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Am96/4116 MonoBoard Computer Monitor (Am96/4630) User's Manual

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PREFACE

This manual provides operating instructions for the Monitor program used with the Am96/4116 AmZ8000 16-Bit Monoboard computer; it is intended to assist the system designer in developing programs for the Am96/4116. Familiarity with the MonoBoard architecture and the serial and parallel I/O interface is assumed.

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INTRODUCTION

The Am96/4116 MonoBoard Computer Monitor provides a basic program development tool for the MonoBoard Computer. The Monitor provides the following capabilities:

- Memory inspection and modification.
- Display and alteration of all registers, program counter, and flag bits.
- Selection of Normal or System mode.
- Up/down loading of user programs thru AmSYS8/8 Development System.
- Trace facility and breakpoint insertion.

When the Monitor is initialized at power-on, an asterisk (*) prompt will be displayed. The monitor then waits for a command via the input device. Commands are specified by alphabetic characters followed by one or more parameters and a carriage return <CR>.

INSTALLATION

The Am96/4116 Monitor is supplied on two 2716 E-PROMs. One of the two E-PROMs is for even-byte addresses, the other for odd-byte addresses. The socket for U75 for ROM ending with -001 and the socket for U91 is for ROM ending in -002. Figure 1 illustrates the Am96/4116 memory address space. The Monitor resides in the address space from 0000H to 0FFFH. The 32K byte on-board RAM must occupy the address space from 8000H to FFFFH.

Interface to the Monitor is through a standard RS232C terminal connected to connector P5. The console facility of an AmSYS 8/8 Microcomputer Development System can also be used, through parallel I/O connector P3. A program called HOST must be in execution on the AmSYS 8/8.

MONITOR FUNCTIONS AND USER CONTROLS

The Monitor allows you to perform the following functions:

Examine, fill or substitute memory locations

Examine or fill CPU registers

Execute a program starting at any location

Single-step through a program

Initiate and manage up/down loading from the AmSYS 8/8 Development System

There are two sets of operating modes for the Monitor:

Normal/System Modes - These modes differentiate between the abilities to execute protected and privileged AmZ8000 instructions, respectively. The Monitor always comes up in Normal Mode; any hex or Assembler instructions can be entered, but only protected instructions are executed. The SM command drops you into System Mode. These modes correspond to the CPU's distinction between Normal and System modes.

Command/Program Modes - These modes differentiate occasions when you are directly interfacing with the Monitor versus interfacing with the Assembler or an application program. In Program Mode, the Monitor acts as a slave to the other program being executed and serves that program's needs. The G command, which executes programs, exemplify actions that cause a change from Command Mode to Program Mode. In Program Mode, calls can be made to the Monitor either through the SC instruction or through direct keyboard entry at program input points. Direct keyboard entry must be preceded by the ESC (escape) key, and this only works when the Monitor is driving I/O for the application program.

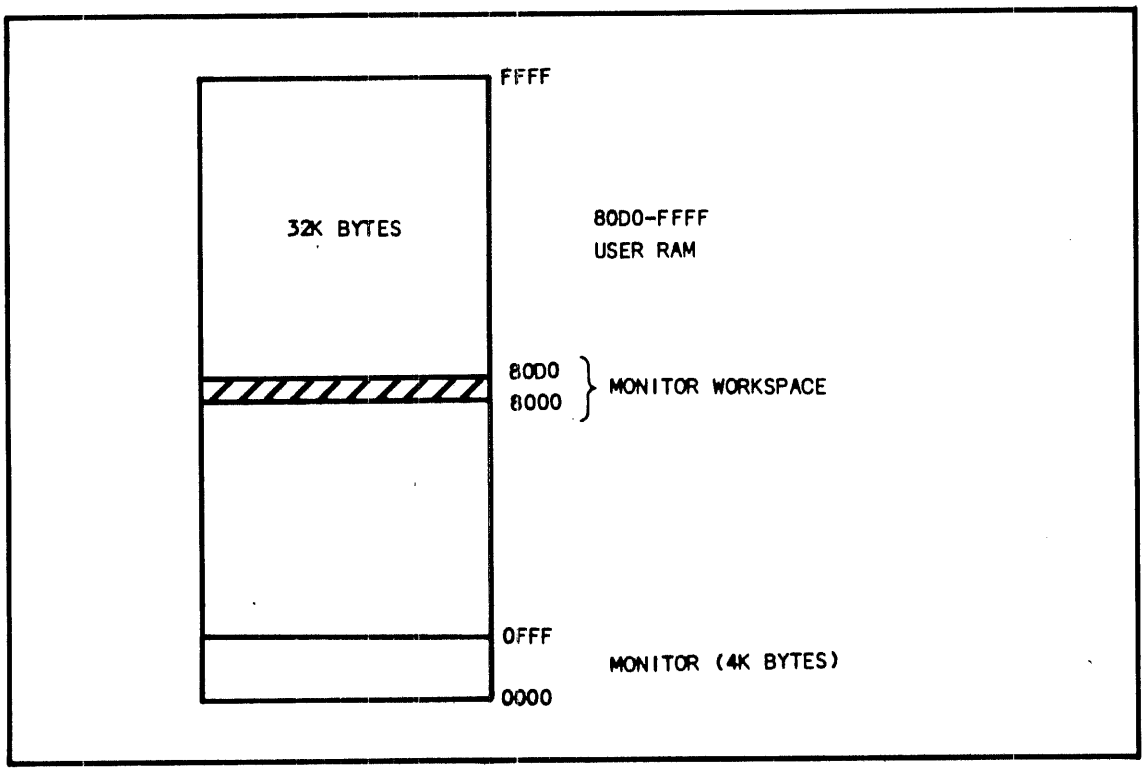

Figure 1. Am96/4116 Memory Map

An asterisk (*) is used for command prompting. However, since the keyboard/display console has only one line of display characters, the prompt does not appear on this console if a line of data is displayed in response to the previous command. When commands are used that require no display in response, the command prompt will appear on the keyboard/display console just as on conventional CRT or printer consoles.

There are two text-editing functions: The last character entered can be deleted with the DEL key on RS232C consoles. Also, the entire current line of entry can be deleted with the Control X key pair.

If unrecognized commands are entered, the Monitor will respond with a question mark (?).

MONITOR COMMANDS

The Monitor commands are listed according to functional categories in table 1. Upper case characters are literal entries, lower-case characters are variable entries. The commands are described in detail on the pages that follow, according to the alphabetical order of the command mnemonic; here the commands are enclosed in parentheses which should not be entered as part of the command. All memory address and CPU register values (the x,y,z, parameters) are hexadecimal. All CPU register numbers, flag values and other m,n parameters are decimal.

In addition to these commands, any AmZ8000 hex-format instructions can be entered through the Monitor. The Monitor initializes the program counter at hex 1000. System calls (the 7F instruction followed by a non-zero reference value) will display the reference value when the program exits to the Monitor.

Blank spaces separating single-character commands and variables are optional.

All addresses are 16 bits long. Memory references always return words and instructions always begin on word boundaries (even addresses).

(B x,y,z) SOFTWARE BREAKPOINT

Sets two or three software breakpoint addresses (x,y and optionally z) and starts execution at the current program counter address. Only the first breakpoint encountered is used, the others are discarded when any one breakpoint is reached.

This command executes to, but not including, instruction X. This command cannot be used in ROM space.

User code is modified temporarily by inserting a system call at the breakpoint address, but the code is restored upon break. Thus the breakpoints are cleared everytime and do not stay set.

Output includes the program counter (PC) at break and the first word of the next instruction (NI) to be executed.

You might need to set the program counter (P=x) prior to entering this command

TABLE 1. MONITOR COMMAND SUMMARY

Edit Functions

Display memory	D x,y
Display and substitute memory	S x
Display program counter	XP
Display all CPU registers	X
Display word register	X n
Display flags	XF
Fill memory	F x,y,z,
Fill program counter	P=x
Fill high-byte register	RHn=x
Fill low-byte register	RLn=x
Fill word register	Rn=x
Move memory	M x,y,z
Set carry flag	C n
Set decimal-adjust flag	D n
Set half-carry flag	H n
Set overflow flag	V n
Set parity flag	P n
Set sign flag	S n
Set Zero flag	Z n

Up/Down Loading

Down Load	LOAD d:file,x
	LDPR d:file
Up Load	SAVE d:file,x,y

NOTE

m,n are decimal values
x,y,z are hexadecimal values

(C n) SET CARRY FLAG

Sets or resets the carry (C) flag to n=1 or 0. See the XF command for displaying flags.

(cr) AFTER B OR T SINGLE-STEP

After a B (breakpoint) or T (trace) command has been executed, single carriage returns (cr) will execute and display subsequent instructions one at a time. This single-step mode is disabled with any macro-type command such as G, LOAD or SAVE.

(D n) SET DECIMAL-ADJUST FLAG

Sets or resets the decimal-adjust (DA) flag to n = 1 or 0. This syntax takes precedence over the Display Memory (d x,y) command. See the XF command for displaying flags.

(D x,y) DISPLAY MEMORY

Displays the contents of memory at addresses x through y. Up to eight hexadecimal words, plus their ASCII byte equivalents and beginning addresses are displayed on each line. Bytes with no ASCII equivalent are represented by an underline (this character may vary with your terminal.

The y ending address is optional and if missing is assumed equal to x. The least significant bit of each address x and y is cleared to insure display on word boundaries.

Display on locations Ø or 1 can conflict with the Dn command. To avoid this conflict, these addresses can be represented ØØ and Ø1, respectively. This is not necessary, however, in the case of a range such as DØ,F.

The ASCII equivalents displayed in the right-hand column are useful for identifying alphanumeric data.

(F x,y,z) FILL MEMORY

The contents of memory words from the x address through the y address are filled with the 16-bit value z. The least significant bit of each address x and y is cleared to insure fill on word boundaries (even addresses). If y is missing, it is assumed equal to x.

(G x) EXECUTE PROGRAM

Executes instructions in memory beginning at memory address x. If x is omitted, execution begins at the current address in the program counter. The G command (without the x) is useful after a breakpoint or other interruption in program execution to resume execution.

You might need to set the program counter (P=x) before entering this command.

(H n) SET HALF-CARRY FLAG

Sets or resets the half-carry (H) flag to n = 1 or 0. See the XF command for displaying flags.

(LOAD d:file,x) DOWN LOAD

Reads the object program named "file" on drive "d" from the AmSYS 8/8 Development System into the Am96/4116 memory beginning at memory address x. The "file" name must be in the AmSYS 8/8 format with the disk drive specified.

If this command is entered from the Development System, a prompt, consisting of the currently logged-in diskette identifier in parentheses, will appear on your console.

See the next section entitled AmSYS 8/8 Up/Down Loading if you are assembling programs on the Development System. The HOST program must be running on the Development System.

(LDPR d:file) DOWN LOAD BINARY FILE

Loads binary (.BIN) file from drive d, on the AmSYS 8/8 Development System. Only binary files can be loaded using the LDPR command. Binary files can be created using the MAR08000 (MACZ) Assembler or LINK8000 (LINKZ) programs on the Development System.

(M x,y,z) MOVE MEMORY

Moves the contents of memory from address x through address y to new address at address z. Memory is moved as 16-bit words. The least significant bit of addresses x, y and z are cleared to ensure memory move on word boundaries (even addresses). Address y must be x+2 or greater.

(NM) ENTER NORMAL MODE

This is the reverse of SM. CPU's normal mode is entered and privileged instructions can not be executed.

(P n) SET PARITY FLAG

Sets or resets the parity/overflow (P/V) flag to n = 1 or 0. This command is equivalent to the Set Overflow Flag (V) command. See the XF command for displaying the flags.

(P = x) FILL PROGRAM COUNTER

Fills the program counter with the address x. The counter can be displayed with the XF command.

(RHn=x) FILL HIGH-BYTE REGISTER

Fills the high-byte register n (where n = 0 to 7) with the 8-bit hex value x. The register can be displayed with the Xn command.

(Rn=x) FILL WORD REGISTER

Fills the general-purpose register n (where n = 0 to 15) with the 16-bit hex value x. The register can be displayed with the Xn command.

(SAVE d:file,x,y) UP LOAD

Writes the contents of Am96/4116 memory between the addresses x and y to the AmSYS 8/8 Development System disk "d" on the "file" specified. If the file already exists, it will be deleted and recreated. The "file" name must be in the AmSYS 8/8 format with the disk drive specified, and the HOST program must be executing.

If this command is entered from the Development System, a prompt, consisting of the currently logged-in diskette identifier in parentheses, will appear on your screen. These simply acknowledge communications received from the Monitor.

See the next section entitled AmSYS 8/8 Up/Down Loading if you are assembling programs on the Development System.

(SM) ENTER SYSTEM MODE

Drops you into the CPU's System Mode, in which all privileged instructions can be executed. The Monitor is initialized at power-up in Normal (protected) Mode.

(S n) SET SIGN FLAG

Sets or resets the sign (s) flag to n = 1 or 0. This syntax takes precedence over the Display and Substitute Memory command. The XF command can be used to display the flags.

(S x) DISPLAY AND SUBSTITUTE

Displays the contents of the memory word at address x and waits for your substitution. A 16-bit hex value will replace the contents of the word at address x and advance to the next word. A carriage return only will advance to the next word without substitution. A period (.) will terminate substitution and return to the Monitor's command mode.

Substitutions of addresses Ø or 1 can conflict with the Sn command. To avoid this conflict, these addresses may be represented by ØØ and 11, respectively.

(T m,n) TRACE

Executes m instructions beginning at the current program counter address and displays each instruction in sequence. If n is specified, the display occurs in intervals of n instructions. This command is useful only for CRT or printer consoles, as an alternative to manual single-stepping.
You might need to set the program counter (P=x) before entering this command.

Care should be taken not to trace over system calls because unpredictable results will occur.

(V n) SET OVERFLOW FLAG

Sets or resets the parity/overflow (P/V) flag to n = 1 or 0. This command is equivalent to the Set Parity Flag (Pn) command. The flags can be displayed with the XF command.

(X) DISPLAY ALL REGISTERS

Displays the contents of all 16 CPU registers, plus the program counter (PC) and flags.

(XF) DISPLAY FLAGS

Displays the six flags contained in the CPU's Flag and Control Word. The bit-setting of the flag immediately follows its mnemonic. The flags are

C	Carry
Z	Zero
S	Sign
P	Parity or overflow (P/V)
D	Decimal adjust (DA)
H	Half-carry

(X n) DISPLAY WORD REGISTER

Displays the 16-bit contents of CPU register n, where n = 0 to 15. Register 15 is the stack pointer and is initialized during power-up to 40AE.

(XP) DISPLAY PROGRAM COUNTER

Displays the address contained in the program counter register.

(Z n) SET ZERO FLAG

Sets or resets the zero (Z) flag to n = 1 or 0. The flags can be displayed with the XF command.

MONITOR I/O SUPPORT FOR USER PROGRAMS

I/O through the serial or parallel ports can be done either by your program, through the CPU's I/O instructions in system mode, or by the Monitor.

To use the Monitor for I/O, these general steps are followed:

1. Store a block of four 16-bit control words in memory.

2. Store the beginning address of this block in register R1.

3. Execute the SC instruction using a value of zero (a non-zero value will be interpreted as a program exit which will return control to the monitor.

The block of four 16-bit control words is ordered as shown in table 2. The function code is stored in the most significant byte of word one; the least significant byte of word one contains the response code. Words two, three and four provide the address of the file name, the beginning address of data, and the number of bytes to be written on read as described in the following function code description.

Read Control Statement (function code 0) - This command is intended for use by the assembler. It transfers the user call command line to the specified area in the same form as the Read Console function code 1.

Read Console (function code 1) - Reads a single line from the console. The file name address is unused. The data length represents a maximum and is replaced by the actual length. A console message is always terminated by a carriage return. The response code is normally zero unless the message was truncated, in which case, the response is 1.

Write Console (function code 2) - Writes a single line to the console. The file name address is unused. The data length represents the write length. The system provides no automatic end of line thus, the message must contain any required carriage return or line feed codes. The response code is zero.

Write Line Printer (function code 3) - Outputs a single line to the line printer. The file name address is unused. The data length represents the write length. All printer controls must be user supplied. The System 8/8 host must be connected and its monitor in execution. The response code is zero.

Open Disk File (function code 4) - Prepares a disk file to be read. The data address and length are unused. The file name address points to the address of the file name, which must be thirteen characters long and in AMDOS format e.g., A:FILEbbbbEXT. The response code is zero if the file was opened, 1 if not found, 2 if a disk error occurred, and 3 if the file is already open. The System 8/8 host must be connected and its monitor in execution.

Close Disk file (function code 5) - Closes a file. The data address and length are unused. The file name address points to the address of the file name, which must be thirteen characters long and in AMDOS format (See function code 4). The response code is zero if the file was closed, 1 if not found, 2 if a disk error occurred, and 3 if not previously opened or created. The System 8/8 host must be connected and its monitor in execution.

Create Disk File (function code 6) - Creates a disk file and prepares it to be written. The data address and length are unused. The file name address specifies the address at which the file name is stored. The file name must be thirteen characters long and in AMDOS format. The response code is zero if the file was created, 1 if no file space, 2 if a disk error occurred, and 3 if the file is already open or created. If a prior file existed, it will be deleted before the new one is created. The System 8/8 host must be connected and its monitor in execution.

Read Disk Sector (function code 7) - Reads one disk sector (128 bytes). Both the file name and record address must be given. The data length is returned. The next sequential sector on the specified file will be transferred to the data area. The response code is zero if no errors, 1 if end of file occurred, 2 if a disk error occurred, or 3 if this file was not previously opened or an attempt is made to read a created file. If a created file is to be read, it must be closed and re-opened. The System 8/8 host must be connected and its monitor in execution.

Write Disk Sector (function code 8) - Write one disk sector (128 bytes). Both the file name and record address must be given. The data length is unused. The next sequential sector on the specified file will be written with the contents of that data area. The response code is zero if no errors, 1 if no disk space, 2 if a disk error occurred, or 3 if this file was not previously created. Attempting to write to an opened file will also return code 3. The System 8/8 host must be connected and its monitor in execution.

HOST AND MONITOR COMMUNICATION

When the AmSYS 8/8 Development System is attached to the Am96/4116, it can be used for the following:

- Assemble (or assemble and link) AMZ8000 source code with MACRO8000 and LINK8000) on AmSYS 8/8.

- Download programs to the Evaluation Board with LOAD Monitor command or LDPR Monitor command, as described later in this section.

- Store programs by uploading the memory image from the Evaluation Board to a file on AmSYS 8/8. The file is uploaded with the SAVE Monitor command and can later be downloaded again with the LOAD Monitor command.

The development System's AMDOS operating system supports a utility called HOST, which communicates with the Am96/4116 Monitor. The HOST utility interfaces with AMDOS for service calls to read the console, print lines, and process disk requests.

TABLE 2. MONITOR I/O CONTROL BLOCK

Word	Byte	Contents
1	High	Function Code 1 = Read from console 2 = Write to console 3 = Write line printer 4 = Open disk file 5 = Close Disk File 6 = Created disk file 7 = Read disk sector 8 = Write disk sector 0 = Read Control Statement
	Low	No entry. Response code is stored here after I/O.
2	High Low	Address at which the file name is stored.
3	High Low	Beginning address of data to be written or read. Data written must include any necessary carriage return, line feeds, etc. Data read will include them also.
4	High Low	Length in number of bytes. It indicates either the total number of bytes to be written, or the maximum number of bytes to be read. The total number of bytes read up to and including the carriage return is stored here upon return to user program.

The program is activated like any other AMDOS program: by typing in its name, in this case HOST. It will respond with the message SYSTEM 8/8 Z8000 HOST followed by a prompt which consists of the currently logged-in disk drive in parentheses, e.g., (A).

After an up or down load, the HOST program can be terminated with the Control L and END sequence so that execution on the Am96/4116 may proceed concurrently with unrelated execution under the development System's operating system. The message HOST SHUTDOWN appears upon termination. This soft shutdown is provided so that the program can close any files left open.

The Control L entry indicates to the HOST program that the command to follow is meant for it. The Control L END sequence is currently the only user command to the HOST program. All other commands entered from the AmSYS 8/8 console (i.e., those without Control L) are transmitted to the Am 96/4116 for interpretation. Upon transmission, the Development System will acknowledge reception of the command with its prompt, another more specific response, or both. Thus, the Development System console can effectively become the Am96/4116 console.

The HOST program can issue five error messages, which are explained below.

COMMAND ERROR - Invalid Control L command.

Z8000 MESSAGE PENDING - A prior message to the Am96/4116 CPU has not yet been acted upon.

MESSAGE EXCEEDS 80 CHARACTERS - Re-enter your message using fewer characters.

ILLEGAL REQUEST FROM Z8000 - The Development System has received an unrecognized message from the Am96/4116.

TRANSMISSION ERROR - Communication with the Am96/4116 produced a parity error and transmission is being retried. If this continues, reset the CPU (power off/on, unless you have connected a reset circuit.)

BINARY FILE DOWNLOADING

The AMC binary file contains program code with address information, as well as a transfer address. Like a .COM file, the .BIN file contains address information and can represent unconnected address spaces. In addition, a .BIN file contains a transfer address used during download to set the Program Counter(PC) of the AmZ8000 on the Evaluation Board.

Either MACRO8000 or LINK8000 can produce a binary file as output from a PROGRAM run. Once the binary file (type .BIN) has been produced, the user can download the file. The first step is:

HOST

to set up communication with the evaluation Board Monitor. The next step is the Monitor command:

LDPR filename

The drive, name, and file type (if any) must all be specified. After the LOAD COMPLETE message appears, the PC has been automatically set to the transfer address (main entry point). The user can then issue the command:

G

to start execution at the current PC address.

SAVE/RESTORE WITH UPLOAD/DOWNLOAD

The user can save the memory image of an AmZ8000 program by uploading to AmSYS 8/8. The SAVE Monitor command saves the specified memory space as a file on AmSYS 8/8. The file type .ZSV is recommended. The user should make a record of the current PC at the time of the SAVE.

The user can later restore the program by downloading from AmSYS 8/8 with the LOAD Monitor command. No special preparation of the file is involved; the information saved with the Monitor SAVE can be directly reloaded with the Monitor LOAD. The PC should then be set to the value it had when the program was saved.

Publication Change Notice

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Am96/4116

Date:	November 25, 1980
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Publication Number:	00680157
Revision Level:	B
Reason for Change:	To correct description of processor to processor data operations via shared memory. Also, correct descriptions in table 2-11.

Instructions:

Page 2-11, Table 2-11	Change description of BHEN* signal (pin 27) to read: Byte High Enable Change the description of the following pins in table: 28 ADR10* See Table 2-1 30 ADR11* See Table 2-1 32 ADR12* See Table 2-1 34 ADR13* See Table 2-1
Page 3-1, paragraph 3-3	In the second sentence, change "word (16-bit)" to "byte (8-bit)".
Pages 3-1 and 3-2	Delete the last paragraph beginning at the bottom of page 3-1 and continuing on page 3-2.
Page 3-3	Delete Figure 3-2.
Page 4-3, third paragraph from bottom of page	Change fourth sentence to read: If the CPU shares an area of memory with an external processor, only byte operations should be used. Delete the last two sentences.
Page 4-5	Delete Figure 4-3.

Comment Sheet	Add revision level to publication number to make it read 00680157B.
Page ii	Add to revision record

Revision	Description
B (11/25/80)	Manual updated to correct errors.

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COMMENTS: (Describe errors, suggested additions or deletions, and include page numbers, etc.)

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