2219          RET


                       2221  **      IOC - INPUT OCTAL CHARACTER
                       2222  *
                       2223  *
                       2224  *       ENTRY   NONE
                       2225  *       EXIT    (A) = INPUT CHARACTER
                       2226  *               'C' = SET IF CHARACTER NOT OCTAL
                       2227  *       USES    A,F
                       2228
                       2229
005.301  315 262 003   2230  IOC     CALL    RCC             INPUT CHARACTER
005,304  376 060       2231          CPI     '0'
005.306  330           2232          RC                      IF CHARACTER < OCTAL
                       2233
005.307  376 070       2234          CPI     '8'             CHARACTER > OCTAL?
005,311  077           2235          CMC                     'C' IF GREATER THAN
005.312  311           2236          RET


                       2238  **      TOA - TYPE OCTAL ADDRESS
                       2239  *
                       2240  *       TOA OUTPUTS TO THE CONSOLE A CRLF, THE SPCECIFIED ADDRESS AND A SPACE
                       2241  *
                       2242  *       ENTRY   (H,L) = ADDRESS TO BE DISPLAYED
                       2243  *       EXIT    NONE
                       2244  *       USES    A,B,C,F
                       2245
                       2246
005.313  076 015       2247  TOA     MVI     A,A.CR          CRLF
005,315  315 302 003   2248          CALL    WCC
005.320  076 012       2249          MVI     A,A.LF
005,322  315 302 003   2250          CALL    WCC
                       2251
005.325  174           2252  TOA.    MOV     A,H             ADDRESS
005.326  315 343 005   2253          CALL    TOB
005,331  175           2254          MOV     A,L
005.332  315 343 005   2255          CALL    TOB
                       2256
005.335  076 040       2257          MVI     A,' '           SPACE
005,337  315 302 003   2258          CALL    WCC
005.342  311           2259          RET
```

```
                        2261  **      TOB - TYPE OCTAL BYTE
                        2262  *
                        2263  *       TOB OUTPUTS TO THE CONSOLE IN OCTAL, THE BYTE IN A
                        2264  *
                        2265  *       ENTRY   (A) = BYTE TO BE OUTPUT
                        2266  *       EXIT    NONE
                        2267  *       USES    A,F
                        2268
                        2269
005.343  305           2270  TOB     PUSH    B
005.344  006 002       2271          MVI     B,2             NUMBER OF CHARACTERS - 1
005.346  117           2272          MOV     C,A             SAVE ORIGINAL BYTE
005.347  267           2273          ORA     A               ASSURE 'C' = ZERO
005.350  037           2274          RAR
005.351  037           2275          RAR                     SHIFT TOP BYTE TO LSB
005.352  037           2276          RAR
005.353  037           2277  TOB1    RAR                     SHIFT MIDDLE BYTE TO LSB
005.354  037           2278          RAR
005.355  037           2279          RAR
005.356  346 007       2280          ANI     00000111B       MASK FOR HALF ASCII
005.360  366 060       2281          ORI     00110000B       MAKE WHOLE ASCII
005.362  315 302 003   2282          CALL    WCC             OUTPUT TO CONSOLE
005.365  171           2283          MOV     A,C             GET ORIGINAL BYTE
005.366  005           2284          DCR     B
005.367  302 353 005   2285          JNZ     TOB1            IF SECOND BYTE STILL NEEDS TO BE OUTPUT
                        2286
005.372  346 007       2287          ANI     00000111B       ELSE, OUTPUT LAST CHARACTER
005.374  366 060       2288          ORI     00110000B
005.376  315 302 003   2289          CALL    WCC
006.001  301           2290          POP     B
006.002  311           2291          RET


                        2293  **      WCR - WAIT FOR A CARRIAGE RETURN
                        2294  *
                        2295  *       WCR INPUTS CHARACTERS FROM THE CONSOLE UNTIL A CARRIAGE RETURN
                        2296  *       IS RECEIVED AND THEN ECHOS A CRLF
                        2297  *
                        2298  *
                        2299  *       ENTRY   NONE
                        2300  *       EXIT    NONE
                        2301  *       USES    A,F
                        2302
                        2303
006.003  315 262 003   2304  WCR     CALL    RCC             INPUT CHARACTER
006.006  376 015       2305          CPI     A,CR
006.010  040 371       2306          JR      NZ,WCR            IF NOT A CR
                        2307
006.012  315 302 003   2308          CALL    WCC             ELSE, ECHO CR
006.015  076 012       2309          MVI     A,A.LF          LINE FEED
006.017  315 302 003   2310          CALL    WCC
006.022  311           2311          RET
```

```
                        2313  ***     DAT     -       DATA BYTE OUTPUT TO Z-47
                        2314  *
                        2315  *       ENTRY:  (A) = BYTE TO OUTPUT
                        2316  *
                        2317  *       EXIT:   (A) = BYTE TO OUTPUT
                        2318  *               (D) = S.DTR
                        2319  *
                        2320  *       USE:    AF, D
                        2321
006.023                 2322  DAT     EQU     *
006.023  026 200        2323          MVI     D,S.DTR                 SET MATCH CONDITION TO DATA TRANSFER
006.025  030 002        2324          JR      COM1                    REQUEST BIT


                        2326  ***     COM     - OUTPUT COMMAND BYTE TO Z-47
                        2327  *
                        2328  *       ENTRY:  (A) = COMMAND BYTE
                        2329  *
                        2330  *       EXIT:   (A) = COMMAND BYTE
                        2331  *               (D) = S.DON
                        2332  *
                        2333  *       USE:    AF, D
                        2334
006.027                 2335  COM     EQU     *
006.027  026 040        2336          MVI     D,S.DON                 SET MATCH CONDITION TO DONE BIT
006.031  365            2337  COM1    PUSH    PSW
006.032  315 170 006    2338  WTDON1  CALL    IN.                     READ CONTROLLER STATUS REGISTER
006.035  242            2339          ANA     D                       GET MATCH BIT ONLY
006.036  050 372        2340          JR      Z,WTDON1                IF NO MATCH, WAIT
006.040  361            2341          POP     PSW
006.041  315 146 006    2342          CALL    OUT1.                   OUTPUT THE BYTE TO THE DATA PORT
006.044  311            2343          RET


006.045                 2345          ORG     6045A
                        2346  **      HRNX - HORN EXTENSION ROUTINE
                        2347  *
                        2348  *       THIS IS AN EXTENSION TO *HORN* TO MAKE ROOM FOR A JUMP
                        2349
006.045  056 011        2350  HRNX    MVI     L,#CTLFLG
006.047  163            2351          MOV     M,E             TURN OFF HORN
006.050  321            2352          POP     D
006.051  341            2353          POP     H
006.052  311            2354          RET
```

```
MTR89 - H89 MONITOR  V09.01.00                                Zenith Data Systems UNIX H8/H89 Cross Assembler   PA
GE   59
SUPPORT ROUTINES                                    NOISE          15:27:52  28-MAY-80


                          2356  **      NOISE - DING BELL ON CONSOLE
                          2357  *
                          2358  *       THIS IS A MODIFICATION TO ALLOW THE H88/H89 TO USE THE CONSOLE BELL
                          2359
 006.053  076 007         2360  NOISE   MVI     A,A,BEL
 006.055  315 302 003     2361          CALL    WCC
 006.060  303 140 002     2362          JMP     HORN            CONTINUE WITH NORMAL HORN DELAY



                          2364  **      OUT.    - OUTPUT BYTE TO Z-47
                          2365  *
                          2366  *       ENTRY:  (A) = OUTPUT BYTE
                          2367  *
                          2368  *       EXIT:   NONE
                          2369  *
                          2370  *       USE:    NONE
                          2371
 006.063                  2372  OUT.    EQU     *
 006.063  305             2373          PUSH    B
 006.064  107             2374          MOV     B,A             SAVE THE OUTPUT DATA
 006.065  072 120 041     2375          LDA     PRIM            GET PORT ADDRESS
 006.070  117             2376  OUT.1   MOV     C,A             SET TO REG C
 006.071  170             2377          MOV     A,B             GET OUTPUT BYTE DATA BACK
                          2378  *       OUT     (C),A           OUTPUT BYTE
 006.072  355 171         2379          DB      355Q,171Q
 006.074  301             2380          POP     B
 006.075  311             2381          RET



 006.100                  2383          ORG     6100H
                          2384  **      TYPMSG - TYPE MESSAGE TO CONSOLE
                          2385  *
                          2386  *       TYPMSG OUTPUTS AN ASCII MESSAGE FROM MEMORY TO THE CONSOLE
                          2387  *       UNTIL A NULL IS SENSED
                          2388  *
                          2389  *       ENTRY   (H,L) = ADDRESS OF MESSAGE
                          2390  *       EXIT    NONE
                          2391  *       USES    A,H,L,F
                          2392
                          2393
 006.100  176             2394  TYPMSG  MOV     A,M             GET CHARACTER
 006.101  267             2395          ORA     A               SEE IF A NULL
 006.102  310             2396          RZ                      IF NULL, EXIT
                          2397
 006.103  315 302 003     2398          CALL    WCC             ELSE OUTPUT CHARACTER TO CONSOLE
 006.106  043             2399          INX     H               POINT TO NEXT CHARACTER
 006.107  030 367         2400          JR      TYPMSG          OUTPUT IT
```

```
                                2402  **      MSG.PR - MESSAGE FOR MONITOR PROMPT
                                2403  *
                                2404  *       CRLF, '  H: '
                                2405
                                2406
     006.111  015 012 040      2407  MSG.PR  DB      A.CR,A.LF,'  H: ',0


                                2409  **      RDBLCK - INPUT A BLOCK FROM Z-47
                                2410  *
                                2411  *       RDBLCK  READS IN A BLOCK FROM THE DISK CONTROOLER
                                2412  *
                                2413  *       ENTRY:
                                2414  *               HL = LOAD ADDRESS
                                2415  *               B  = COUNT
                                2416  *               C  = SIDE/UNIT/SECTOR
                                2417  *
                                2418  *       EXIT:   NONE
                                2419  *
                                2420  *       USES:   ALL
                                2421
     006.121                    2422  RDBLCK  EQU     *
     006.121  076 007           2423  RD1     MVI     A,DC.REAB
     006.123  315 027 006       2424          CALL    COM                     SEND THE COMMAND
     006.126  257               2425          XRA     A                       FOR TRACK 0
     006.127  315 023 006       2426          CALL    DAT                     SEND IT TO DISK
     006.132  171               2427          MOV     A,C                     LOAD SIDE/UNIT/SECTOR
     006.133  315 023 006       2428          CALL    DAT                     SEND IT TO DISK
                                2429
     006.136  315 067 001       2430  RD2     CALL    PIN                     INPUT A BYTE FROM DISK
     006.141  167               2431          MOV     M,A                     STORE IN BUFFER
     006.142  043               2432          INX     H                       BUFFER TO NEXT ADDRESS
     006.143  020 371           2433          DJNZ    RD2
     006.145  311               2434          RET                             CONTINUE


                                2436  **      OUT1, - OUTPUT BYTE TO PORT (PRIM+1)
                                2437  *
                                2438  *       ENTRY:  (A) = OUTPUT PORT
                                2439  *
                                2440  *       EXIT:   NONE
                                2441  *
                                2442  *       USE:    NONE
                                2443
     006.146                    2444  OUT1,   EQU     *
     006.146  305               2445          PUSH    B
     006.147  107               2446          MOV     B,A                     SAVE THE OUTPUT DATA
     006.150  072 120 041       2447          LDA     PRIM                    GET PORT ADDRESS
     006.153  074               2448          INR     A                       SET TO (PRIM+1)
     006.154  030 312           2449          JR      OUT.1                   GO TO OUTPUT ROUTINE
```

```
                        2451  **      IN1.    - INPUT BYTE FROM (PRIM+1) PORT
                        2452  *
                        2453  *       ENTRY:  NONE
                        2454  *
                        2455  *       EXIT:   (A) = INPUT BYTE
                        2456  *
                        2457  *       USE:    A
                        2458
    006.156             2459  IN1.    EQU     *
    006.156  305        2460          PUSH    B
    006.157  072 120 041 2461          LDA     PRIM            GET PORT ADDRESS
    006.162  074        2462          INR     A               SET TO (PRIM+1)
    006.163  030 007    2463          JR      IN.1            GO TO INPUT ROUTINE


    006.165             2465          ORG     6165A
                        2466  **      MSG.GO - (G)O
                        2467  *
                        2468  *       'GO'
                        2469
    006.165  157 040 000 2470  MSG.GO DB      'o ',0


                        2472  **      IN.     - INPUT BYTE FROM PORT (PRIM)
                        2473  *
                        2474  *       ENTRY:  NONE
                        2475  *
                        2476  *       EXIT:   (A) = INPUT BYTE
                        2477  *
                        2478  *       USE:    A
                        2479
    006.170             2480  IN.     EQU     *
    006.170  305        2481          PUSH    B
    006.171  072 120 041 2482          LDA     PRIM            GET PORT ADDRESS
    006.174  117        2483  IN.1    MOV     C,A             SET ADDR. TO REG.C
                        2484  *       IN      A,(C)
    006.175  355 170    2485          DB      355Q,170Q       INPUT BYTE
    006.177  301        2486          POP     B
    006.200  311        2487          RET


    006.201             2489          ORG     6201A
                        2490  **      MSG.SUB - (S)UBSTITUTE
                        2491  *
                        2492  *       'SUBSTITUTE'
                        2493
    006.201  165 142 163 2494  MSG.SUB DB      'ubstitute ',0
```

```
                        2496  **      MSG.PC - (P)ROGRAM COUNTER
                        2497  *
                        2498  *       'PROGRAM COUNTER'
                        2499
 006.214 162 157 147    2500  MSG.PC  DB      'rogram Counter ',0


                        2502  **      MSG.BT - (B)OOT
                        2503  *
                        2504  *       'BOOT'
                        2505
 006.234 157 157 164    2506  MSG.BT  DB      'oot',0
```

```
                        2509  ***     SPEED - ROTATIONAL SPEED TEST FOR 5.25 INCH DISK DRIVE
                        2510  *
                        2511  *       *SPEED* IS USED ONLY FOR GROSS ADJUSTMENT OF DRIVE ROTATIONAL
                        2512  *       SPEED IF THE FIRST READ/WRITE TEST OF THE UNIT FAILS DURING SET UP.
                        2513  *
                        2514  *               USE OF *SPEED* IS AS FOLLOWS:
                        2515  *
                        2516  *                       1.  ENTER 'GO AND THE ENTRY ADDRESS OF *SPEED*
                        2517  *                       2.  ADJUST DRIVE SPEED UNTIL DATA AT DISPLAYED
                        2518  *                           EQUALS 200
                        2519  *                               A.  IF SPEED < 200, TURN ADJUSTMENT CLOCKWISE
                        2520  *                               B.  IF SPEED > 200, TURN COUNTERCLOCKWISE
                        2521  *
                        2522  *       THE ABOVE TEST ADJUSTS SY0:.  TO ADJUST SY1:, USE HDOS


                        2524  **      LABLE EQUIVALENCES
                        2525  *
                        2526  *       I/O PORTS
    000,177             2527  OP.DC   EQU     177Q            DRIVE CONTROL OUTPUT PORT
    000,177             2528  IP,DS   EQU     177Q            DRIVE STATUS INPUT PORT


                        2530  *       MASKS
                        2531  *
    000,001             2532  DS,HOLE EQU     00000001B       DRIVE STATUS SECTOR/INDEX HOLE


                        2534  *       CONSTANTS
                        2535  *
    000,022             2536  ONDRO   EQU     022Q            TURN ON SY0:
```

```
006,240 041 371 006  2538  SPEED   LXI   H,MSG.SPD      OUTPUT SPEED MESSAGE
006.243 315 100 006  2539          CALL  TYPMSG
006,246 076 000      2540          MVI   A,0            SET FLAG AT IOWRK FOR 'WORKING' MESSAGE
006.250 062 002 040  2541          STA   IOWRK
006,253 076 022      2542          MVI   A,ONDRO        TURN ON DRIVE ZERO
006.255 323 177      2543          OUT   OP.DC
006,257 052 033 040  2544  SPEED1  LHLD  TICCNT         GET TICK COUNTER
006.262 174          2545          MOV   A,H            FORM TWO'S COMPLEMENT OF TICK COUNTER
006,263 057          2546          CMA
006.264 127          2547          MOV   D,A            (D,E) = NEGATIVE TICK COUNTER
006,265 175          2548          MOV   A,L
006.266 057          2549          CMA
006,267 074          2550          INR   A
006.270 137          2551          MOV   E,A
006,271 322 275 006  2552          JNC   SPEED2         IF NO CARRY FROM LSB
                     2553
006,274 024          2554          INR   D              ELSE, INCREMENT MSB
006.275 001 000 000  2555  SPEED2  LXI   B,0            ZERO REV COUNTERS
006,300 333 177      2556  SPEED3  IN    IP.DS          INPUT DISK STATUS
006.302 346 001      2557          ANI   DS.HOLE        MASK FOR SECTOR/INDEX PULSES
006,304 312 300 006  2558          JZ    SPEED3         IF NO HOLE PRESENT
                     2559
                     2560  *       HOLE PRESENT, WAIT FOR IT TO LEAVE
                     2561  *
006,307 333 177      2562  SPEED4  IN    IP.DS          GET DISK STATUS
006.311 346 001      2563          ANI   DS.HOLE        GET HOLE PULSES
006,313 302 307 006  2564          JNZ   SPEED4         WAIT UNTIL HOLE IS GONE AND WE HAVE MEDIA
                     2565
006,316 004          2566          INR   B              INCREMENT HOLE COUNTER
006.317 170          2567          MOV   A,B            TEST FOR FIVE REVOLUTIONS
006,320 376 070      2568          CPI   56
006.322 302 300 006  2569          JNZ   SPEED3         NOT FIVE, WAIT FOR MORE HOLES
                     2570
                     2571  *       HAVE FIVE REVS, DISPLAY DIFFERENCE OF TICK COUNTER AND EXPECTED TIME DIF
                     2572  *
006.325 052 033 040  2573          LHLD  TICCNT         GET CURRENT TICK VALUE
006,330 031          2574          DAD   D              SUBTRACT START VALUE
006.331 021 214 376  2575          LXI   D,377377A-500+1+200Q   SUBTRACT 500 FOR REVS, +200Q FOR OFFSET
006,334 031          2576          DAD   D              (H,L) = OFFSET RESULT
006.335 345          2577          PUSH  H              SAVE RESULT
006,336 041 062 007  2578          LXI   H,MSG.WRK      POINT TO 'WORKING' MESSAGE
006.341 072 002 040  2579          LDA   IOWRK          GET 'WORKING' FLAG
006,344 356 001      2580          XRI   1              INVERT LOWER BIT
006.346 062 002 040  2581          STA   IOWRK          SAVE NEW VALUE
006,351 302 357 006  2582          JNZ   SPEED5         IF TO DISPLAY 'WORKING'
                     2583
006,354 041 100 007  2584          LXI   H,MSG.HSS      POINT TO 'HOME', 'SPACES', AND SPEED MSG
006.357 315 100 006  2585  SPEED5  CALL  TYPMSG         OUTPUT MESSAGE
006,362 341          2586          POP   H              GET TEST RESULT
006.363 315 325 005  2587          CALL  TOA.           OUTPUT RESULT TO CONSOLE
006,366 303 257 006  2588          JMP   SPEED1         PERFORM ANOTHER SAMPLE
```

```
MTR89 - H89 MONITOR  #09.01.00.                          Zenith Data Systems UNIX H8/H89 Cross Assembler   PA
GE    65
SPEED - ROTATIONAL SPEED TEST FOR H89 DISK DRIVE                MSG.SPD         15:27:55  28-MAY-80


                          2590  **      MSG.SPD - SPEED TEST MESSAGE
                          2591  *
                          2592  *       '       Disk drive rotational speed test.
                          2593  *
                          2594  *
                          2595  *                       Drive speed = '
                          2596
    006.371  033 105 012  2597  MSG.SPD DB      A.ESC,'E',A.LF
    006.374  011 104 151  2598          DB      '       Disk drive rotational speed test.',A.CR,A.LF,A.LF
    007.041  011 011 104  2599          DB      '               Drive speed = '
    007.061  000          2600          DB      0


                          2602  **      MSG.WRK - 'WORKING' MESSAGE FOR SPEED TEST
                          2603  *
                          2604  *       DISPLAYS 'WORKING' AT HOME POSITION AND RETURNS CURSOR TO SPEED =
                          2605
    007.062  033 110      2606  MSG.WRK DB      A.ESC,'H'       CURSOR HOME
    007.064  127 157 162  2607          DB      'Working'
    007.073  033 131 043  2608          DB      A.ESC,'Y#>'     CURSOR ADDRESS OF SPEED = VALUE
    007.077  000          2609          DB      0               END MESSAGE


                          2611  **      MSG.HSS - BLANKS 'WORKING' MESSAGE
                          2612  *
                          2613
    007.100  033 110      2614  MSG.HSS DB      A.ESC,'H'       CURSOR HOME
    007.102  040 040 040  2615          DB      '   '           BLANKS
    007.111  033 131 043  2616          DB      A.ESC,'Y#>'     CURSOR ADDRESS OF SPEED = VALUE
    007.115  000          2617          DB      0               END MESSAGE
```

```
                        2620  **      DYMEM - DYNAMIC MEMORY TEST
                        2621  *
                        2622  *       DYMEM TESTS THE DYNAMIC MEMORY IN THE H88/H89 BY PLACING
                        2623  *       A KNOWN PATTERN IN EACH DYNAMIC MEMORY CELL AND THEN
                        2624  *       PERFORMING A READ, INCREMENT, READ SEQUENCE WITH A DELAY
                        2625  *       BETWEEN EACH PASS OF THE TEST
                        2626  *
                        2627  *
                        2628  *       ENTRY   NONE
                        2629  *
                        2630  *       EXIT    ON RESET
                        2631  *
                        2632  *       USES    A,B,C,D,E,H,L,F,A',F',IX,IY
                        2633
                        2634
007.116  076 000        2635  DYMEM   MVI     A,0             MAKE SURE CLOCK AND SINGLE STEP ARE OFF
007.120  323 362        2636          OUT     H88,CTL
                        2637
                        2638  *       DETERMINE END OF MEMORY
                        2639  *
000.001                 2640          IF      .RAM.
                        2643          ELSE
007.122  041 000 040    2644  DYMEM1  LXI     H,START
                        2645          ENDIF
007.125  076 001        2646          MVI     A,1
007.127  066 000        2647  DYMEM2  MVI     M,0             SET RAM TO ZERO
007.131  064            2648          INR     M               SET MEMORY TO ONE
007.132  276            2649          CMP     M               SEE IF (A) = ((H,L))
007.133  040 003        2650          JR      NZ,DYMEM3       IF NOT EQUAL, THE END OF RAM HAS BEEN REACHED
                        2651
007.135  043            2652          INX     H               ELSE, POINT TO NEXT LOCATION IN RAM
007.136  030 367        2653          JR      DYMEM2
                        2654
                        2655
007.140  053            2656  DYMEM3  DCX     H               POINT TO LAST GOOD LOCATION
007.141  353            2657          XCHG                    PUT ENDING ADDRESS IN D,E
007.142  041 324 007    2658          LXI     H,MSG.RAM       OUTPUT ENDING ADDRESS
                        2659
                        2660  *       LD      IX,DY3.3        RETURN ADDRESS
007.145  335 041        2661          DB      MI.LDXA,MI.LDXB
007.147  153 007        2662          DW      DY3.3
                        2663
007.151  030 133        2664          JR      DYMSG
                        2665
007.153  172            2666  DY3.3   MOV     A,D             OUTPUT ADDRESS MSB
                        2667
                        2668  *       LD      IX,DY3.5        RETURN ADDRESS
007.154  335 041        2669          DB      MI.LDXA,MI.LDXB
007.156  163 007        2670          DW      DY3.5
                        2671
007.160  303 160 003    2672          JMP     DYBYT
                        2673
007.163  173            2674  DY3.5   MOV     A,E             LSB
                        2675
                        2676  *       LD      IX,DY3.7        RETURN ADDRESS
007.164  335 041        2677          DB      MI.LDXA,MI.LDXB
```

```
007.166  173 007      2678          DW      DY3.7
                      2679
007.170  303 160 003  2680          JMP     DYBYT
                      2681
007.173  023          2682  DY3.7   INX     D               (D,E) = LAST BYTE OF RAM + 1
                      2683
                      2684  *       TEST MEMORY
                      2685  *
007.174  006 001      2686          MVI     B,1             (B) = CONTENTS OF RAM AFTER SIZING
007.176  041 237 003  2687          LXI     H,MSG.PAS       OUTPUT PASS MESSAGE
                      2688
                      2689  *       LD      IX,DYMEM4       RETURN ADDRESS
007.201  335 041      2690          DB      MI.LDXA,MI.LDXB
007.203  207 007      2691          DW      DYMEM4
                      2692
007.205  030 077      2693          JR      DYMSG
                      2694
000.001               2695          IF      .RAM.
                      2697          ELSE
007.207  041 000 040  2698  DYMEM4  LXI     H,START         POINT BACK TO BEGINNING OF RAM
                      2699          ENDIF
007.212  176          2700  DYMEM5  MOV     A,M             READ CURRENT CONTENTS
007.213  270          2701          CMP     B               SEE IF CORRECT CONTENTS STILL REMAIN
007.214  302 307 000  2702          JNZ     DYMEM9          FAILURE, SEE IF AT END OF RAM
                      2703
007.217  074          2704          INR     A
007.220  167          2705          MOV     M,A             INCREMENT RAM
007.221  276          2706          CMP     M               SEE IF WRITE WAS SUCCESSFUL
007.222  302 307 000  2707          JNZ     DYMEM9
                      2708
007.225  043          2709          INX     H
007.226  175          2710          MOV     A,L             GET LSB AND TEST FOR REACHING END OF RAM
007.227  273          2711          CMP     E
007.230  040 360      2712          JR      NZ,DYMEM5       IF LSB NOT EQUAL
                      2713
007.232  174          2714          MOV     A,H             CHECK LSB
007.233  272          2715          CMP     D
007.234  040 354      2716          JR      NZ,DYMEM5
                      2717
                      2718  *       HAVE REACHED END OF MEMORY!
                      2719  *       OUTPUT LAST VALUE TESTED
                      2720  *
007.236  046 003      2721          MVI     H,3             OUTPUT 3 BACKSPACES
007.240  076 010      2722          MVI     A,A.BKS
                      2723
007.242               2724  DYME5.5 EQU     *
                      2725
                      2726  *       LD      IY,DY5.53       RETURN ADDRESS
007.242  375 041      2727          DB      MI,LDYA,MI.LDYB
007.244  251 007      2728          DW      DY5.53
                      2729
007.246  303 143 003  2730          JMP     DYASC
                      2731
007.251  045          2732  DY5.53  DCR     H
007.252  040 366      2733          JR      NZ,DYME5.5
                      2734
```

```
007.254  004              2735            INR     B               SHOW NEXT PASS VALUE
007.255  170              2736            MOV     A,B             VALUE TESTED
                          2737
                          2738  *         LD      IX,DYMEM6       RETURN ADDRESS
007.256  335 041          2739            DB      MI.LDXA,MI.LDXB
007.260  273 000          2740            DW      DYMEM6
                          2741
007.262  303 160 003      2742            JMP     DYBYT
                          2743
                          2744
                          2745  **        !!THE DYNAMIC RAM TEST CONTINUES ELSEWARE!!      **
                          2746  *         !!AND THEN RETURNS TO HERE!!!!!!!!!!!!!!!!!      **
                          2747
                          2748
007.265  041 000 000      2749  DY10.5    LXI     H,0             DELAY AND DING BELL AGAIN
007.270  006 002          2750            MVI     B,2             2 LOOPS
007.272  045              2751  DYMEM11   DCR     H
007.273  040 375          2752            JR      NZ,DYMEM11
                          2753
007.275  055              2754            DCR     L
007.276  040 372          2755            JR      NZ,DYMEM11
                          2756
007.300  005              2757            DCR     B
007.301  040 367          2758            JR      NZ,DYMEM11
                          2759
007.303  303 360 003      2760            JMP     DYMEM10         AGAIN


                          2762  **        DYMSG - DYNAMIC RAM TEST MESSAGE OUTPUT ROUTINE
                          2763  *
                          2764  *         ENTRY   (H,L) = MESSAGE ADDRESS
                          2765  *                 (IX) = RETURN ADDRESS
                          2766  *
                          2767  *         EXIT    TO (IX)
                          2768  *
                          2769  *         USES    A,H,L,F,IY
                          2770
                          2771
007.306  176              2772  DYMSG     MOV     A,M             GET MESSAGE BYTE
                          2773
                          2774  *         LD      IY,DYMSG.5      RETURN ADDRESS
007.307  375 041          2775            DB      MI.LDYA,MI.LDYB
007.311  316 007          2776            DW      DYMSG.5
                          2777
007.313  303 143 003      2778            JMP     DYASC           OUTPUT ASCII
                          2779
007.316  267              2780  DYMSG.5   ORA     A               SEE IF NULL TO END STRING
007.317  043              2781            INX     H               POINT TO NEXT CHARACTER
007.320  040 364          2782            JR      NZ,DYMSG        IF NOT DONE YET
                          2783
                          2784  *         JP      (IX)            RETURN TO CALLER
007.322  335 351          2785            DB      MI.JIXA,MI.JIXB
```

```
                        2787  **      MSG.RAM - RAM TEST MESSAGE
                        2788  *
                        2789
    007.324  033 105     2790  MSG.RAM DB      A.ESC,'E'
    007.326  104 171 156 2791          DB      'Dynamic RAM test'
    007.346  015 012 012 2792          DB      A.CR,A.LF,A.LF
    007.351  011 040 114 2793          DB      '       LWA = '
    007.361  000         2794          DB      0


                        2796  **      MSG.EQ - EQUALS MESSAGE
                        2797  *
                        2798
    007.362  040 075 040 2799  MSG.EQ  DB      ' = '
    007.365  000         2800          DB      0
                        2801
    007.366  107 101 103 2802          DB      'GAC.'
```

```
                        2805  **      ENTRY POINT FOR FLOPPY DISK ROTATIONAL SPEED TEST
                        2806  *
    000.001             2807          IF      .RAM.
                        2808          ELSE
    000.000             2809          ERRNZ   10000A-6-*      MUST BE SIX BYTES BEFORE END
                        2810          ENDIF
                        2811
    007.372 303 240 006 2812  ESPEED  JMP     SPEED


                        2814  **      ENTRY POINT FOR DYNAMIC MEMORY TEST
                        2815  *
    000.001             2816          IF      .RAM.
                        2817          ELSE
    000.000             2818          ERRNZ   10000A-3-*      MUST BE THREE BYTES BEFORE END
                        2819          ENDIF
                        2820
    007.375 303 116 007 2821  EDYMEM  JMP     DYMEM
                        2822
    000.001             2823          IF      .RAM.
                        2824          ELSE
    000.000             2825          ERRNZ   *-10000A        MUST NOT EXCEED 2K BYTES
                        2826          ENDIF
                        2827
```

```
                        2830  **      THE FOLLOWING ARE CONTROL CELLS AND FLAGS USED BY THE KEYSET
                        2831  *       MONITOR.
                        2832
    040.000             2833          ORG     40000A          8192
    040.000             2834  START   DS      2               DUMP STARTING ADDRESS
    040.002             2835  IOWRK   DS      2               IN OR OUT INSTRUCTION
    040.004             2836  PRSRAM  EQU     *               FOLLOWING CELLS INITIALIZED FROM ROM
    040.004             2837          DS      1               RET
                        2838
    040.005             2839  REGI    DS      1               INDEX OF REGISTER UNDER DISPLAY
    040.006             2840  DSPROT  DS      1               PERIOD FLAG BYTE
    040.007             2841  DSPMOD  DS      1               DISPLAY MODE
                        2842
    040.010             2843  .MFLAG  DS      1               USER FLAG OPTIONS
                        2844  *                               SEE *HO.XXX* BITS DESCRIBED AT FRONT
                        2845
    040.011             2846  CTLFLG  DS      1               FRONT PANEL CONTROL BITS
    040.012             2847  REFIND  DS      1               REFRESH INDEX (0 TO 7)
    000.007             2848  PRSL    EQU     *-PRSRAM        END OF AREA INITIALIZED FROM ROM
                        2849
    040.013             2850  FPLEDS  EQU     *               FRONT PANEL LED PATTERNS
    040.013             2851  ALEDS   DS      1               ADDR 0
    040.014             2852          DS      1               ADDR 1
    040.015             2853          DS      1               ADDR 2
                        2854
    040.016             2855          DS      1               ADDR 3
    040.017             2856          DS      1               ADDR 4
    040.020             2857          DS      1               ADDR 5
                        2858
    040.021             2859  DLEDS   DS      1               DATA 0
    040.022             2860          DS      1               DATA 1
    040.023             2861          DS      1               DATA 2
                        2862
    040.024             2863  ABUSS   DS      2               ADDRESS BUSS
    040.026             2864  RCCA    DS      1               RCC SAVE AREA
    040.027             2865  CRCSUM  DS      2               CRC-16 CHECKSUM
    040.031             2866  TPERRX  DS      2               TAPE ERROR EXIT ADDRESS
    040.033             2867  TICCNT  DS      2               CLOCK TIC COUNTER
                        2868
    040.035             2869  REGPTR  DS      2               REGISETR CONTENTS POINTER
                        2870
    040.037             2871  UIVEC   DS      0               USER INTERRUPT VECTORS
    040.037             2872          DS      3               JUMP TO CLOCK PROCESSOR
    040.042             2873          DS      3               JUMP TO SINGLE STEP PROCESSOR
    040.045             2874          DS      3               JUMP TO I/O 3
    040.050             2875          DS      3               JUMP TO I/O 4
    040.053             2876          DS      3               JUMP TO I/O 5
    040.056             2877          DS      3               JUMP TO I/O 6
    040.061             2878          DS      3               JUMP TO I/O 7
                        2879
                        2880  **      H88/H89 RAM USAGE BEYOND THAT OF H8MTRF
                        2881  *
    040.064             2882  NMIRET  DS      2
                        2883  *
    041.120             2884          ORG     41120A
    041.120             2885  PRIM    DS      1               PRIMARY DEVICE ADDR. PORT
```

```
041,121                 2886  TMFG    DS      1               TIMER INTERRUPT FLAG, =1 FOR Z47, =0 FOR H17
041,122                 2887  MYCNT   DS      1               COUNTER FOR TIMER INTERRUPT
041,123                 2888  AUTOB   DS      1               AUTO BOOT FLAG
041,124                 2889  STK     DS      2               STACK POINTER FOR RE-BOOT
                        2890
040,066                 2891          ORG     40066A
040,066                 2892  DATA    DS      1               OUTPUT 362Q DATA SAVE AREA
040,067                 2893          END
ASSEMBLY COMPLETE
 2893 STATEMENTS
    0 ERRORS DETECTED
14204 BYTES FREE
```

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```
$MOVE   030252   340E   1343
$ZERO   031212   342E   1401
.       000004   533S    732S   910S  1084S  1849S  1850
.MFLAG  040010   732     780    853    859   1208   1324   1409   2843L
.RAM.   000001    42E     44    472    492    500    511    523    544    554    564    578    588
                 600     619    646    674    696    707    727    740    761    847    868    947   1049
                1060    1076   1270   1278   1477   1497   1515   1544   1765   1780   2640   2695   2807
                2816    2823
.UIVEC  040037   344E   1373   1410   1421
A.BEL   000007   156E    797    895   1118   1751   2100   2128   2154   2197   2360
A.BKS   000010   157E   2722
A.CR    000015   159E    936   1004   1025   1108   1564   1643   2071   2097   2125   2145   2247
                2305   2407   2598   2792
A.DEL   000177   161E   1692   2021
A.ESC   000033   160E   2597   2606   2608   2614   2616   2790
A.LF    000012   158E    936    936   1028   1643   2249   2309   2407   2597   2598   2598   2792
                2792
A.STX   000002   155E
A.SYN   000026   154E
ABUSS   040024   952    2863L
AC.DLY  000156   405E
AIO.UNI 041061   343E   1145   1171   1233
ALARM   002136   863    1275E
ALARMB  002166  1276    1304L
ALEDS   040013  2851L
AS.ODD  000100   227E   1189
AS.IDD  000040   228E
AS.S1A  000020   229E
AS.SLW  000003   230E
ATB     004243  1258    1973L
AUTOB   041123  1256    1836   2888L
AUTOBO  001212  1040L   1976
B170    003040  1436    1439   1460E
B174    003012  1437    1440L
BH17    003030  1444    1453L
BOOT    004256   921    1988L
BOOTO   001336  1042    1109   1137L
BOOT2   002335  1411L   1418
BOOT5   001341  1113    1140L
BOOT6   001353  1138    1145L
BOOTA   037132   339E   1341
BOOTAL  000130   338E   1340
BOOTX   004274  1977    1993L
BR19.2  004103  1845L
BR96    004101  1844L
BRTAB   004101  1797    1842E  1850
BSEC    001325  1129E
BSMSG   001041   927L   1130
C.128   000200   259E
C.256   001000   258E
C.DSYN  000375   301E
CB.CLI  000100   167E    202    596    858   1949
CB.MTL  000040   166E    715    777    858   1086
CB.SPK  000200   168E    596    858   1284
CB.SSI  000020   165E    596    715    858   1068   1082   1949
CHAT2   002130  1255    1259L
CKAUTO  002113   879    1252E
CLK4    000270   784     807E
```

```
CLOCK    000201      510      513     766L
CLOCK17  034031      345E    1372     2045
COM      006027     1185     2335E    2424
COM1     006031     2324     2337L
CRCSUM   040027     2865L
CS.UNR   000200      222E
CS.WPD   000100      223E
CTLFLG   040011      533      770      775      780      859     1067     1070     1084     1289     1857     2350     2846L
CUI1     000165      733L     796      808
D.CON    040110      316L    1342
D.DAT    000171      212E
D.DECNT  040264      352E    1232
D.RAM    040240      319L    1399
D.RAML   000037      341E    1400
D.SDP    040206      348E    1349
D.STA    000170      211E     212     1423
D.VEC    040130      318L
DAT      006023     1187     2322E    2426     2428
DATA     040066     1837     1957     2892L
DC.BOOT  000000      234E
DC.CPY   000013      245E
DC.FRM0  000014      246E
DC.FRM1  000015      247E
DC.FRM2  000016      248E
DC.FRM3  000017      249E
DC.LSC   000003      237E
DC.RAD   000004      238E
DC.RAS   000002      236E    1184
DC.REA   000005      239E
DC.REAB  000007      241E    2423
DC.RST   000001      235E
DC.WRD   000011      243E
DC.WRDB  000012      244E
DC.WRI   000006      240E
DC.WRIB  000010      242E
DEV2     003025     1446L    1464
DEVICE   002301     1041     1106     1393E
DF.DI    000040      277E
DF.DS0   000002      273E
DF.DS1   000004      274E
DF.DS2   000010      275E
DF.HD    000001      267E
DF.MO    000020      276E
DF.SD    000010      270E
DF.ST    000100      278E
DF.TO    000002      268E
DF.WG    000001      272E
DF.WP    000004      269E
DF.WR    000200      279E
DLEDS    040021     2859L
DLY      000053      583L
DM.MR    000000      172E
DM.MW    000001      173E
DM.RR    000002      174E
DM.RW    000003      175E
DOD      003122     1549L
DP.DC    000177      265E    1325     1402
DS.HOLE  000001     2532E    2557     2563
```

```
DSPMOD  040007  2841L
DSPROT  040006  2840L
DY10.5  007265  1755    2749L
DY3.3   007153  2662    2666L
DY3.5   007163  2670    2674L
DY3.7   007173  2678    2682L
DY5.53  007251  2728    2732L
DY9.3   003315   830    1717L
DY9.4   003326  1722    1726L
DY9.5   003335  1730    1734L
DY9.8   003350  1739    1743L
DYASC   003143  1577E   1611   1624   1634   1757   2730   2778
DYASC1  003144  1580L   1582
DYBYT   003160  1597L   1724   1732   1749   2672   2680   2742
DYBYT.2 003202  1609    1613L
DYBYT.4 003221  1622    1626L
DYBYT.6 003235  1632    1636E
DYME5.5 007242  2724E   2733
DYMEM   007116  1830    2635L  2821
DYMEM1  007122  2644L
DYMEM10 003360  1747    1751L  2760
DYMEM11 007272  2751L   2752   2755   2758
DYMEM2  007127  2647L   2653
DYMEM3  007140  2650    2656L
DYMEM4  007207   821    2691   2698L
DYMEM5  007212  2700L   2712   2716
DYMEM6  000273   815L   2740
DYMEM7  000276   816L    819
DYMEM9  000307   825L   2702   2707
DYMSG   007306   832    1741   2664   2693   2772L  2782
DYMSG.5 007316  2776    2780L
EDYMEM  007375  2821L
EIXIT   034027   350E   1413   1415
ERPTCNT 000012   351E   1231
ERRMSG  001045   929L   1322
ERROR   000322   654     801    852E  1326   1693
ESPEED  007372  2812L
FPLEDS  040013  2850E
GO      001222  1030    1054L
GO.     000063   596L   1054   1997
GO88    001146   912    1015L
GO88.1  001177  1018    1027L
H17     002207  1339E   1453
H17A    002237  1357L   1359
H88.CTL 000362   130E   1791   1959   2636
H88.SW  000362   134E   1253   1430   1798   1828
H88B.CK 000002   131E   1790
H88B.SS 000001   132E
H88S.0  000014   140E   1462
H88S.4  000003   142E   1443
H88S.AT 000200   135E   1254
H88S.BR 000100   136E   1799
H88S.DV 000020   138E   1432
H88S.M  000040   137E   1829
HORN    002140  1283L   2362
HRN0    002143   585    1286L
HRN2    002160  1297L   1298
HRNX    006045  1300    2350L
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IN.      006170      966      1205     2338     2480E
IN.1     006174     2463      2483L
IN1.     006156      969      2459E
INIT     000073      490       494      624L     628
INIT0    000000      488L
INIT0.0  000003      489L     1838
INIT0X   004000      488      1790L
INIT0X1  004050     1821L     1822     1824
INIT1    000107      637L      642
INIT2    000117      644L
INT1     000010      503E
INT2     000020      526E
INT3     000030      549L
INT4     000040      559L
INT5     000050      569L
INT6     000060      593L
INT7     000070      605L
INTXIT   000172      745L      778     1072
IOA      003062     1005      1026     1502L    2072
IOA1     005176     1502      2170L
IOA2     005204     2174L     2192     2201
IOA3     005242     2176      2179     2194L
IOA4     005260     2195      2205L
IOB      003066     1520L
IOB1     003070     1521L     1528     1560     1567
IOB1.S   003126     1539      1557L
IOB2     003135     1526      1564L
IOC      005301     2081      2116     2230L
IOWRK    040002     2070      2541     2579     2581     2835L
IP.DS    000177     2528E     2556     2562
IP.PAD   000360      124E
IP.TPC   000371      147E
IP.TPD   000370      149E
IROC     005150      994       998     1017     2067     2144L    2156
IROC1    005166     2149      2154L
LRA      003047     1482L
LRA.     003052      789       988     1022     1483L    1975     1991
MI.ANI   000346      184E
MI.EXAF  000010      191E     1114     1116     1122     1394     1433     1435     1438     1579     1585     2027     2040
                    2043
MI.HLT   000166      179E      795
MI.IN    000333      181E     1929     1938
MI.JIXA  000335      192E     1638     2785
MI.JIXB  000351      193E     1638     2785
MI.JIYA  000375      194E     1588
MI.JIYB  000351      195E     1588
MI.JMP   000303      186E     1411
MI.LDA   000072      183E
MI.LDXA  000335      187E      829     1721     1729     1738     1746     2661     2669     2677     2690     2739
MI.LDXB  000041      188E      829     1721     1729     1738     1746     2661     2669     2677     2690     2739
MI.LDYA  000375      189E     1608     1621     1631     1754     2727     2775
MI.LDYB  000041      190E     1608     1621     1631     1754     2727     2775
MI.LXID  000021      185E
MI.OUT   000323      182E     1926     1945
MI.RET   000311      180E     1778
MSG.BT   006234     1988      2506L
MSG.EQ   007362     1735      2799L
MSG.ERR  001047      826       936L
```

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```
MSG.GO  006165  1015   2470L
MSG.HSS 007100  2584   2614L
MSG.PAS 003237  1643L  2687
MSG.PC  006214   985   2500L
MSG.PR  006111  1259   2407L
MSG.RAM 007324  2658   2790L
MSG.SPD 006371  2538   2597L
MSG.SUB 006201  2065   2494L
MSG.WRK 007062  2578   2606L
MTR     000344   873E  1087
MTR.15  000354   880L  1260
MTR.2   000357   882L   897
MTR.3   000371   886L   893
MTR.4   001014   887    899L
MTR1    000345   876E  877
MTRA    001025   884    909E   923
MTRAL   000004   885    923E
MYCNT   041122  1404   2032   2887L
NB7     001316  1115   1122L
NBOOT   001261  1105L  1992
NBOOT0  001262  1106L  1133
NMI     004116   705   1898L
NMI0,5  004154  1916   1919   1924L
NMI1    004173  1911   1936L
NMI1,5  004206  1939   1945L
NMI2    004212  1948L
NMI2.2  004225  1955   1957L
NMI2.5  004236  1922   1927   1930   1946   1963L
NMI3    004237  1934   1943   1965L
NMIENT  000146   705L
NMIRET  040064  1899   1906   2882L
NODEV   002171  1148   1207   1321E  1368   2022   2036
NOISE   006053  1304   2360L
ONDRO   000022  2536E  2542
OP.CTL  000360   125E   771   1069   1083
OP.DC   000177  2527E  2543
OP.DIG  000360   126E
OP.SEG  000361   127E
OP.TPC  000371   148E   660
OP.TPD  000370   150E
OUT.    006063  1180   2372E
OUT.1   006070  2376L  2449
OUT1.   006146  2342   2444E
PCA     001103   918    985L
PCA1    001137   995   1003L
PIN     001067   965E   968   1188   2430
PRIM    041120  1424   1441   2375   2447   2461   2482   2885L
PRSL    000007   489   2848E
PRSRAM  040004   489   2836E  2848
PRSROM  003371  1771E  1834
R.ABORT 033366   346E  1363
R.READ  034077   347E  1367
R.SDP   002071  1230E  1348   1356
R.SDP1  002110  1236   1238L
RCC     003262   882   1107   1521   1684E  2144   2174   2230   2304
RCC1    003262  1686L  1688
RCC2    003270  1690L
RCCA    040026  2864L
```

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RCK       003260  1663E
RD1       006121  2423L
RD2       006136  2430L   2433
RDBLCK    006121  1198    1201    2422E
REFIND    040012  2847L
REGI      040005  1482    2839L
REGPTR    040035   719     861    1485    2869L
RESET     002003  1179L
RETRY     002063  1222L   2041
ROMBOOT   030000   311E
S.DON     000040   215E   2336
S.DTR     000200   216E    967    2323
S.ERR     000001   214E   1206
S.GRT     024000   308E
S.GRT1    025000   309E
S.INT     040343   321L
S.SOVR    041146   323L    325
S.VAL     040277   320L
SAE       001063   952L
SAVALL    000132   508     531    679L
SAVALLR   000151   709     712E   1859
SAVALLX   004105   694    1854E
SC.ACE    000350   404E   1580   1586   1686   1690   1707   1712   1796   1808   1811   1813   1815
                  2015   2019
SC.UART   000372   364E
SDP3      036073   349E   1238
SECOND    003007  1434    1438L
SECSCR    026000   310E
SINCR     004000   630E    632    633
SPEED     006240  2538L   2812
SPEED1    006257  2544L   2588
SPEED2    006275  2552    2555L
SPEED3    006300  2556L   2558   2569
SPEED4    006307  2562L   2564
SPEED5    006357  2582    2585L
SST1      001235   597    1070L
SSTEP     001225  1065E
STACK     042200   327E
STACKL    001032   325E
START     040000   633    2644   2698   2834L
START1    001265  1107L   1120
STK       041124  1167    1222   2889L
STPRTN    001244   534    1081E
SUBM      004370   915    2065L
SUBM1     005013  2075L   2088   2095
SUBM2     005027  2081L   2102
SUBM3     005042  2087L   2120
SUBM4     005046  2085    2090L
SUBM5     005053  2093L   2123
SUBM6     005062  2091    2097L
SUBM7     005075  2082    2104L
SUBM8     005077  2106L   2117
SUBM9     005115  2116L   2130
SYDD      040130   317E
TICCNT    040033   766     768   1293   1403   2028   2544   2573   2867L
TMFG      041121  1407    1455   2024   2032   2886L
TMOUT     004302  1420    2014E
TMOUT1    004345  2037L   2039
```

```
MTR89 - H89 MONITOR  #09.01.00.                                  XREF V1.1
  CROSS REFERENCE TABLE                                          PAGE  79

  TMOUT2  004361      2030      2038    2043L
  TMOUT3  004363      2042      2045L
  TMOUT4  004321      2017      2024L
  TOA     005313       997      2075    2247L
  TOA.    005325      2252L     2587
  TOB     005343      2077      2253    2255    2270L
  TOB1    005353      2277L     2285
  TPERRX  040031      2866L
  TYPMSG  006100       880       986    1016    1131    1323    1989    2066    2394L   2400    2539    2585
  UC.2SB  000004      430E
  UC.5BW  000000      426E
  UC.6BW  000001      427E
  UC.7BW  000002      428E
  UC.8BW  000003      429E      1812
  UC.RI   000020      449E
  UC.CTS  000020      458E
  UC.DCS  000001      454E
  UC.DDR  000002      455E
  UC.DLA  000200      435E      1795
  UC.DR   000001      445E      1687    2016
  UC.DRL  000010      457E
  UC.DSR  000040      459E
  UC.DTR  000001      438E
  UC.EDA  000001      416E
  UC.EPS  000020      432E
  UC.FE   000010      448E
  UC.IID  000006      423E
  UC.IIP  000001      422E
  UC.LOO  000020      442E
  UC.MSI  000010      419E
  UC.OR   000002      446E
  UC.OU1  000004      440E
  UC.OU2  000010      441E
  UC.PE   000004      447E
  UC.PEN  000010      431E
  UC.RI   000100      460E
  UC.RLS  000200      461E
  UC.RSI  000004      418E
  UC.RTS  000002      439E
  UC.SB   000100      434E
  UC.SKP  000040      433E
  UC.TER  000004      456E
  UC.THE  000040      450E      1581    1708
  UC.TRE  000002      417E
  UC.TSE  000100      451E
  UCI.ER  000020      386E
  UCI.IE  000002      388E
  UCI.IR  000100      384E
  UCI.RE  000004      387E
  UCI.RO  000040      385E
  UCI.TE  000001      389E
  UDR     000000      361E
  UF.FCT  000100      294E
  UF.RDA  000001      291E
  UF.ROR  000002      292E
  UF.RPE  000004      293E
  UF.TBM  000200      295E
  UIVEC   040037       549       559     569     593     605     736    1088    2871L
```

```
UMI.16X 000002      379E      659
UMI.1B  000100      369E      659
UMI.1X  000001      378E
UMI.2B  000300      371E
UMI.64X 000003      380E
UMI.HB  000200      370E
UMI.L5  000000      374E
UMI.L6  000004      375E
UMI.L7  000010      376E
UMI.L8  000014      377E      659
UMI.PA  000020      373E
UMI.PE  000040      372E
UNT.0   000000      253E
UNT.1   000040      254E
UNT.2   000100      255E
UNT.3   000140      256E
UO.CLK  000001      204E      734   1408
UO.DDU  000002      203E      855
UO.HLT  000200      201E      782
UO.NFR  000100      202E      855
UP.DP   000174      285E     1440
UP.FC   000175      286E
UP.SC   000176      288E
UP.SR   000176      289E
UP.ST   000175      287E
UR.DLL  000000      411E     1811
UR.DLM  000001      413E     1808
UR.IER  000001      415E     1815
UR.IIR  000002      421E
UR.LCR  000003      425E     1796  1813
UR.LSR  000005      444E     1580  1686  1707  2015
UR.MCR  000004      437E
UR.MSR  000006      453E
UR.RBR  000000      407E     1690  2019
UR.THR  000000      409E     1586  1712
USERFWA 042200      328E     1196  1209  1364  1374
USR     000001      362E
USR.FE  000040      393E
USR.OE  000020      394E
USR.PE  000010      395E
USR.RXR 000002      397E
USR.TXE 000004      396E
USR.TXR 000001      398E
W.RES   000002      218E     1179
WCC     003302      798       800   896   899  1027  1029  1119  1140  1532  1706L 2079  2093
                   2101      2106  2129  2155  2181  2198  2205  2248  2250  2258  2282  2289  2308
                   2310      2361  2398
WCC1    003303     1707L     1709
WCR     006003     1143      2304L 2306
WHD     036235      335E     1358
WNH     036271      336E     1357
WRONG   001307     1111      1117E 1125
WTDON1  006032     2338L     2340
Z47     001364     1164E     1425  1449
Z47A    001370     1169E     1224
```

22314 BYTES FREE

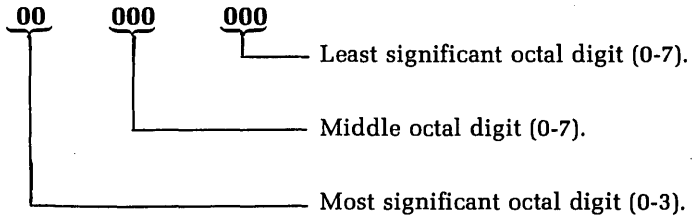
APPENDIX B

OCTAL DEFINITIONS

Binary numbers are converted to octal format for display. The following table shows binary to octal conversion.

BINARY NUMBER	OCTAL DIGIT
000	0
001	1
010	2
011	3
100	4
101	5
110	6
111	7

Each byte is displayed as two-and-one-half octal digits. The octal numbers lie in the range of 000 to 377 for binary numbers in the range 00000000 to 11111111, as shown below.



NOTE: As there are only eight bits in a byte, the most significant octal digit only represents two bits and is therefore displayed as 0 to 3. If the user should inadvertently enter the octal digits 4 to 7 into the most significant digit, the most significant bit is lost. Losing this bit converts 4 through 7 into the digits 0 through 3 respectively.

Also note that 16-bit numbers, such as memory addresses and certain register contents, are displayed as two eight-bit numbers. Therefore, the representation of 16-bit numbers is made up of **two** groups of three octal numbers in the range of 000 to 377. This representation of 16-bit binary numbers is known as offset octal or **split-octal**, and is used consistantly for displays of 16-bit numbers.

Split-octal must not be confused with octal. For example:

11 111 111 11 111 111	A 16-bit binary number
3 7 7 3 7 7	Split-octal representation (377 377)
1 111 111 111 111 111	A 16-bit binary number
1 7 7 7 7 7	True Octal representation (177777)

The lower example shows true octal representation of a 16-bit binary number. True octal representation is never used in standard Zenith Data Systems software. Occassionally you will see split-octal numbers printed with a decimal point separating the upper and lower bytes. For example:

377.377

Hi Byte Lo Byte

Note that 001.000 follows 000.377.