Z8S18000ZEM

User's Manual

UM000900-Z8X1098

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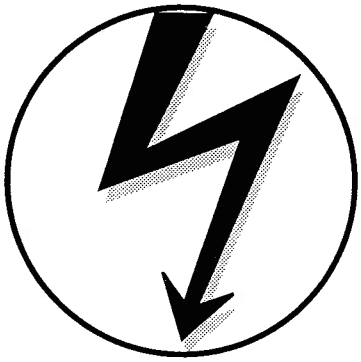
Electrical  Safeguards

WARNING!

Follow the precautions listed below to avoid permanent damage to the emulator.

I. Always use a grounding strap to prevent damage resulting from electrostatic discharge (ESD).

II. Power-Up Precautions.

1. If the target application board has its own power, remove the U_V_{CC} jumper J1 position 1-2 and set jumper J1 to position 2-3 on the Z90239 Emulation Board.
2. Ensure that all power to the emulator and the target application (if any) is turned off.
3. Connect the target pod to the target application (if any).
4. Power up the emulator, then press the RESET button.
5. Power up the target application (if any).

III Power-Down Precautions.

When powering down, follow this procedure in the precise order shown below:

1. Power down the target application board (if any).
2. Remove the target pod.
3. Power down the emulator.

NOTES:

1. Refer to the "Precaution List" section of the *Product Information* sheet for additional operating precautions specific to various devices.
2. Do not leave the emulator powered up with the RS-232C cable connected to a powered-down PC.
3. Before inserting target pod into target application board, refer to Chapter 2 to determine appropriate jumper selections and options.

ABOUT THIS MANUAL

We recommend that you read and understand everything in this manual before setting up and using the product. However, we recognize that users have different styles of learning. Therefore, we have designed this manual to be used either as a how-to procedural manual or a reference guide to important data.

The following conventions have been adopted to provide clarity and ease of use:

- Courier Font For Executables

  Commands, variables, icon names, entry field names, selection buttons, code examples, and other executable items are distinguished by the use of the Courier font. Where the use of the font is not possible, like in the Index, the name of the entity is capitalized. For example, a procedure may contain an instruction which appears as: Click on `File`. However, an Index entry would appear as FILE.

- Grouping of Actions Within A Procedure Step

  Actions in a procedure step are all performed on the same window or dialog box. Actions performed on different windows or dialog boxes appear in separate steps.

- Sequencing Words Within A Procedure Step

  When an item in a procedure contains a series of actions, the second action is preceded by the word *then*, and the third and subsequent actions are preceded by the word *and*. For example: Click on `View`, then `Memory`, and `Z8 Code Memory`.

- Unavailable menu items are presented in gray.

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ZiLOG

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CHAPTER 1

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CHAPTER 1

INTRODUCTION

OVERVIEW

The Z8S180 Emulator (Z8S18000ZEM) is a cost-effective, in-circuit emulator for design and development using the Z8S180 Microprocessor Unit (MPU). The purpose of the Z8S180 Emulator is twofold:

1) Provide a Learning Environment for Students of the Z80 and Z180 Architecture

2) Provide a Cost-Effective Emulator for Z8S180 Design-Related Activities

The Z8S180 Emulator includes a Debug Monitor in EPROM that can be used with a PC and a software program, `TZ.EXE`, that provides terminal emulation facilities for a PC. Users of the Z8S180 Emulator can create software on the PC by using a ZiLOG assembler, linker, and other development toots included with the Z8S180 Emulator, or using Z8012180 software development tools from other companies. This software then can be downloaded from the PC to the Z8S180 Emulator for execution, by means of the `TZ` program and the Debug Monitor.

The Z8S180 Emulator does not require a target board for initial debugging and development because the 8 KB of RAM can be assigned to any 8-KB block within the first 64 KB of address space. For larger applications and advanced development, the Z8S180 Emulator can be plugged into a 68-Pin PLCC Emulation Adapter, which, in turn, is plugged into the Z8S180 socket of the user's target board for additional RAM and ROM. The Z8S180 also includes header pins for logic-analyzer support for hardware development and software debugging. The Z8S180 includes logic that implements switching between a Monitor and a User mode, making the Z8S180 Emulator is a true in-circuit emulator.

The Z8S180 Emulator is carefully engineered to provide the best balance between reasonable cost and useful features to shorten your development time for products using the Z8S180 (see Figure 1-1 for the Functional Block Diagram). The Z8S180 Emulator provides an excellent environment for hardware and software development.

KEY FEATURES

- Effective Learning Tool for Students of Z80 and Z180 Architecture
- Simple Emulator Environment for Z8S180-Based Design and Development
- Serves as a Developmental Platform for Trial Implementation of a Specific Application
- Configured to Operate as a Stand-Alone Unit

SUPPORTED ZILOG DEVICES

Device	Packaging
Z8S180	68-Pin PLCC

HARDWARE SPECIFICATIONS

Dimensions	4.2 in. H x 4.2 in W
Oscillator Frequency (OSC) Host Interface	18.432-MHz RS-232 (EIA-232)
Serial Baud Rate	1,200 to 57,600 Bits/sec.
Power Supply Voltage	+5 VDC ±5%
Power Supply Current	Less than 1A
Operating Temperature	20°C, ±10°C
Operating Humidity	10-90% RH (Noncondensing)

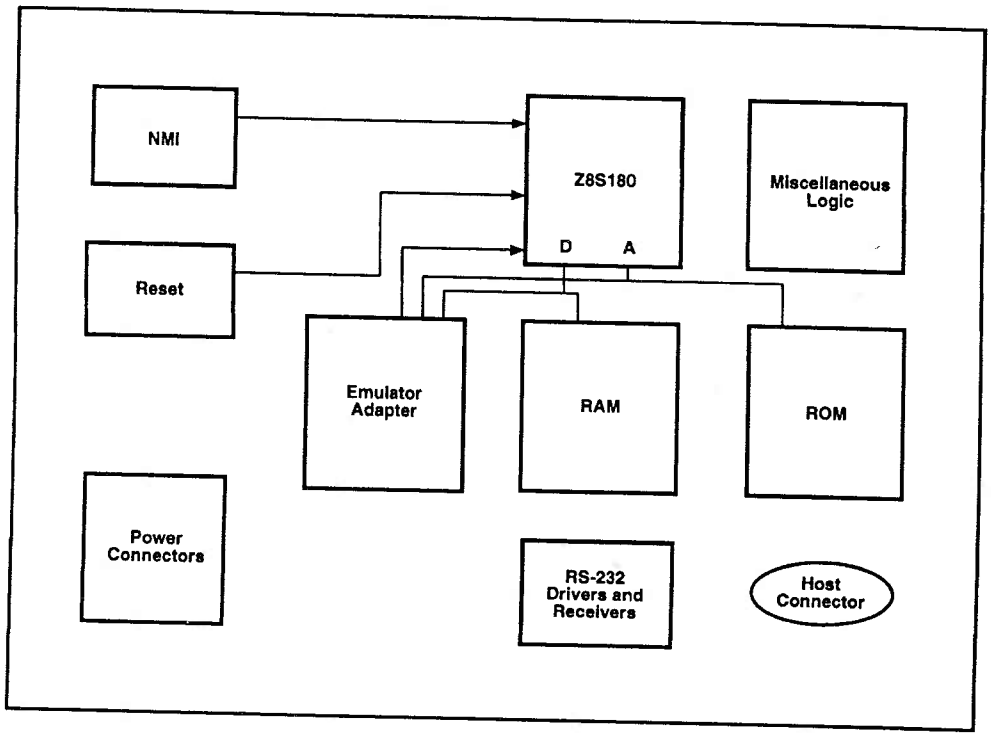

Figure 1-1. Functional Block Diagram

SUPPORT PRODUCTS PACKAGE CONTENTS

Hardware

Z8S180 Emulator Board, including:

Z8S180 MPU

18.432-MHz Crystal

8Kx8 EPROM (Contains Debug Monitor Program)

8Kx8 SRAM

Altera FPGA (Controls Emulation and ROM and RAM Decoding)

RS-232 Line Drivers and Receivers

Test Points Surrounding the Z8S180 Location (For All MPU Signals)

NMI and RESET Buttons

Z8S180 68-Pin PLCC Emulation Adapter

Software

Z8S180 Sample Files and Monitor Source Diskette

ZMASM-Cross Assembler Diskette/MOBJ-Object Utility Diskette

Z8S180 Files on Source Diskette

MAKE.BAT	Assembly Macro
F1XLSTG.EXE	Listing-Fixer Executable
TZ.EXE	Terminal Emulator Executable
180MACRO.LIB	Z8S180 Include File and Macros
180MON.HEX	Z8S180 Debug Monitor Source (Intel HEX Format)
180MON.S	Z8S180 Debug Monitor Source
DISTEST.HEX	Disassembly Test (Intel HEX Format)
DISTEST.S	Disassembly Test Source
TSTRST20.HEX	Test Program for Monitor Services (Intel HEX Format)
TSTRST20.S	Test Program for Monitor Services Source
TZ96COM1.PIF	Windows Startup for TZ on COM1
TZ96COM2.PIF	Windows Startup for TZ on COM2

Publications

Z8S18000ZEM User's Manual

ZASM 800, Z800 Cross Assembler User's Guide

ZiLOG Universal Object File Utilities User's Guide

Z80180/Z180 MPU User's Manual

Z180 Family Microprocessors and Peripherals Databook

HOST COMPUTER SYSTEM REQUIREMENTS

The following requirements apply when the optional ZiLOG ZMASM/ZDS assembler is implemented. If another assembler is used, refer to its requirements.

Table 1-1. Host Computer System Requirements

	ZMASM (Windows 3.1)		ZMASM (Windows 95) ZDS			
	Min.	Recommended	Min.	Recommended	Min.	Recommended
Processor	386	486	486	Pentium	486	Pentium
Speed (MHz)	33	66	55	100 (or higher)	66	150 (or higher)
RAM (MB)	4	8	8	16 (or more)	8	32 (or more)
Video Adapter	VGA	SVGA	VGA	SVGA	SVGA	SVGA
Hard Disk (MB) (Free Space)	2.0	4.0	3.0	4.0	10.0	16.0
3.5-Inch, HD Floppy Disk Drive	✔	✔	✔	✔	✔	✔
RS-232C COM Port	✔	✔	✔	✔	✔	✔
Color Monitor		✔		✔	✔	✔
Mouse/Pointer Device	✔	✔	✔	✔	✔	✔
Printer		✔		✔	✔	✔
Editor		✔		✔	Included	Included

ADDITIONAL ITEMS NOT SUPPLIED WITH THE SUPPORT PACKAGE

A source of power (+5 VDC ±10%) can be used in place of the PC. This can be a laboratory power supply with supply current of 1.GA.

NOTES:

1. **Debug Monitor with a Dumb Terminal.** Two Debug Monitor commands (`L` for loading a hex file and `N` for changing the Serial Data Rate) do not properly function when running on a dumb terminal (refer to Chapter 3, "Using the Debug Monitor," "TZ Program Restrictions").

2. **TZ Terminal Emulation Program.** The TZ program, which is included on the Z8S180 Sample Files and Monitor Source Diskette, was developed to run with MS-DOS V.5.0; however, the program may run on earlier versions. One (or more) copies of the TZ program run under Windows 3. 1 (and also may run under earlier versions). The kit includes .PIF files on the Z8S180 Sample Files and Monitor Source Diskette to help start the TZ program in the Windows environment.

3. **PC Models/Serial Baud Rates.** The maximum serial rate that can be used between a PC and the development kit board is dependent upon which PC model and configuration that is used. If the baud rate is too fast for the PC, characters will be lost during lengthy display sequences initiated by certain commands. Also, downloading may fail if the serial rate is too fast.

TARGET DESIGN RESTRICTIONS

$\overline{\text{MREQ}}$

4. In order for the Z8S180 emulator to emulate the processor in a target board, the target board must enable its memories only when the $\overline{\text{MREQ}}$ signal is low. The target board may include $\overline{\text{MREQ}}$ in a $\overline{\text{CS}}$ signal, or in $\overline{\text{OE}}$ and $\overline{\text{WE}}$ signals, of its memories.

The Z8S180 emulator avoids conflicts with target resources during cycles that access its ROM or RAM by blocking the $\overline{\text{MREQ}}$ signal to the target board.

Clocking

A crystal or oscillator on the target board is not used by the Z8S10 emulator in order to use a different clock rate than the standard 18.432 MHz, the following steps must be taken:

1. A different crystal, of the desired frequency, must be plugged into the crystal socket on the Z8S180 emulator.

2. The symbol clockHz in the Debug Monitor source (included with the emulator) must be changed to the new value.

3. The MAKE.BAT file, assembler, and object utilities includes with the emulator must be used to assemble the source and create a .HEX file.

4. A corresponding new EPROM must be programmed and installed in the U2 socket.

NOTE: Steps 2-4 can be avoided if the new frequency is a simple multiple or divisor of the old. Just start the TZ program at whatever serial rate the new crystal plus the old EPROM result in. (Refer to Chapter 3, "Using the Debug Monitor.")

Execution Restrictions

While running a program in User Mode, execution of an instruction starting at any of the following addresses makes the emulator enter Monitor Mode:

Table 1-2. Execution Restrictions

Address	Significance
00000	Reset, illegal instruction trap, RST 0, or jumping to a Null pointer.
00020	RST 20 instruction, used to provide services to user program.
00028	RST 28 instruction, used for breakpoints.
00066	Nonmaskable Interrupt.

User programs can easily work around the first problem by including a NOP at 00000, and starting execution under the Debug Monitor at 00001.

There are five other RST instructions that applications can use.

For user programs intended for eventual stand-alone use, that is, for operation without the Debug Monitor, debugging of the user's NMI routine must wait for final system integration, when the emulator is no longer plugged into the target board.

Last 256 Bytes of Emulator RAM Protected

The Z8S180 Emulator includes 8 KB of RAM that you can locate at various 8-KB address boundaries, or optionally eliminate from the user memory map. When you do include this RAM, its last 256 bytes are protected/hidden from access by your software and by monitor commands to protect the monitor's internal states, variables, and tables.

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CHAPTER 2

SETUP AND INSTALLATION

INTRODUCTION

This chapter describes the various steps necessary to start development using the Z8S180 Emulator. The sections covered in this chapter are as follows:

- Installing the Software
- Setting Up the Hardware
- Connecting to Power
- Initial Checkout/Sample Session

INSTALLING THE SOFTWARE

Software for the Z8S180 Emulator is stored on two diskettes:

- Z8S180 Sample Files and Monitor Source Diskette
- ZiLOG ZASM Cross Assembler/Zilog MOBJ Object File Utility diskette Z8S180 Source Diskette Installation

To install the software, perform the following actions:

1. Select the `Run` command from the `File` menu under `Program Manager`.
2. Insert the diskette labeled "Z8S180 Sample Files and Monitor Source" into drive A (or drive B, if appropriate).

3. Type `a:\setup` and press <ENTER>. (Type `b:\setup` if drive B is used.)

   A dialog box will now prompt you for the directory into which the software will be installed (default is `C:\180`). The setup program will copy the files into the target directory, creating an icon in the Windows environment. After the installation is finished, you can move the icon into any program group of your choice.

NOTE: Note: The icon will be created in the window that is currently selected.

4. Remove diskette and store in a safe place when installation is completed.

Creating TZ Program Icon Using Windows Program Manager

This kit includes a software monitor program that runs on a PC. If you choose to create a TZ icon from which you can run the TZ program (`TZ.EXE`), perform the following steps:

1. Select `New` from the `File` menu and select `OK` or press <ENTER> on the keyboard.
2. Type the designated name (such as `TZ 9600 COM1`) in the `Program Manager` window.
3. Type the full path and filename of (one of) the `.PIF` files you copied from the source diskette, such as `C:\WINDOWS\IZ96COMI.PIF`.
4. Type the full path of the directory you created (such as `C:\180`), then press <ENTER>.

The program item icon should be ready to use. If you want to run copies of `TZ` on both COM1 and COM2, repeat Steps 1-4.

NOTES:

1. Modification of the `win.ini`, `autoexec.bat`, or `config.sys` files is not required.
2. Consult MS Windows documentation if you need additional information about alternate installation procedures.
3. Refer to the `README` files on diskettes. (The `README` files are easily accessed via the `Notepad` program.)

SETTING UP THE HARDWARE

Serial Connections to the Host

The Z8S180 Emulator includes two serial channels, ASCIO and ASCI1. Header `J4` connects one of these channels to the RS-232 interface chip, `U7`, which, in turn, is connected to the DB-9 Host connector `P5`.

Using ASCIO (Instead of Default ASCI1) As User Interface 1

1. Move shunts to the other side of J4 as follows:

From ASCI1	To ASCIO
J4 2-3, 5-6, 8-9, 11-12, 14-15	J4 1-2, 4-5, 7-8, 10-11, 13-14

2. Connect a DB-9 to DB-9 straight-through (EGA Extender) cable between one of the COM ports of your PC and P5 on the Z8S180 board.

RS-232 Signals

The serial interface of the Z8S180 consists of four RS-232 signals: Transmit and Receive data plus one control output and one status input.

Control Output

The control output drives pins 1, 6, and 8 of the DB-9 connector P5, (DCD, DSR, and CTS respectively). When using ASCIO, the control output is controfled by the 180's /RTSO output; when using ASCI1, the control output is always asserted.

Control Input

The control input is taken from pin 7 of the DB-9 connector P5, which is RTS from the host. When using ASC I0, it is routed to both the /CTS0 and /DCD0 pins. When using ASCI1 , it is routed to the RXS/CTSI pin.

Receiving Data Using CSIO Facility, While Using ASCI1 for Host Communications

To receive data using the Z8S180 Emulator's CSIO facility, while using ASCI1 for host communications, remove the shunt between J4-11 and J4-12.

Using ASCI0 for Host Communications Without "Request to Send"

To use ASCI0 for host communications, but your PC does not assert Request to Send, remove the shunts between J4-10 and J4-11, and between J4-1 3 and J4-1 4, and wire J 4-10 and J4-13 to Ground, which is available on J4-9, P1-2, P1-9, P2-11, P3-17, P4-8, and P4-9.

RAM Size

16-KB (Or Larger) RAM at U4

The Z8S180 Emulator is shipped with an 8-KB RAM in the U4 location, and a shunt between J3-1 and J3-2. If you want to put a 16-KB (or larger) RAM at U4, move the shunt to between J3-2 and J3-3.

RAM Presence/Location in User Address Space

The J5 header controls whether the RAM on the emulator appears in the user (target) memory map, and if so, at what 8-KB boundary. It includes three separate shunt positions, between pins 1-2, 3-4, and 5-6. The

emulator is shipped with all three shunts installed, which locates the RAM to start at address 00000. Other options include the following:

Table 2-1. RAM Presence/Location in User Address Space

J5-5 to J5-6	J5-3 to J5-4	J5-1 to J5-2	Emulator RAM Starts At
IN	IN	IN	00000
IN	IN	OUT	02000
IN	OUT	IN	Not In User Space
IN	OUT	OUT	06000
OUT	IN	IN	08000
OUT	IN	OUT	0A000
OUT	OUT	IN	0C000
OUT	OUT	OUT	0E000

NOTE: When you locate Z8S180 Emulator RAM in user space, the emulator hides the last 256 bytes of the RAM from being accessed by your software and your monitor commands, in order to protect its internal variables, states, and tables. It passes accesses to these 256 bytes on to the target board, if any.

EPROM Size

32-KB (27256) or Larger ROM at U3

The Z8S180 Emulator is shipped with an 8-KB ROM in the U3 location, and a shunt between J2-1 and J2-2. If you want to put a 32-KB (27256) or larger ROM at U3, move the shunt to between J2-2 and J2-3.

RESET and NMI Drive to Target

The RESET and NM1 push buttons always assert $\overline{\text{RESET}}$ and $\overline{\text{NMI}}$ to the Z8S180 processor. The J8 and J9 shunt positions control whether or not the emulator drives these signals to the target board as well.

Insert the J8 shunt to drive $\overline{\text{RESET}}$ to the target, if the target board drives $\overline{\text{RESET}}$ only with open-collector (open drain) driver(s). Leave J8 open if the target board drives $\overline{\text{RESET}}$ with a totem pole (High and Low) driver.

Insert the J9 shunt to drive $\overline{\text{NMI}}$ to the target, if the target board does not drive $\overline{\text{NMI}}$, or drives it only with open-collector (open drain) driver(s). Leave J5 open if the target board drives $\overline{\text{NMI}}$ with a totem pole (High and Low) driver.

No-Emulation Option

The Emulator board is normally configured with an Altera EPLD device at U2, which implements its in-circuit emulation functions. This part can be eliminated if emulation is not desired, which converts the board to a simple evaluation board.

If the U2EPLD is present, leave shunt positions J1, J6, and J7 open. In this configuration, the Emulator board operates as described in this document.

If an EPLD is not present at U2, insert shunts at J1, J6, and J7. In this case all addresses with A15 low (including 00000-07FFF) select the ROM, and all addresses with A15 High (08000-OFFFF) select the RAM. If the ROM and RAM are both 8-KB devices as shipped, each is replicated four times within each 32-KB window. (This is the same as the address map in Monitor Mode when U2 is present.)

Connecting the Serial Cable to the PC

Locate the serial cable. Connect the serial cable plug to the socket on the emulator board, and the other end of the cable to either the COM 1, COM2, COM3, or COM4 connector of your PC.

NOTE: If connector availability is limited to a 9-pin COM1 through COM4, a different cable or a 25-pin to 9-pin converter must be used. (ZiLOG does not provide either of these items.)

CONNECTING TO POWER

Connecting to the Power Supply

Refer to Figure 2-1, which follows.

1. Turn the 2.GA power supply on and adjust it to +5V (if your power supply allows adjustment).
2. Set the +5V power supply for at least 1.5A, if there is a current-limiting adjustment.
3. Turn the supplies off, or make sure nonadjustable supplies are off.
4. Connect the Ground screw and V_{CC} screw terminals on the emulator to Ground (or COM) and power connections (usually labeled + or +V or +5V) on the power supply, respectively.

NOTE: Some manufacturers will also have black or white jacks. Refer to individual manufacturer's manuals to decide how to connect in this case.

SETTING UP FOR IN-CIRCUIT EMULATION

Refer to Figure 2-1, Z8S180 Emulator Board and PC, and Emulation Adapter Hook-Up Diagram.

If you already have a Z8S180 board, or when your new design is built, you can use the Z8S180 Emulator in place of the Z180 processor chip. (See Chapter 1, "Introduction", for the requirements and restrictions involved in such use.) To perform in-circuit emulation, the target board must have a 68-pin PLCC socket for the 68-pin PLCC Emulation Adapter/Z8S180 Emulator.

1. Locate the 68-pin PLCC Emulation Adapter, which is supplied.
2. Looking at the top of both boards (the sides with yellow markings), align the Z8S180 Emulator Board and the Emulation Adapter so that the P1-4 connectors match up.
3. Plug the Emulation Adapter into the connectors on the bottom of the Emulator Board. Fully seat the connectors.
4. Align the Emulator Board and Emulation Adapter with your target board, so that the beveled corner on the Emulation Adapter matches up with the beveled corner of the 68-pin PLCC socket on the target board.
5. Plug the Emulation Adapter into the PLCC socket.

Power Distribution for In-Circuit Emulation.

The Z8S180's power pin and four Ground pins are connected through the included 68-Pin PLCC Emulation Adapter. When using the Z8S180 Emulator for in-circuit emulation, there are three power-distribution options (refer to Figure 2-1):

- Leave V_{CC} and GND screw terminals on the emulator board open. Power is drawn from the target board.
- Connect power to the emulator board. Target board draws its power from the emulator by means of the 68-Pin PLCC Emulation Adapter.
- Connect power to both the emulator board and the target board. Each board then has lower impedance power distribution than the other options.

NOTE: This may cause "Ground loop" in some applications.

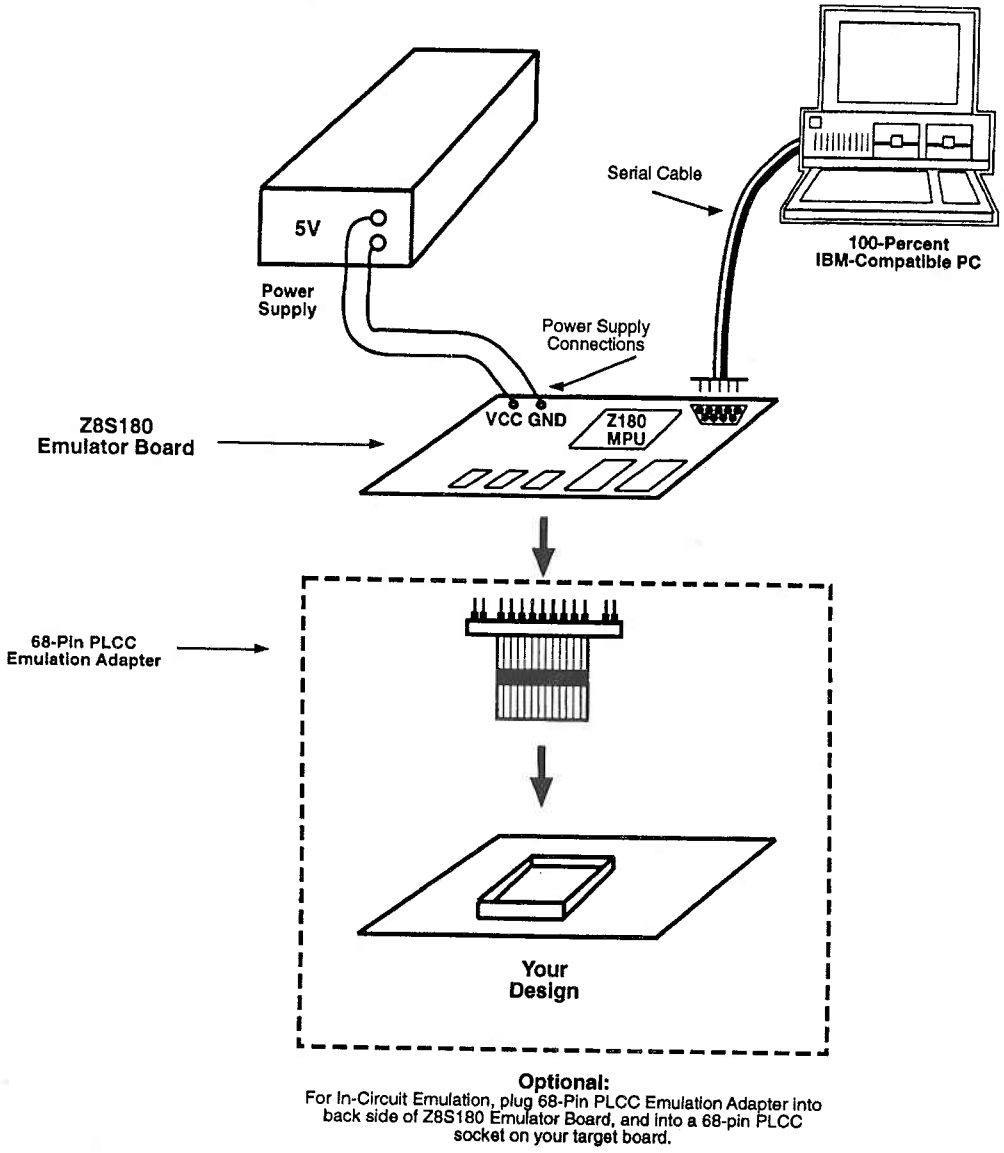

Figure 2-1. Z8S180 Emulator Board, PC, and Emulation Adapter Hook-Up Diagram

INITIAL CHECKOUT/SAMPLE SESSION

The section that follows provides an initial checkout of the hardwarelsoftware installation and setup and introduce you to some of the features of the TZ terminal emulation program.

NOTE: There must be RAM between addresses 00000 and 01FFF for purposes of this exercise; therefore, all three shunts must be inserted in the J5 header, unless you have already joined the emulator board to a target board that includes RAM at these addresses.

1. If necessary, power-up the PC and wait for the boot process to complete.
2. Double-click the TZ icon (if you have installed the TZ program as an icon within Program Manager).
3. At the DOS prompt (in the directory containing TZ . EXE, DISTEST . HEX, and TSTRST20 . HEX), type TZ COMn (where n is the number of the COM port to which you connected the Monitor serial cable), then press <ENTER>.

   You should now see the Debug Monitor's initial screen message:

   Zilog Z80180 Monitor Version *n.m* (where *n.m* is the version number of the Debug Monitor). Z80180>
4. Power-up the system.

If powering up the board from a separate power supply: Set the voltage to +5V.

5. Type H (for Help) at a Monitor command prompt to see a list of commands.
6. Type an L. The screen should show Enter File Name:.

NOTE: Only if using the TZ emulation program only. Not available if you are using a dumb terminal or running a PC communications program other than TZ.

7. 6. Type DISTEST, then press <ENTER>. You should see an incrementing count. Its final value should be followed with the message Intel hex lines--Done and a new Monitor command prompt: Z80180>

NOTE: Refer to Chapter 3, "Using the Debug Monitor", if you do not get the HEX done message.

7. Type a U. The screen should display the following message: Disassemble Starting At (just CR = from PC):

8. Press <ENTER> to indicate that you wantto disassemble from the current Program Countervalue, which was set to the start of the DISTEST program as it was downloaded.

   The screen should now show a new prompt Number of Instructions:

9. Type `16`, then press <ENTER>.

   A screen full of assembly-language instructions should appear, followed by another command prompt.

```
1000    00      NOP
1001    10FD    DJNZ    1000
1003    1018    DJNZ    101D
1005    20FD    JR      NZ,1000
1007    2014    JR      NZ,101D
1009    30F5    JR      NC,1000
100B    3010    JR      NC101D
100D    08      EX      AF,AF'
100E    18F0    JR      1000
1010    180B    JR      101D
1012    28EC    JR      Z,1000
1014    2807    JR      Z,101D
1016    38E8    JR      C,1000
1018    3803    JR      C,101D
101A    013412  LD      BC,1234
101D    11DCFE  LD      DE,0REDC
1020    215A5A  LD      HL,5A5A
1023    31A5A5  LD      SP,0A5A5
1026    09      ADD     HL,BC
1027    19      ADD     HL,DE
1028    29      ADD     HL,HL
1029    39      ADD     HL,SP
Z80180>
```

10. Press <ENTER> at the command prompt to disassemble more of the instructions in `DISTEST`.

NOTE: The file, which preceded, is not intended to be an executable program. Rather, it is the test file for the disassembly command in this Debug Monitor. `DISTEST` includes all the instructions that can be executed by the Z8018x family of processors.

11. Type another `L` at the command prompt, then type `TSTRST20` as the file name, followed by pressing <ENTER>.

12. Again you should see the final count followed by the `Intel hex lines--Done` and a Monitor command prompt.

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CHAPTER 3

USING THE MONITOR PROGRAM

INTRODUCTION

This chapter begins by describing the Debug Monitor program, followed by the simple procedures necessary to start and stop the program. This chapter concludes with the full descriptions of each of the available Program Commands and RST 20H Services. This chapter is divided into the following sections:

- About the Monitor Program
- Getting Started
- Program Commands
- RST 20H Services

ABOUT THE MONITOR PROGRAM

The Z8S180 Emulator includes a Debug Monitor program in its EPROM chip (U3). This monitor program can be used with a character-oriented dumb terminal; however, terminal emulation facilities are available on a PC when the TZ.EXE program is used. The TZ program on the PC allows you to do the following:

- Download a PC Program
- Run a PC Program (With or Without Breakpoints)
- Display/Fill Memory Locations
- Compare Memory Contents
- Display/Modify Registers
- Read/Write From/To I/O Ports, Including Z8S180 Registers

Two hex files, DISTEST.HEX and TSTRST20.HEX, containing binary/absolute programs for the Z8S180 processor are provided on the Z8S180 Sample files and Monitor Source Diskette. You can use the ZiLOG 2800 assembler and object utilities provided with this emulator, or third-party 280 or 2180 software development tools to generate your own Z8S180 programs and .HEX files.

DEBUG MONITOR MEMORY MAP

The Debug Monitor occupies about 6 KB in the EPROM on the emulator, however, this EPROM is never visible in the user memory map.

The 8 KB of RAM on the emulator can be mapped to any of seven different 8-KB blocks within the first 65 KB of user memory space, or can be left out of the user memory space. The Monitor uses the last 256 bytes of this RAM for its variables, stacks, and tables. When the RAM is mapped into the user address space, the emulator hides these last 256 bytes from access by user programs or Monitor commands.

GETTING STARTED

Starting Up The TZ Program in DOS

In DOS or at DOS Prompt in Windows, perform the following steps.

NOTE: Proper installation of the monitor program assumes that the proper hardware setup is complete. Before loading the monitor program, refer to Chapter 2, "Setup and Installation," for the complete procedure for hardware setup and applying power.

1. Ensure that the PC is powered up and is functioning properly.
2. Verify that all hardware connections and settings are correct per Chapter 2, "Setup and Installation."
3. If using a PC, load the Z8S180 Sample Files and Monitor Source Diskette and copy the TZ.EXE program to the PC.
4. Enter TZ COM*n* (where *n* is the COM serial port number [1-4] of choice); press <RETURN>.
5. Connect the emulator and power supply.
6. Power up (if power has been OFF) or press the RESET button on the emulator.

Starting Up the TZ Program in Windows

At the TZ Icon in Windows, perform the following steps.

NOTE: Proper installation of the monitor program assumes that the proper hardware setup is complete. Before loading the monitor program, refer to Chapter 2, "Setup and Installation," for the complete procedure for hardware setup, including setting up jumpers, connecting cables, and cowering up the emulator.

1. Ensure that the PC is powered up and is functioning properly.
2. Verify that all hardware connections and settings are correct per Chapter 2 "Setup and installation.
3. Double-click on the TZ icon (specifying one of the COM serial ports).
4. Connect the emulator and power supply. 5. Press the RESET button on the emulator.

Opening Screen Message

If all connections to your PC are correct, you should see the following opening message at power up or by pressing the RESET button on the board:

```
Zilog 280180 Monitor Version v.m
280180 >
```

Where *v* is the current version of the debug monitor and *m* is the revision.

Exiting the TZ Program

If the TZ Program was started with DOS, enter `CTRL+C` (hold the <CONTROL> key down and enter `C`, then release both). `TZ` will return you to the DOS prompt.

If the TZ Program was started in Windows by double-clicking the `TZ` icon, the window will close or the full-screen display will be replaced by the Windows environment.

TZ Program Restrictions

If the Debug Monitor is used with a dumb terminal, or with a PC running a terminal emulator other than `TZ`, two commands will not work as described in this chapter:

- An `L` command (for loading a `.hex` file) will not be followed by the `Enter File Name:` prompt.
- An `N` command (changing the serial data rate) will either show nonsense characters, or no characters at all, after you enter the speed-selection digit.

Monitor Debug Program and Serial Baud Rates

If an N command is used to change the baud rate between the board and the PC, both the TZ Program on the PC and the Debug Monitor on the board change the rate simultaneously. Quitting, starting, or pressing RESET on the board always sets the rate used by the Monitor to 9600 bps. However, TZ can be started at any of the baud rates available by using the N command.

Type the baud rate after the COM*n* (where *n* is the COM serial port number [1-41) argument in a DOS command, as in the following example:

```
TZ COM2 57600
```

This third argument (as in 57000 in the preceding example) can be any of the following entrees: 1200, 2400, 4800, 9600, 14400, 19200, 28800, 38400, or 57600.

PC Models/Serial Baud Rates

The maximum serial baud rate that can be used between a PC and the emulator is dependent upon which PC model and configuration that is used. If the baud rate is too fast for the PC, characters will be lost during lengthy display sequences initiated by the Debug Monitor D, U, or F commands. Also, downloading may fail if the serial baud rate is too high.

Table 3-1. PC Models/Serial Baud Rates

PC Configuration	Maximum Baud Rate (bps)
286 or 386 (Slower)	19,200
386 (Faster), 486, Pentium	57,600

NOTE: Under Windows, you can use the Windows .PIF editor to make a new .PIF file that includes such a command line, and then use a File and New commands under the Program Manager to make a new icon that references the new .PIF file.

PROGRAM COMMANDS

Program Basics

- The monitor program will prompt for all commands (A-X) with 280180 >.
- Press the <ESC> key if you make a mistake or want to return to the command prompt.
- An audible signal is given if the monitor does not recognize a command.

- Numerical values are expected to be in hex. If a value is not entered (just <RETURN>), a zero value is assumed, except in the editing modes of the A and E commands.
- Many commands (A, C, D, E, F, G, I, M, R, S, T, and U, for example) are repeatable from where they left off, by pressing <RETURN> at the command prompt.
- When the first letter of the command is entered, the monitor will automatically type in the rest of the prompt.
- To exit the program (and DOS), hold the <CONTROL> key down and enter C, then release both.
- The monitor program is not case sensitive.

Table 3-2. Program Command Reference Chart

Command	Description	Page No.
A	Alter Memory	3-5
B	Set or Show Breakpoints	3-5
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F	Fill Memory	3-8
G	Go To Program	3-8
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I	Input Data from 1/0 Address	3-10
K	Kill Breakpoint(s)	3-10
L	Load an intel Hex File	3-11
M	Move Memory to Memory	3-12
N	Change Serial Data Rate	3-12
O	Output Byte to I/O Address	3-13
R	Display/Alter Registers	3-14
S	Step (Over Subroutine Calls)	3-15
T	Step (Into Subroutine Calls)	3-15

Table 3-2. Program Command Reference Chart (Continued)

Command	Description	Page No.
U	Disassemble Instructions	3-16
V	Display Version of the Program	3-16
X	EXamine the MMU	3-17

Alter Memory [A]

Use the Alter Memory command to modify bytes in memory. The display shows the address and current data. When a byte value is entered, it is written to the address shown, and the next higher or lower address and data are displayed. The monitor program does not write to the location when entering a terminating value without the hex value before it. Terminating is as follows:

< ESC>	Does not store a receding value and returns to the command prompt.
.	Stores a preceding value if any and returns to the command prompt.
=	Stores a preceding value if any, stays at the same location, re-reads and redisplays.
RET, tab, Space, +, >	Stores a preceding value if any, and go to the next location.
-, <, ^	Stores a preceding value if any, and go to previous location.

Example:

```
280180>Alter Memory starting at : 0100
0100 FF : 22
0101 FF : 14
0102 FF : 50^
0101 14 :
Z80180>
```

Set or Show Breakpoints [B]

A break point is a special status you can associate with a memory address in RAM, so that when you set a program running with a G command, and the execution comes to that address at the start of the instruction, it will stop running and return to the monitor command prompt. Up to eight (8) breakpoints can be set at one time. The code at each break address is replaced with the RST 28H (hex EF). This op-code will bring the control back to the monitor if execution reaches the breakpoint. The user can code RST 28H instruction right into the program, at the end of the program, and/or at any point the user needs the control to come back to the monitor. In the case of this hard-coded RST 28H, the monitor program simply increments the address to the following instruction before it starts execution, if a breakpoint is set at the starting address in a G command,

the monitor program will set one single-steps over the first instruction, then sets all the breakpoints and goes. The monitor also checks to see whether a requested breakpoint is in fact in RAM (where it must be).

NOTES: Breakpoints must be set at the first byte of an instruction. (Instruction starting points can be determined by using the `U` command.) Breakpoints that are randomly set (or breakpoints that are set in the middle of an instruction) may cause faulty operation of the instruction.

Example:

```
Z80180>Breakpoint at Address (just <ENTER> to Display All) :
No Breakpoints
Z80180>Breakpoint at Address (just <ENTER> to Display All) : 1234
Z80180>Breakpoint at Address
     (Just <ENTER> to Display All) :
Breakpoints 1234
Z80180>
```

Compare Memory Data [C]

This command compares the contents of two areas of memory acid displays any differences found. If the Monitor returns the command prompt, the two memory areas have identical contents.

Example:

```
Z80180>Move From Memory starting at : 800
              to Memory starting at : 900
                    Number of Bytes : 100
Z80180>Alter Memory starting at : 904
0904 FF : 11
0905 FF :
0906 FF : 22
0907 FF :
Z80180>Compare Memory Data starting at : 800
          with Memory Data starting at : 900
                         Number of Bytes : 100
0804=FF:0904=11
0806=FF:0906=22
Z80180>
```

Display Memory [D]

When a `D` is entered at the command prompt, the Monitor displays the `Display Memory...` prompt and waits for you to enter a starting address and a number of bytes. The Monitor then displays the contents of that part of memory as shown in the following example. (The part on the right shows ASCII characters.)

If you <ENTER> only at the command prompt after a D command, the Monitor will display the same number of bytes again, starting at the address after the last one it displayed.

Example:

```
Z80180>Display Memory starting at : 1000
          Number of Bytes : 40
1000 CD 3AOF E5 21 01 11 B7 28 OA 3D F5 7E 23 87 20 ..:..!.. ( .=.~#.
1010 FB F1 18 F3 CD 1C 10 El C9 CD 3A OF C5 F5 06 00 ..... ...:..... !....
1020 18 03 CD 60 OF 7E 23 87 28 16 F2 22 10 E5 F5 04 ...'..~#. (...".....
1030 21 1D 16 D~ 7F 4F OD 28 EC 7E 23 B7 20 FB 18 F6 !....O.( .~#. ...
Z80180>
```

Edit/Display I/O Data [E]

This command combines the functions of the A command and the D command, except that it applies to I/O ports rather than memory. When you key in an E command at the command prompt, the Monitor displays the Edit/Display... prompt and waits for you to enter an I/O address followed by an <ENTER>. Then it asks how many bytes you want to display,

If you answer this second prompt with <ENTER> only, as in the example that follows, the Monitor reads and displays the I/O address you entered in response to the first prompt, and waits to see if you want to change it, as in the A command.

If you answer the second prompt by entering a hex number of bytes followed by <ENTER>, the Monitor reads and displays the number of I/O addresses you entered, as in the D command, except that data is not displayed in ASCII form on the right side of each line.

If a hex value is entered and followed by a terminator (other than <ESC>), the Monitor writes it to the I/O address.

The program recognizes the following terminating characters:

<ESC>	Does not store a preceding value and returns to the command prompt.
.	Stores a preceding value if any and returns to the command prompt.
=	Stores a preceding value if any, stays at the same location, re-reads and redisplays.
RET, tab, Space, +, >	Stores a preceding value if any, and go to the next location.
-, <, ^	Stores a preceding value if any, and go to previous location.

Example:

```
2801 80> Edit/Display starting at 1/0 Register: dc
  Display How Many Bytes (Just <ENTER> to Edit):
OODC 00 : 5
OODD 00 : 1F.
Z80180>Edit/Display starting at I/O Register: c0
  Display How Many Bytes (just <ENTER> to Edit): 40
OOCO 78 78 78 78 78 78 78 78 78 78 78 78 78 78 78 78
OODO 78 78 78 78 78 78 78 78 00 00 F8 F8 05 1F 00 5C
OOEO FF 5F FF FF FF FF FF FF C4 00 23 02 01 04 FF 78
OOFO 03 78 78 78 78 78 78 78 78 78 78 78 78 78 78 78
Z80180>
```

Fill Memory [F]

When you key an F at a command prompt, the Monitors displays the three prompt messages shown in the following example, and waits for you to enter, in succession, the starting address in memory that you want to clear to a constant value, the value, and the length of the area in bytes, each terminated with <ENTER>. As at any Monitor prompt, if you change your mind above filling memory, you can press the <ESC> key to return directly to the command prompt.

After you <ENTER> the third time, the Monitor will perform the requested filling operation, and return to the command prompt. The number of bytes can be up to 65 KB.

On the Z8SI80 Emulator, you can clear all of memory with this command, because the emulator does not allow the Monitor's internal states, variables, and tables to be accessed by Monitor commands.

Example:

```
Z80180>Fill Memory starting at : 1108
                    with Data : 00
                Number of Bytes : 7
Z80180>Display Memory starting at : 1100
                   Number of Bytes : 20
1100 22 14 50 FF FF FE FF FF 00 00 00 00 00 00 00 FF ".P,.... ........
1110 FF FF FF FF FF FF FF FF FF FF FF FF FD FF FF FF.P ........ ........
Z80180>
```

Go to Program [G]

When a G command is entered, the Monitor displays the `Go starting at...` prompt and waits for a hex address entry and an <ENTER>. The entered address is taken as a starting address for execution. The code typically has been downloaded from a Personal Computer host using an L command. If hex address is not

entered, the program simply starts execution from the current Program Counter (PC) value, which can be from previous execution or the starting address from a preceding download.

In the example that follows, the user downloaded a program named JONESTST.HEX and then started it with a G command with no address, since JONESTST.HEX included a valid starting address. The program then displays several messages and begins waiting for the user to type another G.

Before the Monitor executes the user program, it proceeds as follows:

1. Checks to see if the opcode at the starting address is a hard-coded RST 28H. If so, it advances the starting address over the RST 28H and proceeds to Step 3.
2. If not, it checks for a breakpoint at the starting address. If so, it invokes an implicit T command, to single step over the first instruction, returning to Step 3 when this has been completed.
3. For each breakpoint, it saves the opcode at that address in a RAM table and substitutes the opcode RST 28H (EF).
4. It stacks the starting address and restores all the user register values that were saved in the last RESET, breakpoint, hard-coded RST 28, or NMI, and may have modified since then.
5. It enables or disables interrupts per the saved EI value.
6. It uses a RET instruction to begin execution at the starting address stacked in Step 4.

After a G command, there are several ways that control can return to the Monitor:

- If execution comes to an RST 28 instruction, either a breakpoint or hard-coded one
- If execution comes to an illegal instruction
- Or when you press the NMI or RESET push button

In all of these cases except RESET, the Monitor saves the program counter. In all cases, it saves the register contents, and restores the opcodes of any set breakpoints. Then, for NMI or an illegal instruction, it displays a message why execution stopped, and in any case displays the register contents, program counter, and the instruction in hexadecimal and disassembled formats.

Example:

```
Z801 80>
File name: jonestst
78 Intel hex lines- Done
Z80180>Go starting at Address :
Z80180 ASCI Tx hacking: v.1.0
 Please set jumpers as follows:
ASCI0 RXA to ESCC TXD(Eval bd. J12-3 to J10-2)
ASCI0 TXA to ESCC RXD(Eval bd. J12-2 to J10-3)
ASCI0 DCD to PIA12(Eval bd. J12-8 to J12-20
      and J14-12 to J14-13)
ASCI0 CTS to ESCC RTS (Eval bd. J12-5 to J10-4)
ASCIO RTS to ESCC CTS (Eval bd. J12-4 to J10-5)
Press 'G' on keyboard when ready...
```

Help [H]

Entering H displays the command set available from the monitor program.

A - Alter Memory

B - Set or Show Breakpoints

C - Compare Memory Data

D - Display Memory Data

E - Edit/Display I/O Data

F - Fill Memory

G - Go to Program

H - Help

I - Input Data from I/O Address

K - Kill Breakpoint(s)

L - Loading an Intel Hex Code

M - Move Memory to Memory

N - Change Serial Data Rate

O - Output Byte to I/O Address

R - Display/Alter Registers

S - Step (Over Subroutine CALLs)

T - Step (Into Subroutine CALLs)

U - Disassemble Instructions

V - Display Version of the Monitor

X - EXamine the MMU

Input Data from I/O Address [I]

When you key in an `I` at the command prompt, the Monitor displays the `Input from...` prompt and waits for an I/O address entry followed by <ENTER>. That address is read and displayed before returning to the command prompt. (See the `E` command description about 16-bit I/O addresses.)

Example:

```
Z80180>lnput From I/O Address : 20
D020 AF
Z80180>
```

Kill Breakpoint(s) [K]

When a `K` is entered at the command prompt, the Monitor displays the `Kill Breakpoint...` prompt and waits for a hex address entry before an <ENTER>. If a hex address is not supplied, the Monitor simply clears any and all breakpoints that may be set, and returns to the command prompt. If a hex address is supplied, and the address is a breakpoint, the Monitor clears that breakpoint and returns to the command prompt. If you type an address that is not a breakpoint, the Monitor displays an error message before returning to the command prompt.

Example:

```
Z80180>Breakpoint at address (just <ENTER> to Display All) :
Breakpoints 0717 0846 134E
Z80180>Kill Breakpoint at Address (just <ENTER> for 811) : 846
Z80180>Breakpoint at Address (just <ENTER> to Display All) :
Breakpoints 0717 134E
Z80180>Kill Breakpoint at Address (just <ENTER> for All) :
Z80180>Breakpoint at Address (just <ENTER> to Display All) : No
Breakpoints
Z80180>
```

Loading an Intel Hex File [L]

When an L is entered at a command prompt, the Monitor displays the courtesy message `Load Hex File`. Then it sends a special sequence of control characters, which a current version of ZiLOG's TZ terminator emulator program will recognize as a download request. TZ itself then displays the `File name` prompt and waits for you to enter a file name. Current versions of TZ assume a `.HEX` extension.

If you happen to enter the file name wrong, TZ will display an error message. To recover from this state, press the <ESC> key or the `NMI` button on the board, to cancel the download. Then enter L again.

If the hex file is found, TZ then displays an increasing count of lines sent. When it has sent the whole file, TZ goes back to its normal mode of terminal emulation. The Monitor then shows how the download was executed. A complete and correct download is indicated by an `Intel hex lines - Done` message.

Error messages can include the following:

- `Bad Record Termination`
- `Unknown Record Type`
- `Bad Record Format`
- `Checksum Error`

If you get one of these messages, first check the `.hex` file you tried to download to see that it conforms to the standard format for Intel-compatible `.hex` files. If the file conforms, try again. If the problem persists, you might want to try a slower serial speed (using the N command), or a different PC host, or a different serial cable, or a different board, or a different `.hex` file.

Example:

```
Z80180>Load Hex File
File name: jonestst
78 Intel hex lines- Done
Z80180>
```

Move Memory to Memory [M]

This command moves a specified number of bytes from one address to another. In order to handle overlapping *from* and *to* areas correctly, the monitor moves data differently, depending on how the addresses compare. If the from address is greater than the to address, the monitor moves the data between the starting address and higher addresses thereafter. If the from address is less than the to address, the monitor begins moving between the highest addresses implied by the number of bytes and lower address thereafter until it gets down to the starting address entered.

You can use this command anywhere in memory because the monitor's internal states, variables, and tables cannot be accessed by monitor commands.

If you change your mind about copying data from one area of memory to another, you can <ESC> to return to command prompt. Otherwise, <ENTER> after the number of bytes moves the data as requested.

Example:

```
Z80180>Move From Memory starting at : 800
to Memory starting at : 900 Number of Bytes : 100
Z80180>Alter Memory starting at : 904 0904 FF: 11
0905 FF :
0906 FF : 22
0907 FF :
Z80180>Compare Memory Data starting at:800 with Memory Data starting at:900
Number of Bytes : 100
0804=FF : 0904=11
0806=FF : 0906=22
Z80180>
```

Change Serial Data Rate [N]

When you enter an `N` at a command prompt, the Monitor displays the `Enter 0-9...` prompt and waits for you to key a single digit. <ENTER> is not needed thereafter.

This command should be used only if you are using a current version of ZiLOG's TZ terminal emulator program for communications on your host PC. If so, when you key the desired digit, the Monitor pauses for a moment and then returns to the command prompt, at the new rate. You may see a difference in performance in commands like `L` and `D`.

The baud rate remains as set until another `N` command, or until you press RESET, which returns the platform's rate to 9600. Before pressing RESET when the rate is other than 9600, you may want to perform `CTRL+C` on the keyboard to terminate your current copy of TZ, and then enter `TZ COM`*n* again to start a new one at 9600.

The main use of this command is to speed up a subsequent `L` command that downloads a long file. In the example, after the download the user returns the rate to 9600, in which case RESET is pressed.

Example:

```
280180>Enter 0 for  1200 Bits/Second
                    1 for   2400
                    2 for    4800
                    3 for    9600
                    4 for    4400
                    5 for 19600
                    6 for 28800
                    7 for 38400
           Enter 8 for 57600 Bits/Second : 8
Z80180>Coad Hex File
File name: joneststst
78 Intel hex lines- Done
280180>Enter 0 for  1200 Bits/Second
                    1 for   2400
                    2 for    4800
                    3 for    9600
                    4 for 14400
                    5 for 19600
                    6 for 28800
                    7 for 38400
            Enter 8 for 57600 Bits/Second :3
Z80180>
```

Output Byte to I/O Address [O]

If an O is entered at a command prompt, the Monitor displays the two prompts shown in the following example and waits for a hex value entry followed by <ENTER> for each. The first value is the I/O address and the second value is the data to be written to it. With the second <ENTER>, the Monitor writes that data to the specified I/O address, and returns to the command prompt.

See the E command description about 16-bit I/O addresses.

Example:

```
Z80180>Output to I/O Address : dd
                         Data: f3
Z80180>
```

Display/Alter Registers [R]

If an R is entered at a command prompt, the monitor displays the Display/Alter Register prompt and waits for entry of the name of a register to be modified, then <ENTER>.

If the name of a register is not entered, the Monitor simply displays the contents of all of the user registers, and displays the PC and the current instruction in hexadecimal and disassembled form.

If a register name is entered, it should be one of the following: A, F, B, C, D, E, H, L, A', F', B', C', D', E', H', L', I, IX, IY, SP, EI, or PC. The Monitor then displays the current contents of that register and waits for modification.

The following terminating characters and entry procedures apply:

<ESC>	Does not store a preceding value and returns to the command prompt.
.	Stores a preceding value if any and returns to the command prompt.
=	Stores a preceding value if any, stays at the same location, re-reads and redisplays.
RET, tab, Space, +, >	Stores a preceding value if any, and go to the next location.
-, <, ^	Stores a preceding value if any, and go to previous location.

Example:

```
Z80180>Display/Alter Register (just <ENTER> Displays All) : b
B       03:1
C       11:2
D       12:3
E       E1:4
H       44:
Z801 80>Display/Alter Register (just <ENTER> Displays All) :
A F B C D E H L A'F' B'·C' D' E' H' L' IX IY SP EI
02 55 01 02 03 04 44 55 00 00 00 00 00 00 00 00 012B 0000 1 EF6 0
18DA 28F9     JR      Z,18D5
Z80180>
```

S and T Commands

Step (Over Subroutine Calls) [S]

Step (Into Subroutine Calls) [T]

If S or T is entered at the command prompt, the monitor displays the Step How Many Instructions prompt and waits for an optional hex value entry, followed by <ENTER>. If a value is not entered, one instruction is assumed.

After stepping over each instruction, the monitor displays the register values, the Program Counter (PC), and the next instruction in both hexadecimal and disassembled format, After the last of the specified number of

instructions, the Monitor returns to the command prompt. If you just <ENTER> at this prompt, the Monitor steps the same number of instructions again.

The instructions to be stepped through must be in RAM. The Monitor accomplishes stepping by placing the opcode EF(RST28) after each instruction, and/or for instructions that can transfer control to other than the next instruction, by placing the EF opcode at the destination. The Monitor then restores the registers and transfers control to the single instruction, being assured of getting control right back because of the RST 28s. Simple operations like unconditional JR, JP, and RET are handled by simply updating the user PC, without storing any RST 28s.

CALL and RST instructions are handled differently for each of the S and T commands. S implies stepping over subroutines: In this case the Monitor simply stores an EF opcode after the instruction, so that it will get control back after the subroutine has completed execution and returned. T implies stepping into subroutines. In this case the monitor stores an EF at the start of the subroutine.

In this environment, only RST 8, 10, 18, 30, and 38 instructions can be stepped into with a T command. This is because RST 0 transfers control to the start of the Monitor like a RESET. RST 20 is used for services provided by the Monitor and RST 28 is used for Breakpoints.

A hard-coded RST 28 is treated as a No-Op while stepping. The Monitor simply advances the PC to the next instruction. RST 28s are not placed at Breakpoints while stepping.

If you step into a HALT or SLP instruction, and no device interrupts occur to escape this state, you will have to press the NMI or RESET to reenter the Monitor.

Example:

```
Z801 80>Display/Alter Register (just <ENTER> Displays All) :
A F B C D E H L A' F' B' C' D' E' H' L' IX IY SP  EI
21 00 1F E9 00 00 BO BO 00 00 00 00 00 00 00 00 012B 0000 1F00 0
0103 7E              LD A, (HL)
A F B C D E H L A' F' B' C' D' E' H' L' IX IY SP  EI
ED 00 1F E9 00 00 A5 7E 00 00 00 00 00 00 00 00 012B 0000 1F00 0
0104 23              INC HL
A F B C D E H L A' F' B' C' D' E' H' L' IX IY SP  EI
ED 00 1F E9 00 00 A5 7E 00 00 00 00 00 00 00 00 012B 0000 1F00 0
105 FECO           CP A, 0C0
Z80180>
```

Disassemble Instructions [U]

This command disassembles a specified number of instructions from a specified starting address. The next instruction is always disassembled whenever the registers are shown the following: R command with no operand, breakpoint, step, and NMI. The maximum value for this command is in the range hex 15-17 (decimal 21-23) since more that this will not fit on the screen. After disassembling the indicated number of instructions,

the monitor returns to the command prompt. If you respond with a <RETURN> only, the monitor disassembles the same number of instructions again, starting from where it left off. This facility is useful for scanning through a program looking for a particular type of code.

Example:

```
Z80180>Disassemble Starting at (just <ENTER> = From PC): 200
                                 Number of Instructions : 16
0200        214D02   LD       L,024D
0203        CD8203   CALL     PUSH
0206        CD7E03   CALL     037E
0209        F5       PUSH     AF
020A        E5       PUSH     HL
020B        21AB02   LD
021E        CD8203   CALL
0211        6F       LD
0212        E3       EX
0213        CD7A03   CALL
0216        21CD02   LD
0219        CD8203   CALL
021C        E1       POP
021D        7D       LD
021E        CD7603   CALL
0221        21F902   LD
0224        CD8203   CALL
0227        F1       POP
0228        5F       LD
0229        2805     JR
022B        3E4E     LD
022D        CD6A03   CALL
Z80180>
```

Display Version of the Monitor [V]

Entering a V displays the software version number of the `Debug Monitor` program.

Example:

```
Z80180 > Version
Zilog Z80180 Monitor Version 1.4
Z80180>
```

RST 20H Services

The monitor program offers a number of console I/O services using the RST 20 instruction. These services have advantages over direct I/O to the ASC1 or ESCC registers--they implicitly use the console port that the user has selected.

Prior to the RST 20h, the user should set the B register to identify the services required, from the following list. No registers are changed except as indicated.

The TSTRST20.HEX program, which is on the Z8S180 Sample Files and Monitor Source Diskette, can be used to test the RST 20 instruction.

Table 3-3.

(B)	Name	Service Performed
O	out char	Waits, if necessary, for monitor console device to be ready for output, then outputs the ASCII character in A. A is not changed.
1	in char	Waits, if necessary, for user to press a key on the monitor console device; returns its ASCII value in A.
2	test char	Returns NZ condition code if user has pressed a key on the monitor console device, else returns Z. A is not changed.
3	out a	Waits, if necessary, for monitor console device to be ready for output, then outputs the 8-bit hexadecimal value in A. A is changed.
4	out hi	Waits, if necessary, for monitor console device to be ready for outputs, then outputs the 16-bit value in HL. A is changed.
5	in hi	Waits for user to enter a hexadecimal value on the monitor console device, and returns it in HL. Terminating characters are as in monitor hex entry; the terminating character is returned in A.
6	message	Outputs a null-terminated string--pointed to by HL-on the monitor console device. HL is advanced over the terminating null. A is not changed.

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CHAPTER 4

REFERENCE

REFERENCE

About RESET

The following occurs when you apply power to the board or press RESET:

1. The Z8S180 sets the user Stack Pointer (SP) to 0000h, so that the first stack locations used by a subsequent PUSH or CALL instruction would be 0FFFEh and 0FFFFh. When the Monitor has been given a G, S, or T command, it checks whether the location that is one less than the current user Stack Pointer acts like RAM, because it needs a working user stack in order to transfer control to a user program. If the current SP, minus one, does not point at RAM, the Monitor searches (top down) the first 65 KB of memory space, by steps of 256 bytes, until it finds RAM, then sets the starting user SP to the address xx00h, one higher than the end of RAM. (If the only RAM is the 8 KB on the Z8S180 board, and it starts at 0000h, the first G, S, or T command sets SP to 1F00h.)

2. The Monitor sets its user Program Counter (PC) value to 0100h. (This value is changed automatically if a hex file containing a starting address is downloaded.)

3. The Monitor saves all other registers in the 180. Pressing RESET to get control back from a runaway program may help determine what is happening from the register values and data on the stack.

4. Clears any previously set breakpoints.

5. Initializes the CPU registers to use the OSC frequency directly (not divided by two), to disable refresh, and to use the appropriate number of Wait States for memory and no Wait States for I/O.

6. Sets up ASCI0 and ASCI1 for 9600 bit/second operation.

7. Checks the RAM location in which it stores whether AS610 or ASCI1 is used for its user interface. If this location does not contain either of two particular ASCI values, the Monitor waits until it sees an ASCII <ENTER > from ASCI0 or ASCI1, and sets the location accordingly.

8. Sends the initial version message and first command prompt through the selected ASCI to the host.

NOTE: You may find that the ASCI selection is sometimes preserved when you turn the board's power supply OFF, so that when you turn the power supply back on, the Monitor immediately shows its version message without waiting for you to press <ENTER>. Enough voltage leaks through the serial interface chip--from the TxD and RTS lines from the host--to maintain the contents of the RAM even though the power supply is OFF. If you need to change which ASCI is used for the Monitor user interface, turn off both the power supply and the PC, change the J7 jumpers, and turn power back on.

Emulation Modes of Operation

The Altera FPGA on the board has two major modes of operation:

- Monitor Mode
- User Mode

The MREQ signal is gated and controlled by the Altera as described below. This introduces about 6 ns worst-case delay in MREQ, which should not perturb user timing. All pins of the Z8S180 are directly connected to pins on the emulation headers except MREQ, XTAL1, XTAL2, RESET, and NMI.

Monitor Mode

The Altera FPGA enters Monitor Mode on RESET and when an M1 cycle occurs in User Mode at any of the addresses 00000h (RESET, Trap, RST 0), 00020h (RST 20, provides console I/O services to user programs), 00028h (RST 28, used for breakpoints and single-step), and 00066h (NMI). In Monitor Mode, the on-board ROM is mapped as addresses 0000-7FFFh (four repetitions for an 8-KB ROM chip), and the RAM is mapped as 8000-FFFFh (4 repetitions for an 8-KB RAM chip).

The monitor accesses memory on the user's target board (if any) by immediately preceding the access with a write to an address in the range 0000-1FFFh, which makes the Alters FPGA treat the next non-MI cycle access as if in the User Mode, or a write to an address in the range 2000-3FFFh, which makes the Altera FPGA treat the next two non-MI accesses as if in User Mode. Except after a write to a ROM address 0000-3FFFh, the Altera FPGA blocks the MREQ signal from propagating to the user's target board while in Monitor Mode. This avoids tri-state conflicts on the data bus (between the ROM and RAM on this board) and memory-space resources on the user's target board.

Debugging - The Debug Monitor State

After RESET and in normal operation, the Monitor looks at memory the way that a downloaded program would see it, that is, in User State. However, in certain situations some of the commands and functions of the Monitor will temporarily display memory as the Debug Monitor itself sees it, that is, in Monitor State. The Monitor has to operate this way, in order to operate correctly if you do such things as pressing the NMI button while a downloaded program has transferred control into the Monitor for one of the RST 20 services (refer to Chapter 3). This would happen most often for one of the input services, such as in_a or in_hl.

The simplest way to enter this state is to press NMI while the Monitor is already running. In this state, the following commands and functions access memory in Monitor Mode rather than User Mode:

- Display (D) Command
- Go (G) Command Without an Address
- Disassembly (U) Command (The Next Instruction in NMI, and R Command With No Operand)

Any of the following cancels this state, so that all Monitor functions operate normally (User state):

- Pressing the RESET Button
- G Command With Starting Address Specified
- L Command
- Entering a New Program Counter (PC) Value via the R Command
- Completion of an RST 20 Service

User Mode

As part of a G, S, or T command, the monitor signals the Altera FPGA to enter User Mode by writing to an address in the range 4000-7FFFh. The Altera FPGA cycle, that is, as the starting address is beginning to be fetched from the stack by a subsequent RET instruction in the monitor.

In User Mode, the Altera FPGA never selects/enables the on-board ROM, it may, however, select/enable the on-board RAM as controlled by J5.

Table 4-1. User Mode Selection of On-Board RAM-J5 Settings

J5 Connections			
5-6	**3-4**	**2-1**	**RAM Location**
No	No	No	E000-FEFF
No	No	Yes	C000-DEFF
No	Yes	No	A000-BEFF
No	Yes	Yes	8000-9EFF
Yes	No	No	6000-7EFF
Yes	No	Yes	No RAM
Yes	Yes	No	2000-3EFF
Yes	Yes	Yes	0000-1EFF

Regardless of J5 jumpering, the Altera FPGA never enables the on-board RAM for the last 256 bytes of the RAM, this region being private to the monitor program. The Altera FPGA enables the MREQ signal into the user's target board whenever it is not selecting/enabling the on-board RAM.

The Altera FPGA leaves User Mode upon seeing an M1 access to location 00000h (RESET), 00020h, 00028h (Breakpoint), or 00066h (NMI).

NMI and RESET

These two push buttons on the board always affect the Z8S180, as do the RESET and NMI signals from the user's board via the Z8S180 Emulation Pod. Inserting the J8 and J9 jumpers make the RESET and NMI buttons on the board drive RESET and NMI low, respectively, to the user's board.

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APPENDIX A

ACCESSING THE ZBBS/INTERNET

BULLETIN BOARD INFORMATION

The ZiLOG Bulletin Board Service (ZBBS) currently provides basic information on ZiLOG products and includes a ROM CODE upload area. In addition, the ZBBS provides valuable information on items of interest, such as ZiLOG specialty software and documentation.

How to Access the ZBBS

The ZBBS can be reached by dialing 1-408-558-8890. The ZBBS supports speeds up to 28.8K Baud with connections 8-N-1 (8 bits, No parity, 1 stop bit). We recommend that you use an ANSI/BBS terminal emulation setup.

To preview information or download files, follow the on-screen instructions.

The latest production released version of the Z8 GUI software can be downloaded from this site.

ZILOG ON THE INTERNET

ZiLOG has a Home Page on the Internet. The Home Page address is:

http://www.zilog.com

The ZiLOG Home Page includes valuable information about hardware and software development tools. The latest production released version of the Z8 GUI software can be downloaded from this site.

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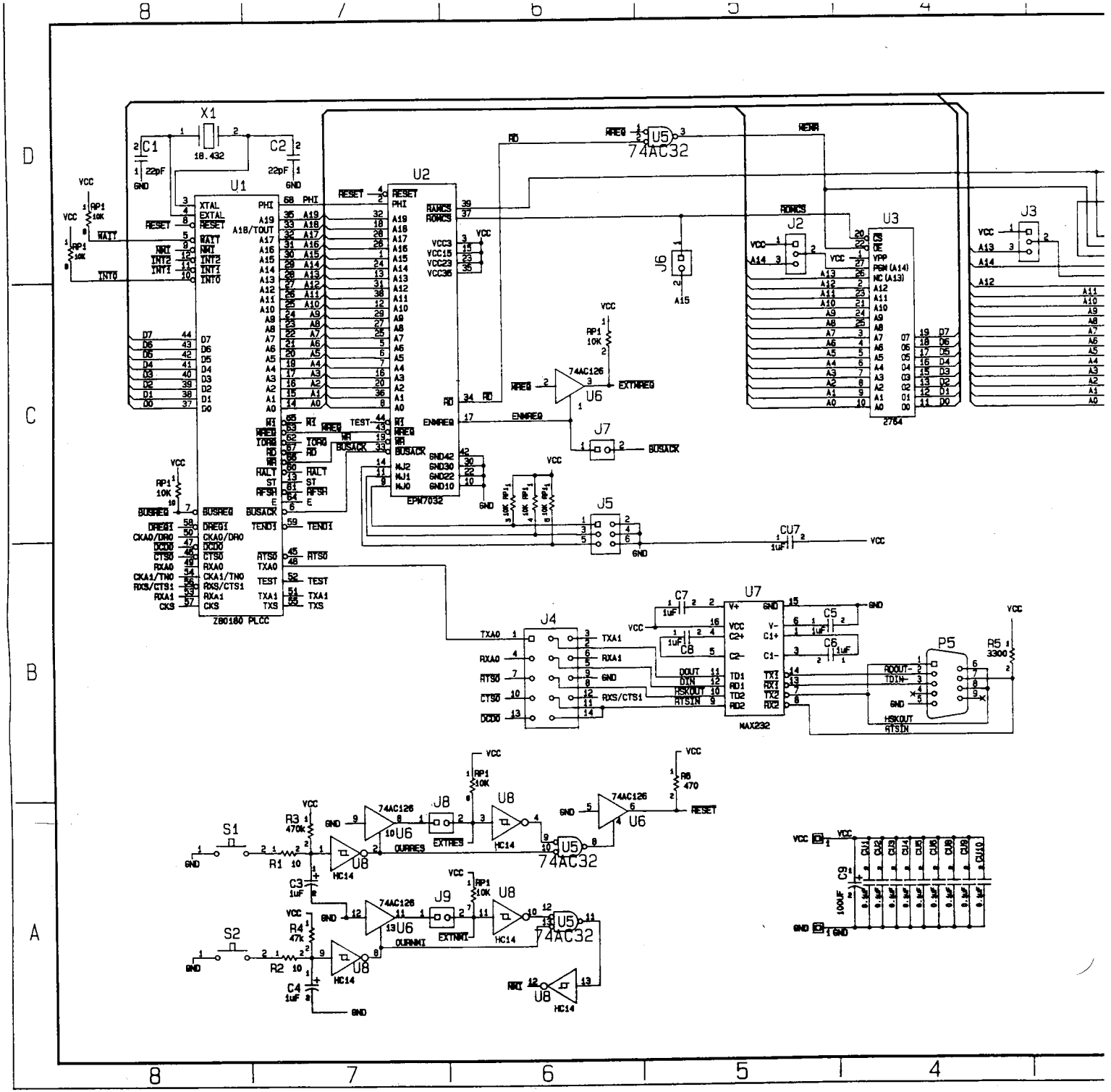
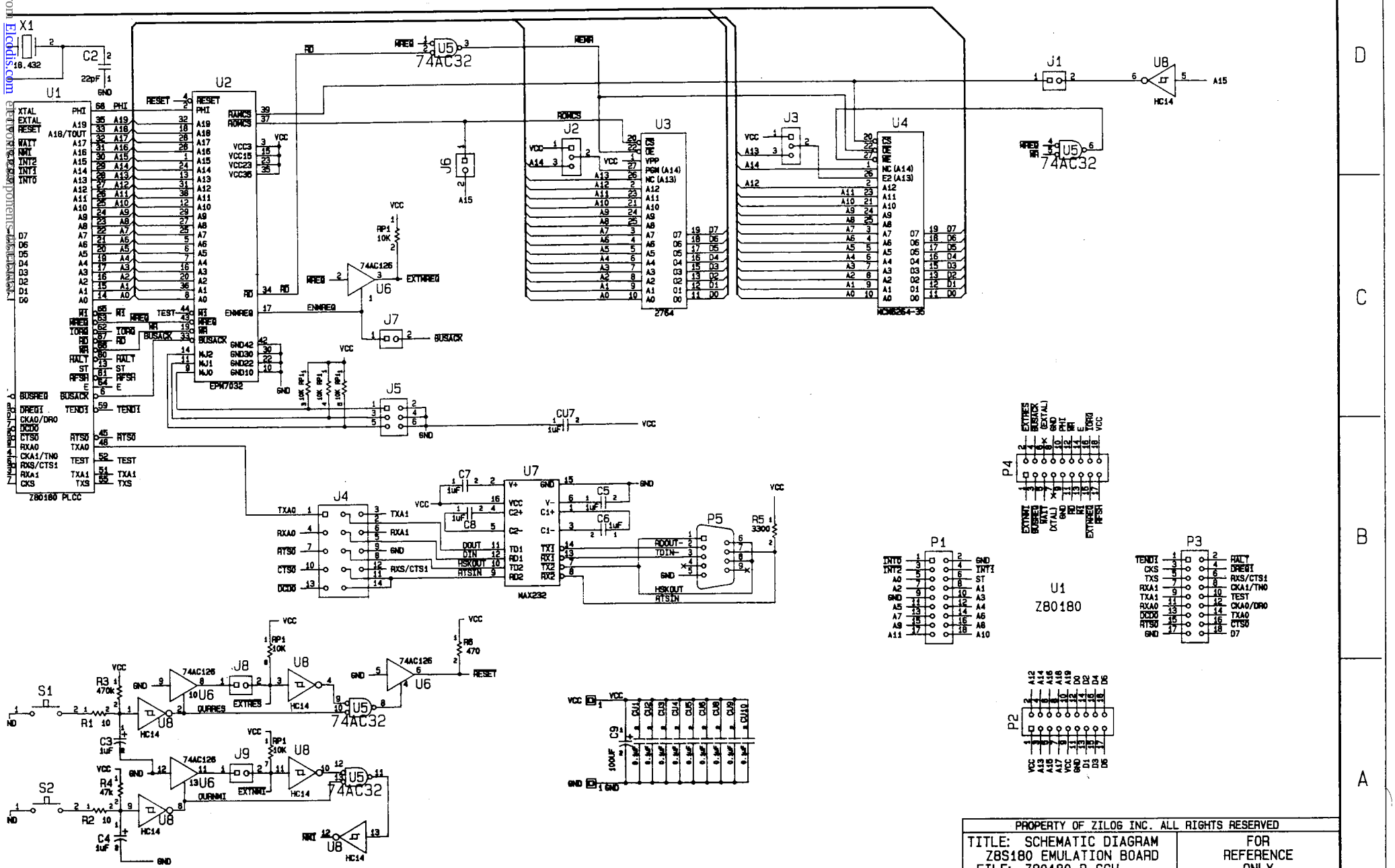
APPENDIX B

EMULATOR SCHEMATIC

The next page containS the schematic for the Z8S18000ZEM board.





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TITLE: SCHEMATIC DIAGRAM Z8S180 EMULATION BOARD FILE: Z80180-B.SCH	FOR REFERENCE ONLY	
DWG NUMBER: 96C0433-001	REV: B	PAGE: 1 OF 1
DWG SIZE: D		

Appendix C—Customer Support

For answers to technical questions about the product, documentation, or any other issues with Zilog's offerings, please visit Zilog's Knowledge Base at http://www.zilog.com/kb.

For any comments, detail technical questions, or reporting problems, please visit Zilog's Technical Support at http://support.zilog.com.