

Instruction Manual



TMS 501 Z80 Microprocessor Support 070-9828-00

There are no current European directives that apply to this product. This product provides cable and test lead connections to a test object of electronic measuring and test equipment.

Warning

The servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to all safety summaries prior to performing service.

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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

While using this product, you may need to access other parts of the system. Read the *General Safety Summary* in other system manuals for warnings and cautions related to operating the system.

To Avoid Fire or Personal Injury

Connect and Disconnect Properly. Do not connect or disconnect probes or test leads while they are connected to a voltage source.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and marking on the product. Consult the product manual for further ratings information before making connections to the product.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Do Not Operate Without Covers. Do not operate this product with covers or panels removed.

Use Proper Fuse. Use only the fuse type and rating specified for this product.

Avoid Exposed Circuitry. Do not touch exposed connections and components when power is present.

Do Not Operate With Suspected Failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

Keep Product Surfaces Clean and Dry.

Provide Proper Ventilation. Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

Symbols and Terms

Terms in this Manual. These terms may appear in this manual:



WARNING. Warning statements identify conditions or practices that could result in injury or loss of life.



CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Terms on the Product. These terms may appear on the product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

Symbols on the Product. The following symbols may appear on the product:



WARNING
High Voltage



Protective Ground
(Earth) Terminal



CAUTION
Refer to Manual



Double
Insulated

Service Safety Summary

Only qualified personnel should perform service procedures. Read this *Service Safety Summary* and the *General Safety Summary* before performing any service procedures.

Do Not Service Alone. Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

Disconnect Power. To avoid electric shock, disconnect the main power by means of the power cord or, if provided, the power switch.

Use Care When Servicing With Power On. Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

To avoid electric shock, do not touch exposed connections.

Preface: Microprocessor Support Documentation

This instruction manual contains specific information about the TMS 501 Z80 microprocessor support package and is part of a set of information on how to operate this product on compatible Tektronix logic analyzers.

If you are familiar with operating microprocessor support packages on the logic analyzer for which the TMS 501 Z80 support was purchased, you will probably only need this instruction manual to set up and run the support.

If you are not familiar with operating microprocessor support packages, you will need to supplement this instruction manual with information on basic operations to set up and run the support.

Information on basic operations of microprocessor support packages is included with each product. Each logic analyzer has basic information that describes how to perform tasks common to support packages on that platform. This information can be in the form of online help, an installation manual, or a user manual.

This manual provides detailed information on the following topics:

- Connecting the logic analyzer to the system under test
- Setting up the logic analyzer to acquire data from the system under test
- Acquiring and viewing disassembled data
- Using the probe adapter

Manual Conventions

This manual uses the following conventions:

- The term disassembler refers to the software that disassembles bus cycles into instruction mnemonics and cycle types.
- The phrase “information on basic operations” refers to online help, an installation manual, or a basic operations of microprocessor supports user manual.
- In the information on basic operations, the term XXX or P54C used in field selections and file names must be replaced with Z80A. This is the name of the microprocessor in field selections and file names you must use to operate the Z80 support.
- The term system under test (SUT) refers to the microprocessor-based system from which data will be acquired.

- The term logic analyzer refers to the Tektronix logic analyzer for which this product was purchased.
- The term module refers to a 68/102/136-channel or a 96-channel module.
- Z80A refers to all supported variations of the Z80 microprocessor unless otherwise noted.
- A tilde (~) following a signal name indicates an active low signal.

Logic Analyzer Documentation

A description of other documentation available for each type of Tektronix logic analyzer is located in the corresponding module user manual. The manual set provides the information necessary to install, operate, maintain, and service the logic analyzer and associated products.

Contacting Tektronix

Product Support	<p>For application-oriented questions about a Tektronix measurement product, call toll free in North America: 1-800-TEK-WIDE (1-800-835-9433 ext. 2400) 6:00 a.m. – 5:00 p.m. Pacific time</p> <p>Or, contact us by e-mail: tm_app_supp@tek.com</p> <p>For product support outside of North America, contact your local Tektronix distributor or sales office.</p>
Service Support	<p>Contact your local Tektronix distributor or sales office. Or, visit our web site for a listing of worldwide service locations.</p> <p>http://www.tek.com</p>
For other information	<p>In North America: 1-800-TEK-WIDE (1-800-835-9433) An operator will direct your call.</p>
To write us	<p>Tektronix, Inc. P.O. Box 1000 Wilsonville, OR 97070-1000</p>

Getting Started

This chapter provides information on the following topics and tasks:

- A description of the TMS 501 microprocessor support package
- Logic analyzer software compatibility
- Your system under test requirements
- Support restrictions
- How to configure the probe adapter
- How to connect to the system under test (SUT)

Support Description

The TMS 501 microprocessor support package disassembles data from systems that are based on the Zilog Z80 microprocessor. The support runs on a compatible Tektronix logic analyzer equipped with a 68/102/136-channel module or a 96-channel module.

Refer to information on basic operations to determine how many modules and probes your logic analyzer needs to meet the minimum channel requirements for the TMS 501 microprocessor support.

The TMS 501 supports the Z80 microprocessor in a 40-pin DIP package.

A complete list of standard and optional accessories is provided at the end of the parts list in the *Replaceable Mechanical Parts* chapter.

To use this support efficiently, you need to have the items listed in the information on basic operations as well as the following manuals:

- *Z80-CPU/Z80A-CPU Technical Manual*, Zilog (03-0029-00)
- *Z80 Microcomputer System Programming Manual*, Mostek (MK78515)

Information on basic operations also contains a general description of supports.

Logic Analyzer Software Compatibility

The label on the microprocessor support floppy disk states which version of logic analyzer software the support is compatible with.

Logic Analyzer Configuration

To use the Z80 support, the Tektronix logic analyzer must be equipped with either a 68/102/136-channel module, or a 96-channel module at a minimum. The module must be equipped with enough probes to acquire channel and clock data from signals in your Z80-based system.

Refer to information on basic operations to determine how many modules and probes the logic analyzer needs to meet the channel requirements.

Requirements and Restrictions

You should review the general requirements and restrictions of microprocessor supports in the information on basic operations as they pertain to your SUT.

You should also review electrical, environmental, and mechanical specifications in the *Specifications* chapter in this manual as they pertain to your system under test, as well as the following descriptions of other Z80 support requirements and restrictions.

System Clock Rate. The microprocessor support product supports the Z80 microprocessor at speeds of up to 20 MHz¹. However, if you use the optional DIP testclip adapter, the maximum supported clock speed is reduced to 6 MHz.

Configuring the Probe Adapter

There is one jumper on the probe adapter used to configure the probe adapter for disassembler operation or to acquire timing data.

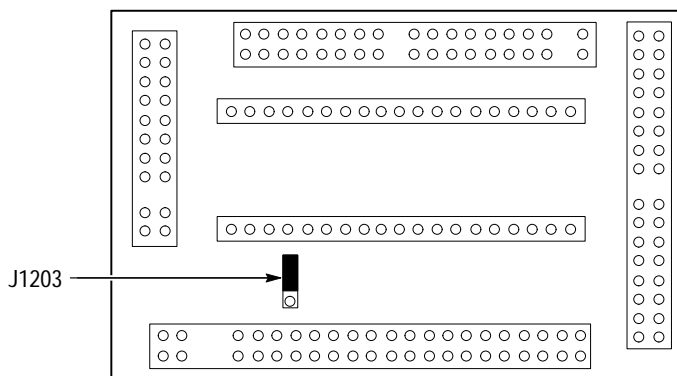
The Disassembly/Timing jumper (J1203) should be placed in the NORMAL position to acquire disassembled data, and in the TIMING position to acquire timing data. Table 1-1 shows how to position this jumper depending on the type of clocking you're using and the type of window you want to view.

¹ Specification at time of printing. Contact your Tektronix sales representative for current information on the fastest devices supported.

Table 1–1: Disassembly/Timing jumper information

J1203 position	Clocking	Data window
NORMAL (Disassembly)	Custom	Listing window or Disassembly or State displays
TIMING	Internal	Waveform window, or Timing display
	External	Waveform window, Listing window, or Timing display

Figure 1–1 shows the location of the Disassembly/Timing jumper.

**Figure 1–1: Jumper location**

Connecting to a System Under Test

Before you connect to the SUT, you must connect the probes to the module. Your SUT must also have a minimum amount of clear space surrounding the microprocessor to accommodate the probe adapter. Refer to the *Specifications* chapter in this manual for the required clearances.

The channel and clock probes shown in this chapter are for a 68/102/136-channel module. The probes will look different if you are using a 96-channel module.

The general requirements and restrictions of microprocessor supports in the information on basic operations shows the vertical dimensions of a channel or clock probe connected to square pins on a circuit board.

DIP Probe Adapter

To connect the logic analyzer to a SUT using a DIP probe adapter, follow these steps:

1. Turn off power to your SUT. It is not necessary to turn off the logic analyzer.



CAUTION. *Static discharge can damage the microprocessor, the probe adapter, the probes, or the module. To prevent static damage, handle all of the above only in a static-free environment.*

Always wear a grounding wrist strap or similar device while handling the microprocessor and probe adapter.

2. To discharge your stored static electricity, touch the ground connector located on the back of the logic analyzer. Then, touch any of the ground pins of the probe adapter to discharge stored static electricity from the probe adapter.
3. Place the probe adapter onto the antistatic shipping foam to support the probe as shown Figure 1–2. This prevents the circuit board from flexing and the socket pins from bending.
4. Remove the microprocessor from your SUT.
5. Line up pin 1 on the microprocessor with the pin 1 indicator on the probe adapter board.



CAUTION. *Failure to correctly place the microprocessor into the probe adapter might permanently damage all electrical components once power is applied.*

6. Place the microprocessor into the probe adapter as shown in Figure 1–2.

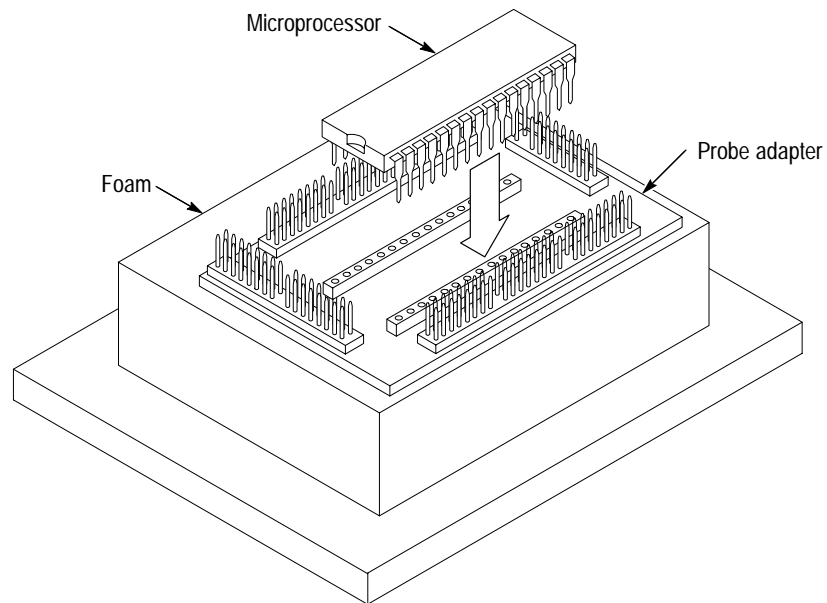


Figure 1-2: Placing a microprocessor into a DIP probe adapter

7. Connect the channel and clock probes to the probe adapter as shown in Figure 1-3. Match the channel groups and numbers on the probe labels to the corresponding pins on the probe adapter. Match the ground pins on the probes to the corresponding pins on the probe adapter.

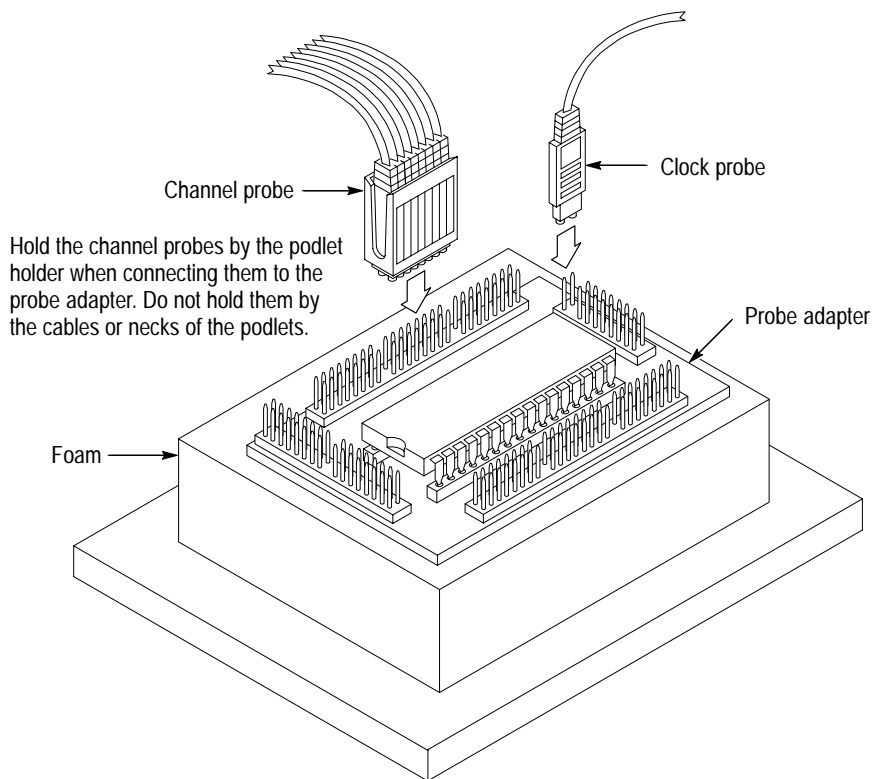


Figure 1-3: Connecting probes to a DIP probe adapter

8. Place the probe adapter onto the SUT as shown in Figure 1-4.

NOTE. You might need to stack one or more replacement sockets between the SUT and the probe adapter to provide sufficient vertical clearance from adjacent components. However, keep in mind that this might increase loading, which can reduce the electrical performance of your probe adapter.

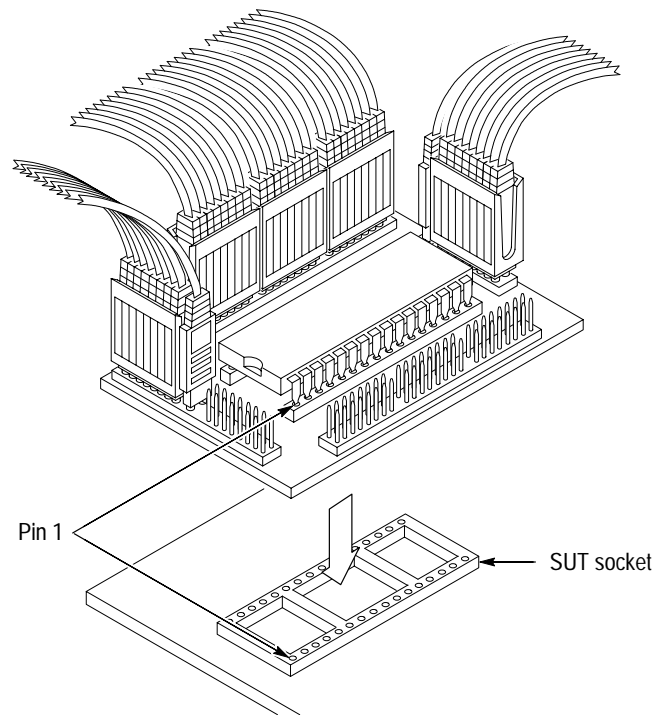


Figure 1–4: Placing a DIP probe adapter onto the SUT

DIP Probe Adapter with a DIP Clip

If your microprocessor is soldered to a circuit board, you will need to use the DIP converter clip with the probe adapter.

One end of the converter clip connects to square pins on the probe adapter. The other end connects to the microprocessor in your SUT. To connect the logic analyzer to your SUT using a DIP probe adapter with a clip, refer to Figure 1–5 and follow these steps:

1. Follow steps 1 through 7 in the previous procedure.
2. Connect the cable end to the square pins on the probe adapter.

NOTE. The red stripe along the side of the cable indicates that it connects to pin 1 on the probe adapter and pin 1 of the microprocessor.

3. Connect the clip end to the microprocessor.

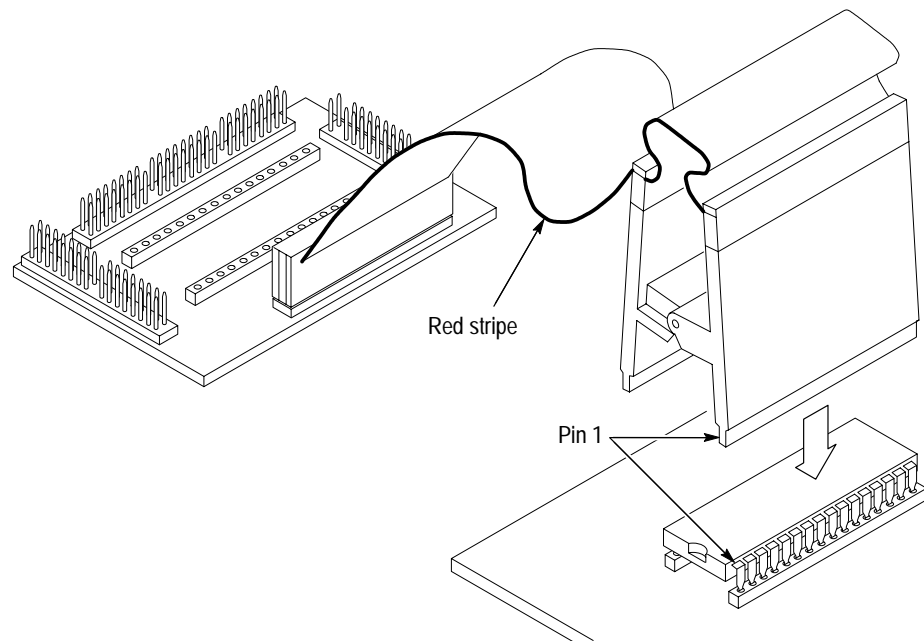


Figure 1-5: Connecting to the SUT using a DIP converter clip

Without a Probe Adapter

You can use channel probes, clock probes, and leadsets with a commercial test clip (or adapter) to make connections between the logic analyzer and your SUT.

To connect the probes to Z80 signals in the SUT using a test clip, follow these steps:

1. Turn off power to your SUT. It is not necessary to turn off power to the logic analyzer.



CAUTION. Static discharge can damage the microprocessor, the probes, or the module. To prevent static damage, handle all of the above only in a static-free environment.

Always wear a grounding wrist strap or similar device while handling the microprocessor.

2. To discharge your stored static electricity, touch the ground connector located on the back of the logic analyzer. If you are using a test clip, touch any of the ground pins on the clip to discharge stored static electricity from it.
3. Use Table 1-2 to connect the channel probes to Z80 signal pins on the test clip or in the SUT.

Use leadsets to connect at least one ground lead from each channel probe and the ground lead from each clock probe to ground pins on your test clip.

Table 1-2: Z80 signal connections for channel probes

Section:channel	Z80 signal	Section:channel	Z80 signal
A1:7	A15	D1:7	Not connected
A1:6	A14	D1:6	Not Connected
A1:5	A13	D1:5	RFSH~*
A1:4	A12	D1:4	RESET~*
A1:3	A11	D1:3	NMI~*
A1:2	A10	D1:2	INT~*
A1:1	A9	D1:1	BUSREQ~*
A1:0	A8	D1:0	WAIT~*
A0:7	A7	D0:7	D7
A0:6	A6	D0:6	D6
A0:5	A5	D0:5	D5
A0:4	A4	D0:4	D4
A0:3	A3	D0:3	D3
A0:2	A2	D0:2	D2
A0:1	A1	D0:1	D1
A0:0	A0	D0:0	D0
C2:7	CLK_B*	C2:3	BUSACK_L~
C2:6	HALT_L~	C2:2	WR_L~
C2:5	IORQ_L~	C2:1	RD_L~
C2:4	MREQ_L~	C2:0	M1_L~

* Signal not required for disassembly.

Table 1-3 shows the clock probes and the Z80 signal to which they must connect for disassembly to be correct.

Table 1-3: Z80 signal connections for clock channels

Section:channel	Z80 signal name
CK:2	HALT_L~
CK:0	CLK

4. Align pin 1 of your test clip with the corresponding pin 1 of the Z80 microprocessor in your SUT and attach the clip.

Setting Up the Support

This section provides information on how to set up the support. Information covers the following topics:

- Channel group definitions
- Clocking options
- Symbol table files

Remember that the information in this section is specific to the operations and functions of the TMS 501 Z80 support on any Tektronix logic analyzer for which it can be purchased. Information on basic operations describes general tasks and functions.

Before you acquire and disassemble data, you need to load the support and specify setups for clocking and triggering as described in the information on basic operations. The support provides default values for each of these setups, but you can change them as needed.

Channel Group Definitions

The software automatically defines channel groups for the support. The channel groups for the Z80 support are Address, Data, Control, and Misc. If you want to know which signal is in which group, refer to the channel assignment tables beginning on page 3–4.

Clocking Options

The TMS 501 support offers a microprocessor-specific clocking mode for the Z80 microprocessor. This clocking mode is the default selection whenever you load the Z80A support.

A description of how cycles are sampled by the module using the support and probe adapter is found in the *Specifications* chapter.

Disassembly will not be correct with the Internal or External clocking modes. Information on basic operations describes how to use these clock selections for general purpose analysis.

The clocking option for the TMS 501 support is DMA Cycles. A DMA cycle is defined as the cycle in which the Z80 microprocessor gives up the bus to an alternate device (a DMA device or another microprocessor). These types of cycles are acquired when you select Included.

Symbols

The TMS 501 support supplies one symbol table file. The Z80A_Ctrl file replaces specific Control channel group values with symbolic values when Symbolic is the radix for the channel group.

Table 2–1 shows the name, bit pattern, and meaning for the symbols in the file Z80A_Ctrl, the Control channel group symbol table.

Table 2–1: Control group symbol table definitions

Symbol	Control group value				Meaning
	RD_L- WR_L- IORQ_LN-	HALT_L- MREQ_L- BUSACK_L M1_L-			
MEM_READ	0 1 1	1 0 1 1			Non-opcode fetch memory read cycle
MEM_WRITE	1 0 1	1 0 1 1			Any memory write
I/O_READ	0 1 0	1 1 1 1			Read from an I/O port
I/O_WRITE	1 0 0	1 1 1 1			Write to an I/O port
DMA_READ	0 1 X	X X 0 X			DMA read cycle
DMA_WRITE	1 0 X	X X 0 X			DMA write cycle
DMA	X X X	X X 0 X			DMA cycle
INT_ACK	1 1 0	1 1 1 0			Responding to an interrupt
FETCH	0 1 1	1 0 1 0			Memory code read (Opcode Fetch)
HALT	0 1 1	0 0 1 0			Halt cycle

Information on basic operations describes how to use symbolic values for triggering and for displaying other channel groups symbolically, such as the Address channel group.

Acquiring and Viewing Disassembled Data

This section describes how to acquire data and view it disassembled. Information covers the following topics and tasks:

- Acquiring data
- Viewing disassembled data in various display formats
- Cycle type labels
- Changing the way data is displayed
- Changing disassembled cycles with the mark cycles function

Acquiring Data

Once you load the Z80A support, choose a clocking mode, and specify the trigger, you are ready to acquire and disassemble data.

If you have any problems acquiring data, refer to information on basic operations in your online help or *Appendix A: Error Messages and Disassembly Problems* in the basic operations user manual.

Viewing Disassembled Data

You can view disassembled data in four display formats: Hardware, Software, Control Flow, and Subroutine. The information on basic operations describes how to select the disassembly display formats.

NOTE. *Selections in the Disassembly property page (the Disassembly Format Definition overlay) must be set correctly for your acquired data to be disassembled correctly. Refer to Changing How Data is Displayed on page 2–6.*

The default display format shows the Address, Data, and Control channel group values for each sample of acquired data.

The disassembler displays special characters and strings in the instruction mnemonics to indicate significant events. Table 2–2 shows these special characters and strings, and gives a definition of what they represent.

Table 2-2: Meaning of special characters in the display

Character or string displayed	Meaning
>> or m	The instruction was manually marked as a program fetch
****	Indicates there is insufficient data available for complete disassembly of the instruction; the number of asterisks indicates the width of the data that is unavailable. Each two asterisks represent one byte.

Hardware Display Format

In Hardware display format, the disassembler displays certain cycle type labels in parentheses. Table 2-3 shows these cycle type labels and gives a definition of the cycle they represent. Reads to interrupt and exception vectors will be labeled with the vector name.

Table 2-3: Cycle type definitions

Cycle type	Definition
(HALT)	A halt cycle. The Z80 is awaiting an interrupt before resuming operation. While halted, the Z80 executes NOPs to maintain memory refresh activity.
(MEM_READ)	A read from memory that is not an opcode fetch
(MEM_WRITE)	Any write to memory
(I/O_READ)	A read from an I/O port
(I/O_WRITE)	A write to an I/O port
(DMA_READ)	A read from a DMA device
(DMA_WRITE)	A write to a DMA device
(INTACK_RD)	An interrupt acknowledge cycle
(2ND_FETCH)	A second opcode fetch *
(READ_EXTENSION)	A read extension to an opcode fetch*
(* ? *)	An illegal opcode*

* Computed cycle types.

Figure 2-1 shows an example of the Hardware display.

	1	2	3	4	5
	Sample	Address	Data	Mnemonics	Timestamp
T	0	0000	F3	DI	0 ns
	1	0001	ED	IM 1	1.250 us
	2	0002	56	(2ND FETCH)	1.250 us
	3	0003	C3	JP 115F	1.250 us
	4	0004	5F	(READ EXTENSION)	1.500 us
	5	0005	11	(READ EXTENSION)	1.000 us
	6	115F	3E	LD A,02	750 ns
	7	1160	02	(READ EXTENSION)	1.500 us
	8	1161	32	LD (3049),A	750 ns
	9	1162	49	(READ EXTENSION)	1.500 us
	10	1163	30	(READ EXTENSION)	1.000 us
	11	3049	02	(MEM WRITE)	1.250 us
	12	1164	31	LD SP,306C	750 ns
	13	1165	6C	(READ EXTENSION)	1.500 us
	14	1166	30	(READ EXTENSION)	1.000 us
	15	1167	CD	CALL 0455	750 ns
	16	1168	55	(READ EXTENSION)	1.500 us
	17	1169	04	(READ EXTENSION)	1.000 us
	18	306B	11	(MEM WRITE)	1.500 us
	19	306A	6A	(MEM WRITE)	1.250 us
	20	0455	3E	LD A,3C	750 ns

Figure 2–1: Hardware display format

- 1 **Sample Column.** Lists the memory locations for the acquired data.
- 2 **Address Group.** Lists data from channels connected to the Z80 address bus.
- 3 **Data Group.** Lists data from channels connected to the Z80 data bus.
- 4 **Mnemonics Column.** Lists the disassembled instructions and cycle types.
- 5 **Timestamp.** Lists the timestamp values when a timestamp selection is made. Information on basic operations describes how you can select a timestamp.

Software Display Format

The Software display format shows only the first fetch of executed instructions. Flushed cycles and extensions are not shown, even though they are part of the executed instruction.

Control Flow Display Format

The Control Flow display format shows only the first fetch of instructions that change the flow of control.

Instructions that generate a change in the flow of control in the Z80 microprocessor are as follows:

JP	JR	DJNZ	CALL
RETI	RETN	RST	RET

Subroutine Display Format

The Subroutine display format shows only the first fetch of subroutine call and return instructions. It will display conditional subroutine calls if they are considered to be taken.

Instructions that generate a subroutine call or a return in the Z80 microprocessor are as follows:

CALL	RET	RETI
RETN	RST	

Changing How Data is Displayed

There are common fields and features that allow you to further modify displayed data to suit your needs. You can make common and optional display selections in the Disassembly property page (the Disassembly Format Definition overlay).

You can make selections unique to the Z80 support to do the following tasks:

- Change how data is displayed across all display formats
- Change the interpretation of disassembled cycles

There are no optional fields for this support package. Refer to the information on basic operations for descriptions of common fields.

Marking Cycles

The disassembler has a Mark Opcode function that allows you to change the interpretation of a cycle type. Using this function, you can select a cycle and change it to one of the following cycle types:

- Opcode (the first word of an instruction)
- 2nd Fetch (the second byte of a two-byte instruction)
- Extension (a subsequent word of an instruction)
- Read (marks a memory reference read as data)

Mark selections for opcode fetches are as follows:

```
OPCODE
2nd FETCH
```

```
Undo marks on this cycle
```

Mark selections for reads or extensions are as follows:

Extension

Read

Undo marks on this cycle

Information on basic operations contains more details on marking cycles.

Viewing an Example of Disassembled Data

A demonstration system file (or demonstration reference memory) is provided so you can see an example of how your Z80 microprocessor bus cycles and instruction mnemonics look when they are disassembled. Viewing the system file is not a requirement for preparing the module for use and you can view it without connecting the logic analyzer to your SUT.

Information on basic operations describes how to view the file.

Specifications

This chapter contains the following information:

- Probe adapter description
- Specification tables
- Dimensions of the probe adapter
- Channel assignment tables
- Description of how the module acquires Z80 signals
- List of other accessible microprocessor signals and extra probe channels

Probe Adapter Description

The probe adapter is nonintrusive hardware that allows the logic analyzer to acquire data from a microprocessor in its own operating environment with little effect, if any, on that system. Information on basic operations contains a figure showing the logic analyzer connected to a typical probe adapter. Refer to that figure while reading the following description.

The probe adapter consists of a circuit board and a socket for a Z80 microprocessor. The probe adapter connects to the microprocessor in the SUT. Signals from the microprocessor-based system flow from the probe adapter to the channel groups and through the probe signal leads to the module.

All circuitry on the probe adapter is powered from the SUT.

The probe adapter accommodates the Zilog Z80 microprocessor in a 40-pin DIP package.

Configuration

There is one jumper on the probe adapter. The probe adapter jumper J1203 needs to be in the NORMAL position (pins 1 and 2 connected) for proper disassembly.

Specifications

These specifications are for a probe adapter connected between a compatible Tektronix logic analyzer and a SUT. Table 3–1 shows the electrical requirements the SUT must produce for the support to acquire correct data.

In Table 3–1, for the 68/102/136-channel module, one podlet load is 20 k Ω in parallel with 2 pF. For the 96-channel module, one podlet load is 100 k Ω in parallel with 10 pF.

Table 3–1: Electrical specifications

Characteristics	Requirements	
SUT DC power requirements		
Voltage	5.0 V \pm .25 V	
Current	Maximum: 400 mA	Nominal: 170 mA
SUT clock		
Clock rate	DC – 20 MHz	
Minimum setup time required with respect to rising edge of CLK		
A15:0	5.0 ns	
D7:0	1.0 ns	
RD-, WR-, IORQ-, MREQ-, BUSACK-, HALT-	1.0 ns	
Minimum hold time required with respect to rising edge of CLK		
A15:0	0	
D7:0 & M1-	6.5 ns	
RD-, WR-, IORQ-, MREQ-, BUSACK-, HALT-	8.0 ns	
	Specification	
Measured typical SUT signal loading	AC load	DC load
CLK	12 pF + 1 podlet	16L8 in parallel with 1 podlet
Address	9 pF + 1 podlet	1 podlet
Data	20 pF	(2) 74FCT652AT
RD-, WR-, IORQ-, MREQ-, BUSACK-, HALT-	11 pF	74F373
M1-	15 pF	74FCT652AT
RESET-, NMI-	17 pF + 1 podlet	1 podlet

Table 3–2 shows the environmental specifications.

Table 3–2: Environmental specifications*

Characteristic	Description
Temperature	
Maximum operating	+50° C (+122° F)†
Minimum operating	0° C (+32° F)
Non-operating	–55° C to +75° C (–67° to +167° F)
Humidity	10 to 95% relative humidity
Altitude	
Operating	4.5 km (15,000 ft) maximum
Non-operating	15 km (50,000 ft) maximum
Electrostatic immunity	The probe adapter is static sensitive

* **Designed to meet Tektronix standard 062-2847-00 class 5.**

† **Not to exceed Z80 microprocessor thermal considerations. Forced air cooling might be required across the CPU.**

Table 3–3 shows the certifications and compliances that apply to the probe adapter.

Table 3–3: Certifications and compliances

EC Compliance	There are no current European Directives that apply to this product.
---------------	--

Figure 3–1 shows the dimensions of the probe adapter. Information on basic operations shows the vertical clearance of the channel and clock probes when connected to a probe adapter.

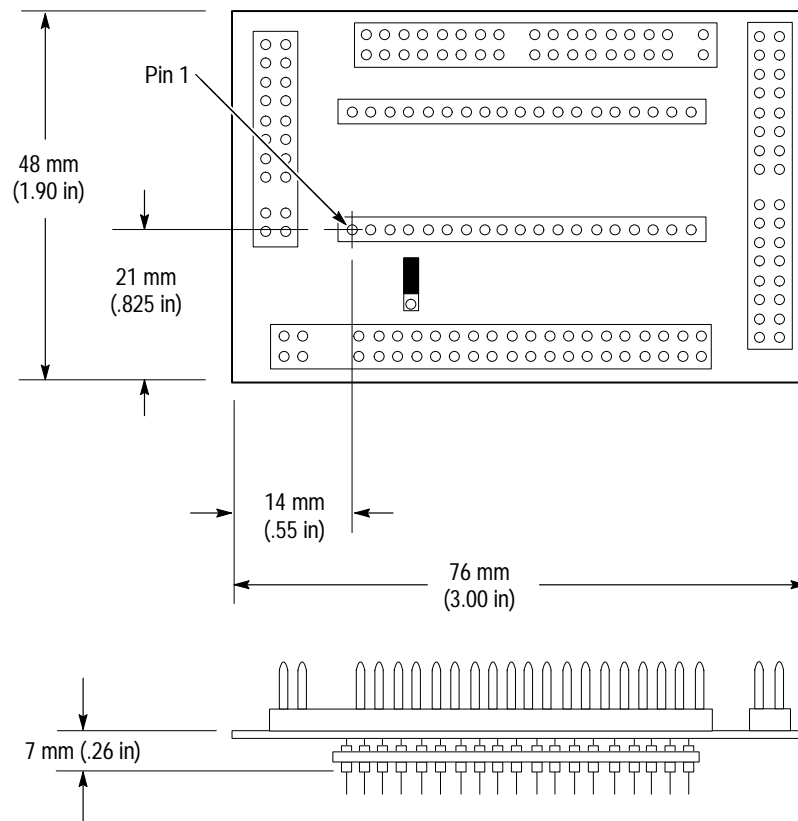


Figure 3–1: Dimensions of the probe adapter

Channel Assignments

Channel assignments shown in Table 3–4 through Table 3–8 use the following conventions:

- All signals are required by the support unless indicated otherwise.
- Channels are shown starting with the most significant bit (MSB) descending to the least significant bit (LSB).
- Channel group assignments are for all modules unless otherwise noted.
- A tilde (~) following a signal name indicates an active low signal.

Table 3–4 shows the probe section and channel assignments for the Address group and the microprocessor signal to which each channel connects. By default, this channel group is displayed in hexadecimal.

Table 3–4: Address group channel assignments

Bit order	Section:channel	Z80 signal name
15	A1:7	A15
14	A1:6	A14
13	A1:5	A13
12	A1:4	A12
11	A1:3	A11
10	A1:2	A10
9	A1:1	A9
8	A1:0	A8
7	A0:7	A7
6	A0:6	A6
5	A0:5	A5
4	A0:4	A4
3	A0:3	A3
2	A0:2	A2
1	A0:1	A1
0	A0:0	A0

Table 3–5 shows the probe section and channel assignments for the Data group and the microprocessor signal to which each channel connects. By default, this channel group is displayed in hexadecimal.

Table 3–5: Data group channel assignments

Bit order	Section:channel	Z80 signal name
7	D0:7	D7
6	D0:6	D6
5	D0:5	D5
4	D0:4	D4
3	D0:3	D3
2	D0:2	D2
1	D0:1	D1
0	D0:0	D0

Table 3–6 shows the probe section and channel assignments for the Control group and the microprocessor signal to which each channel connects. By default, this channel group is displayed symbolically.

Table 3–6: Control group channel assignments

Bit order	Section:channel	Z80 signal name
6	C2:1	RD_L~
5	C2:2	WR_L~
4	C2:5	IORQ_L~
3	C2:6	HALT_L~
2	C2:4	MREQ_L~
1	C2:3	BUSACK_L~
0	C2:0	M1_L~

Table 3–7 shows the probe section and channel assignments for the Misc group and the microprocessor signal to which each channel connects. By default, this channel group is not visible.

Table 3–7: Misc group channel assignments

Bit order	Section:channel	Z80 signal name
6	C2:7	CLK_B*
5	D1:5	RFSH~*
4	D1:4	RESET~*
3	D1:3	NMI~*
2	D1:2	INT~*
1	D1:1	BUSREQ~*
0	D1:0	WAIT~*

* Signal not required for disassembly.

Table 3–8 shows the probe section and channel assignments for the clock probes (not part of any group) and the Z80 signal to which each channel connects.

Table 3–8: Clock channel assignments

Section:channel	Z80 signal name
CK:3	Not connected
CK:2	HALT_L~
CK:1	Not connected
CK:0	CLK

How Data is Acquired

This part of this chapter explains how the module acquires Z80 signals using the TMS 501 software and probe adapter. This part also provides additional information on microprocessor signals accessible on or not accessible on the probe adapter, and on extra probe channels available for you to use for additional connections.

Custom Clocking

A special clocking program is loaded to the module every time you load the Z80A support. This special clocking is called Custom.

With Custom clocking, the module logs in signals from multiple groups of channels at different times as they become valid on the Z80 bus. The module then sends all the logged-in signals to the trigger machine and to the memory of the module for storage.

In Custom clocking, the module clocking state machine (CSM) generates one master sample for each microprocessor bus cycle, no matter how many clock cycles are contained in the bus cycle.

Figure 3–2 shows the sample points and the master sample point for an M1 cycle.

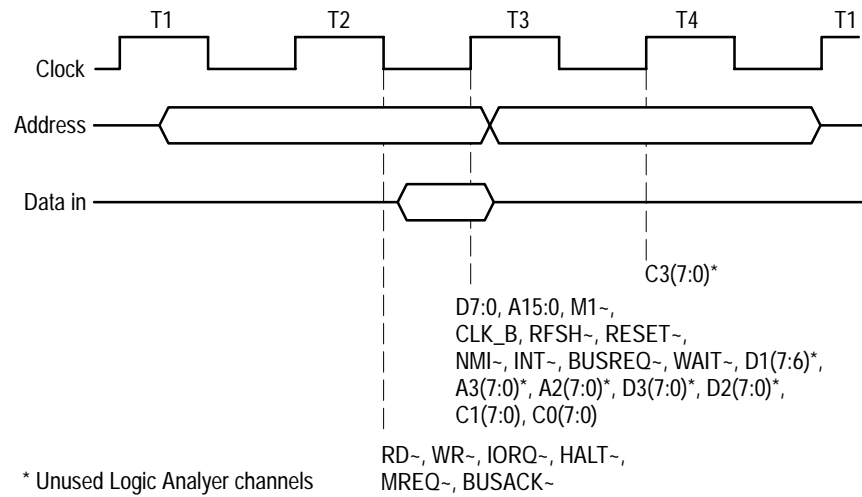


Figure 3-2: M1 cycle (opcode fetch or interrupt acknowledge)

Figure 3-3 shows the sample points and the master sample point for a Read or Write cycle.

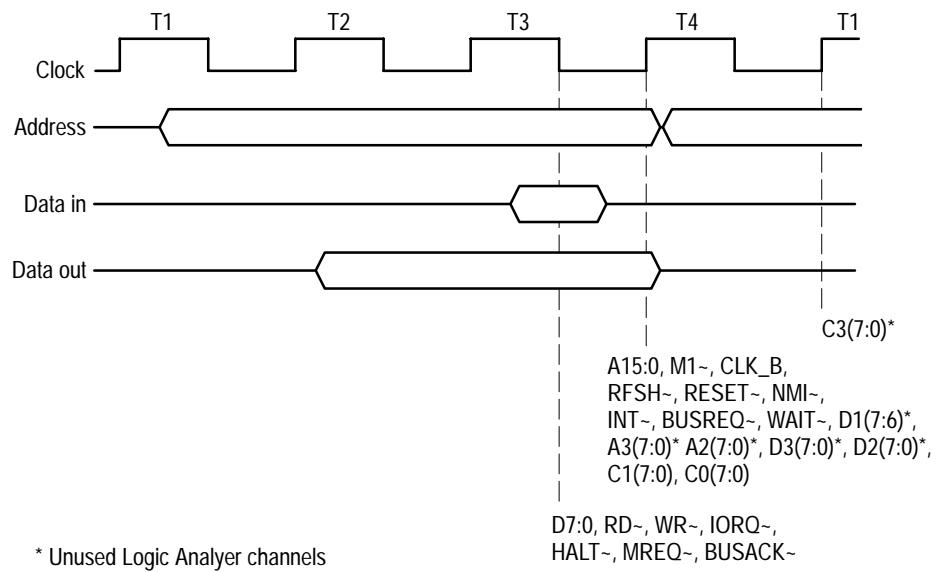


Figure 3-3: Read or Write cycle (memory or I/O, but not M1)

Clocking Options

The clocking algorithm for the Z80 support is DMA cycles.

DMA Cycles Excluded. When BUSACK $\bar{~}$ is inactive, a bus cycle starts when M1 $\bar{~}$, RD $\bar{~}$, or WR $\bar{~}$ become active. The bus cycle ends when the signal becomes inactive. The nature of the bus cycle depends on the following:

- M1 $\bar{~}$ is active. The bus cycle is either an opcode fetch or interrupt acknowledge cycle. Figure 3–2 shows when the various signals and unused channels are logged.
- WR $\bar{~}$ or RD $\bar{~}$ are active while M1 $\bar{~}$ is inactive. The bus cycle is a data write or read cycle with either memory or I/O. Figure 3–3 shows when the various signals and unused channels are logged.

When BUSACK $\bar{~}$ is active, the bus cycle is considered a DMA cycle and nothing is logged in. No record is made of the bus cycle taking place.

HALT cycles are a special M1 cycles. The only exit from HALT cycles is an interrupt or reset. This can result in a contiguous string of HALT cycles (hundreds long). However, only the first HALT cycle is stored.

DMA Cycles Included. All bus cycles are logged, including those bus cycles with BUSACK $\bar{~}$ signal active.

When BUSACK $\bar{~}$ is active, any bus cycle logged in is considered a DMA cycle. A DMA cycle can be logged in two different ways:

- BUSACK $\bar{~}$ becomes active, then inactive, without RD $\bar{~}$ or WR $\bar{~}$ becoming active. The information on the bus immediately before BUSACK $\bar{~}$ became inactive is logged in as the bus cycle.
- RD $\bar{~}$ or WR $\bar{~}$ become active while BUSACK $\bar{~}$ is active. The cycle is logged in the same manner as a memory read or write cycle (except that BUSACK $\bar{~}$ is active.)

When logging in DMA cycles the data bus and control signals are logged in on the falling clock edge as shown in Figure 3–3.

Alternate Microprocessor Connections

You can connect to microprocessor signals that are not required by the support so that you can do more advanced timing analysis. These signals might or might not be accessible on the probe adapter board.

For a list of signals required or not required for disassembly, refer to the channel assignment tables beginning on page 3–4. Remember that these channels are already included in a channel group. If you do connect these channels to other signals, you should set up another channel group for them.

Signals On the Probe Adapter

All Z80 microprocessor signals are accessible on the probe adapter.

Extra Channels

Table 3–9 lists extra sections and channels that are left after you have connected all the probes used by the support. You can use these extra channels to make alternate SUT connections.

These channels are not defined in any channel group and data acquired from them is not displayed. To display data, you will need to define a channel group.

Channels not defined in a channel group by the TMS 501 software are logged in according to Figures 3–2 and 3–3.

Table 3–9: Extra module sections and channels

Module	Section: channels
68-channels	C3:7-0, A3:7-0, A2:7-0, D1:7, D1:6
102-channels	C3:7-0, C1:7-0, C0:7-0, A3:7-0, A2:7-0, D3:7-0, D2:7-0, D1:7, D1:6, Qual:1, Qual:0
136-channels	C3:7-0, C1:7-0, C0:7-0, A3:7-0, A2:7-0, D3:7-0, D2:7-0, D1:7, D1:6, E3:7-0, E2:7-0, E1:7-0, E0:7-0, Qual:3-0
96-channels	C3:7-0, C1:7-0, C0:7-0, A3:7-0, A2:7-0, D3:7-0, D2:7-0, D1:7, D1:6

Maintenance

This chapter contains information on the following topics:

- Probe adapter circuit description
- How to replace a fuse

Probe Adapter Circuit Description

The probe adapter board uses active circuitry to guarantee the state of various signals for the clocking state machine (CSM) to properly log in the signals. The CSM uses the rising edge of CLK to determine when to log the signals in. Schematic diagrams for the probe adapter board are located in chapter 5.

The control channels that can be active on the falling edge of CLK go through U1302. They are held until the next rising edge of CLK clocks them into U1301. U1301 is configured to behave as a D type flip-flop in order to latch all of the control lines into the module. U1301 is clocked on a buffered version of CLK.

Data channels D7-D0 drive U2291 and U2391. U2291 is clocked on the rising edge of a buffered version of CLK (CLK_BH). U2391 is clocked on the rising edge of the inverted version of CLK (CLK_B~). This clocking scheme allows D7-D0 to be stored on both edges of the clock.

The outputs of U2291 and U2391 are wire ORed together. However, only one is enabled at a time. Signals M1_L~, BUSACK_L, and TIMING~ are used to determine which one is enabled. M1 cycles, and the interrupt acknowledgment enables U2291. I/O reads and writes, and DMA cycles enables U2391. U2391 is also enabled when the probe adapter is configured for timing mode (J1203 to pins 2 and 3). U1201 generates clocks and the output-enables used by U2291 and U2293.

Replacing Signal Leads

Information on basic operations describes how to replace signal leads (individual channel and clock probes).

Replacing Protective Sockets

Information on basic operations describes how to replace protective sockets.

Replacing the Fuse

If the fuse on the Z80 probe adapter opens (burns out), you can replace it with a 3 A, 125 V fuse. Refer to the *Replaceable Mechanical Parts List* for information on ordering a replacement fuse.

Replaceable Electrical Parts

This chapter contains a list of the replaceable electrical components for the TMS 501 Z80 microprocessor support. Use this list to identify and order replacement parts.

Parts Ordering Information

Replacement parts are available through your local Tektronix field office or representative.

Changes to Tektronix products are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest improvements. Therefore, when ordering parts, it is important to include the following information in your order:

- Part number
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

If you order a part that has been replaced with a different or improved part, your local Tektronix field office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

Using the Replaceable Electrical Parts List

The tabular information in the Replaceable Electrical Parts List is arranged for quick retrieval. Understanding the structure and features of the list will help you find all of the information you need for ordering replacement parts. The following table describes each column of the electrical parts list.

Manufacturers cross index

Mfr. code	Manufacturer	Address	City, state, zip code
01295	TEXAS INSTRUMENTS INC	SEMICONDUCTOR GROUP 13500 N CENTRAL EXPRESSWAY PO BOX 655303	DALLAS, TX 75272-5303
04222	AVX/KYOCERA	PO BOX 867	MYRTLE BEACH, SC 29577
04713	MOTOROLA INC	SEMICONDUCTOR PRODUCTS SECTOR 5005 E MCDOWELL ROAD	PHOENIX, AZ 85008-4229
61772	INTEGRATED DEVICE TECHNOLOGY	2975 STENDER WAY	SANTA CLARA, CA 95054
61857	SAN-O INDUSTRIAL CORP	91-3 COLIN DRIVE	HOLBROOK, NY 11741
63058	BERG ELECTRONICS INC.	MCKENZIE SOCKET DIV 910 PAGE AVE	FREMONT, CA 94538-7340
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON, OR 97077-0001
91637	DALE ELECTRONIC COMPONENTS	1122 23RD ST	COLUMBUS, NE 68601
TK0875	MATSUO ELECTRONICS	2134 MAIN STREET SUITE 200	HUNTINGTON BEACH, CA 92648

Replaceable electrical parts list

Component number	Tektronix part number	Serial no. effective	Serial no. discontin'd	Name & description	Mfr. code	Mfr. part number
A01	671-2361-00			CIRCUIT BD ASSY:Z80,DIP40,SOCKETED,PROBE ADAPTER(LASI III),389-1337-XX WIRED	80009	671-2361-00
A01C1202	283-5004-00			CAP,FXD,CERAMIC:MLC,0.1UF,10%,25V,X7R,1206,SMD,8MM T&R	04222	12063C104KAT3A
A01C1210	290-5005-00			CAP,FXD,TANT:47UF,10%,10V,5.8MM X 4.6MM,5846,SMD,T&R	TK0875	267M-1002-476-KR-533
A01C1211	283-5004-00			CAP,FXD,CERAMIC:MLC,0.1UF,10%,25V,X7R,1206,SMD,8MM T&R	04222	12063C104KAT3A
A01C1212	283-5004-00			CAP,FXD,CERAMIC:MLC,0.1UF,10%,25V,X7R,1206,SMD,8MM T&R	04222	12063C104KAT3A
A01C1301	283-5004-00			CAP,FXD,CERAMIC:MLC,0.1UF,10%,25V,X7R,1206,SMD,8MM T&R	04222	12063C104KAT3A
A01C2291	283-5004-00			CAP,FXD,CERAMIC:MLC,0.1UF,10%,25V,X7R,1206,SMD,8MM T&R	04222	12063C104KAT3A
A01C2292	283-5004-00			CAP,FXD,CERAMIC:MLC,0.1UF,10%,25V,X7R,1206,SMD,8MM T&R	04222	12063C104KAT3A
A01F1201	159-0204-00			FUSE,WIRE LEAD:3.0A,125V,5 SECONDS,T&R,	61857	SP7-3A
A01J1201	131-5267-00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326-4
A01J1202	131-5267-00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326-4
A01J1203	131-5267-00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326-4
A01J1211	131-5267-00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326-4
A01J1302	131-5267-00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326-4
A01J1311	131-5267-00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326-4
A01P1230	131-4530-00			CONN,HDR:PCB,MALE,STR,1 X 3,0.1 CTR,0.230 MLG X 0.120 TAIL,30 GOLD,BD RETENTION,	00779	104344-1
A01R2281	307-5002-00			RES NTWK,FXD,FI:8,51 OHM,2%,ISOLATED,0.16W EA,1.28W PKG,SMD,SO16.200,TUBE	91637	SOMC-1603-510G
A01U1201	160-8768-00			IC,DIGITAL:STTL,PLD,PAL,16L8,5NS,180MA,16L8-5,PLCC20,PRGM 156-6225-00	80009	160-8768-00
A01U1211	136-0916-00			SOCKET,DIP:PCB,FEMALE,STR,2 X 20,0.1 X 0.6 CTR,0.173 H X 0.183 TAIL,GOLD/GOLD,OPEN FRAME,	63058	DIP-640-101B
A01U1211	136-1193-00			SOCKET,DIP:PCB,MPC,FEMALE,STR,40,2 X 20,0.1 X 0.6 CTR,0.173H X 0.273L,0.020 DIA TAIL,GOLD	63058	MPC 2SIP-640-115B-R
A01U1301	156-6176-00			IC,DIGITAL:FCTCMOS,TRANSCEIVER,OCTAL REGISTERED,3-STATE,74FCT652AT,SO24.300,TUBE	61772	IDT74FCT652ATSO
A01U1302	156-5059-00			IC,DIGITAL:FCTL,LATCH,OCTAL D-TYPE,3-STATE,74F373,SO20.300,TUBE	01295	SN74F373DW
A01U2291	156-6176-00			IC,DIGITAL:FCTCMOS,TRANSCEIVER,OCTAL REGISTERED,3-STATE,74FCT652AT,SO24.300,TUBE	61772	IDT74FCT652ATSO

Replaceable electrical parts list (cont.)

Component number	Tektronix part number	Serial no. effective	Serial no. discont'd	Name & description	Mfr. code	Mfr. part number
A01U2391	156-6176-00			IC,DIGITAL:FCTCMOS,TRANSCIEVER,OCTAL REGISTERED,3-STATE,74FCT652AT,SO24.300,TUBE	61772	IDT74FCT652ATSO
A01UXXX	156-6225-00			IC,DIGITAL:STTL,PLD,PAL,16L8,5NS,180MA,16L8-5,PLCC20, TUBE	01295	TIBPAL16L8-5CFN

Replaceable Mechanical Parts

This chapter contains a list of the replaceable mechanical components for the TMS 501 Z80 microprocessor support. Use this list to identify and order replacement parts.

Parts Ordering Information

Replacement parts are available through your local Tektronix field office or representative.

Changes to Tektronix products are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest improvements. Therefore, when ordering parts, it is important to include the following information in your order:

- Part number
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

If you order a part that has been replaced with a different or improved part, your local Tektronix field office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

Using the Replaceable Mechanical Parts List

The tabular information in the Replaceable Mechanical Parts List is arranged for quick retrieval. Understanding the structure and features of the list will help you find all of the information you need for ordering replacement parts. The following table describes the content of each column in the parts list.

Parts list column descriptions

Column	Column name	Description
1	Figure & index number	Items in this section are referenced by figure and index numbers to the exploded view illustrations that follow.
2	Tektronix part number	Use this part number when ordering replacement parts from Tektronix.
3 and 4	Serial number	Column three indicates the serial number at which the part was first effective. Column four indicates the serial number at which the part was discontinued. No entries indicates the part is good for all serial numbers.
5	Qty	This indicates the quantity of parts used.
6	Name & description	An item name is separated from the description by a colon (:). Because of space limitations, an item name may sometimes appear as incomplete. Use the U.S. Federal Catalog handbook H6-1 for further item name identification.
7	Mfr. code	This indicates the code of the actual manufacturer of the part.
8	Mfr. part number	This indicates the actual manufacturer's or vendor's part number.

Abbreviations Abbreviations conform to American National Standard ANSI Y1.1-1972.

Chassis Parts Chassis-mounted parts and cable assemblies are located at the end of the Replaceable Electrical Parts List.

Mfr. Code to Manufacturer Cross Index The table titled Manufacturers Cross Index shows codes, names, and addresses of manufacturers or vendors of components listed in the parts list.

Manufacturers cross index

Mfr. code	Manufacturer	Address	City, state, zip code
00779	AMP INC.	CUSTOMER SERVICE DEPT PO BOX 3608	HARRISBURG, PA 17105-3608
26742	METHODE ELECTRONICS INC	BACKPLAIN DIVISION 7444 WEST WILSON AVE	CHICAGO, IL 60656-4548
53387	3M COMPANY	ELECTRONICS PRODUCTS DIV 3M AUSTIN CENTER	AUSTIN, TX 78769-2963
61857	SAN-O INDUSTRIAL CORP	91-3 COLIN DRIVE	HOLBROOK, NY 11741
63058	BERG ELECTRONICS INC.	MCKENZIE SOCKET DIV 910 PAGE AVE	FREMONT, CA 94538-7340
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON, OR 97077-0001
TK2548	XEROX CORPORATION	14181 SW MILLIKAN WAY	BEAVERTON, OR 97005

Replaceable mechanical parts list

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. dis-cont'd	Qty	Name & description	Mfr. code	Mfr. part number
1-0	010-0536-00			1	PROBE ADAPTER,Z80,DIP40,TMS 501	80009	010-0536-00
-1	131-4356-00			1	CONN,SHUNT:SHUNT/SHORTING,FEMALE,1 X 2,0.1 CTR,0.63 H,BLK,W/HANDLE,JUMPER,	26742	9618-302-50
-2	131-4530-00			1	CONN,HDR:PCB,MALE,STR,1 X 3,0.1 CTR,0.230 MLG X 0.120 TAIL,30 GOLD,BD RETENTION,	00779	104344-1
-3	131-5267-00			2	CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326-4
-4	671-2361-00			1	CIRCUIT BD ASSY:Z80,DIP40,SOCKETED,PROBE ADAPTER(LASI III),389-1337-XX WIRED	80009	671-2361-00
-5	136-0916-00			2	SOCKET,DIP:PCB,FEMALE,STR,2 X 20,0.1 X 0.6 CTR,0.173 H X 0.183 TAIL,GOLD/GOLD,OPEN FRAME,	63058	DIP-640-101B
					STANDARD ACCESSORIES		
	070-9828-00			1	MANUAL,TECH:INSTRUCTION,Z80,DISSASSEMBLER, TMS 501	80009	070-9828-00
	070-9803-00			1	MANUAL, TECH:TLA 700 SERIES MICRO SUPPORT INSTALLATION	80009	070-9803-00
					OPTIONAL ACCESSORIES		
	070-9802-00			1	MANUAL, TECH:BASIC OPS MICRO SUP ON DAS/TLA 500 SERIES LOGIC ANALYZERS	80009	070-9802-00
-6	015-0646-00			1	TEST CLIP ASSY:RIBBON,32DMXX,MXD,40,28 AWG,4.0 L,40 POS DIP CLIP X 2X20 0.1 CTR RCPT W/CTR PLZ,	53387	015-0646-00
	159-0204-00			1	FUSE,WIRE LEAD:3.0A,125V,5 SECONDS,T&R,	61857	SP7-3A

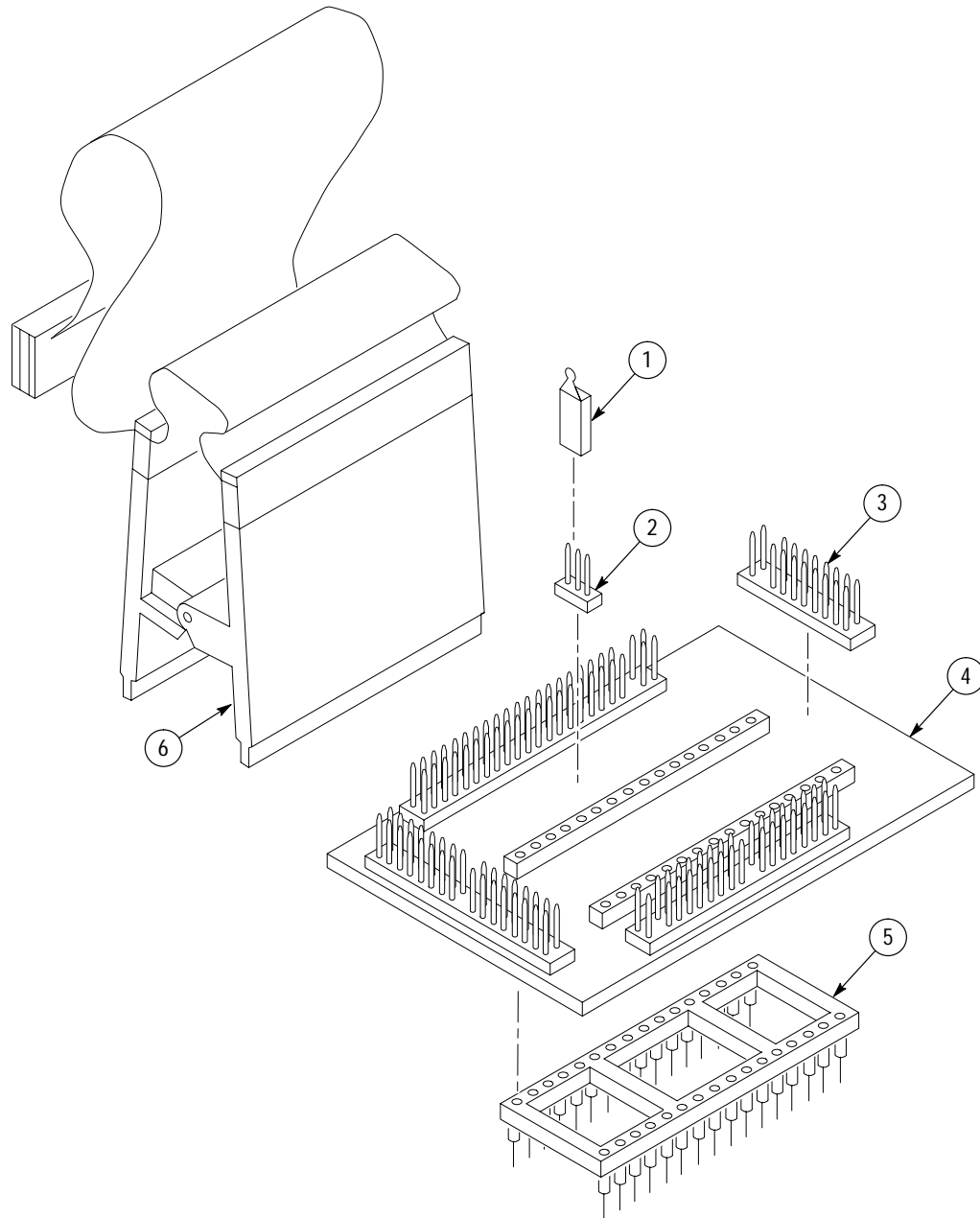


Figure 1: Z80 probe adapter exploded view

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