# Instruction Manual

**Tektronix**

# TMS 144
# MCS296 Microprocessor Support

# 071-0067-01

**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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In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes, and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; c) to repair any damage or malfunction caused by the use of non-Tektronix supplies; or d) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

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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.

**Ground the Product.** This product is indirectly grounded through the grounding conductor of the mainframe power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

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

**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          Protective Ground          CAUTION          Double
High Voltage      (Earth) Terminal          Refer to Manual  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.

TMS 144 MCS296 Microprocessor Support Instruction Manual

# Preface

This instruction manual contains specific information about the TMS 144 MCS296 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 144 MCS296 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

## Manual Conventions

This manual uses the following conventions:

■ In this manual the term "MCS296" refers to the Intel MCS296 as well as the 80296SA and the 296SA/196NT/NP.

■ 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 MCS296. This is the name of the microprocessor in field selections and file names you must use to operate the MCS296 support.

- The term "SUT" (system under test) 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 "HI module" refers to the module in the higher-numbered slot and the term "LO module" refers to the module in the lower-numbered slot.

- MCS296 refers to all supported variations of the MCS296 microprocessor unless otherwise noted.

- An asterisk (*) 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 | For questions about using Tektronix measurement products, 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 |
| | Or contact us by e-mail: tm_app_supp@tektronix.com |
| | For product support outside of North America, contact your local Tektronix distributor or sales office. |
| Service Support | Tektronix offers extended warranty and calibration programs as options on many products. Contact your local Tektronix distributor or sales office. |
| | For a listing of worldwide service centers, visit our web site. |
| For other information | In North America: 1-800-TEK-WIDE (1-800-835-9433) An operator will direct your call. |
| To write us | Tektronix, Inc. P.O. Box 1000 Wilsonville, OR 97070-1000 USA |
| Website | Tektronix.com |

TMS 144 MCS296 Microprocessor Support Instruction Manual

# Getting Started

# Getting Started

This chapter contains information on the TMS 144 microprocessor support, and information on connecting your logic analyzer to your system under test.

## Support Package Description

The TMS 144 microprocessor support package displays disassembled data from systems based on the Intel MCS296 microprocessor.

The TMS 144 supports the 80296SA in a QFP package.

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

To use this support efficiently, you need to have the items listed in the information on basic operations as well as the *80296SA Microcontroller User's Manual,* Intel, 1996.

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

The probe adapter consists of a circuit board and a test QFP test clip for a MCS296 microprocessor. The probe adapter connects to the microprocessor in the SUT. Signals from the microprocessor-based system flow through the probe adapter to the P6434 probes and through the probe cables to the logic analyzer.

## Logic Analyzer Software Compatibility

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

## Logic Analyzer Configuration

For use with a TLA 700 Series, the TMS 144 support requires a minimum of one 102-channel module.

For use with a DAS 9200 Series, the TMS 144 support requires a minimum of one 96-channel module.

## Labeling P6434 Probes

The TMS 144 channel assignments follow the standard channel mapping and labeling scheme for P6434 probes. You must follow the procedure to apply labels using the standard method as described in the *P6434 Mass Termination Probe Instructions*.

## DAS Mass Termination Interface (MTIF) Probes

The MTIF probes are already labeled since the probe sections for each probe are permanent. The TMS 144 channel assignments follow the standard channel mapping.

## Requirements and Restrictions

Review the electrical, environmental, and mechanical specifications in the *Specifications* chapter in this manual as they pertain to your system under test.

**System Clock Rate.** The MCS296 microprocessor support can acquire data from the MCS296 microprocessor operating at speeds of 40 and 50 MHz[1].

**DMA Mode.** The DMA mode is not supported.

**Hardware Reset.** If a hardware reset occurs in your MCS296 system during an acquisition, the application disassembler might acquire an invalid sample.

**ONCE Mode.** The ONCE mode is not supported.

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

**Idle or Power Down Mode.** When the system enters the Idle mode or Power down mode, a message "SLOW CLOCK" is displayed and the acquisition is stopped. The acquisition is resumed once the system reverts back to its original state.

**Code In Internal RAM.** When the code in internal RAM is executed, it can not be acquired.

**Using the Support Without A Probe Adapter.** If you connect the logic analyzer directly to the microprocessor without the TMS 144 MCS296 probe adapter, the MCS296 support will function only in the following modes:

- 8-bit operation in Write strobe mode and Standard Write Control mode.

- 16-bit operation in Standard Write Control mode.

**Block Move Instruction.** When the following piece of code is executed:

```
        ...
        ...
BMOV        20,24
LD          72,#1234h
LD          28,89ABh
        ...
        ...
```

The disassembly is displayed as follows:

```
    Sample   Address  Data   Mnemonics
    ------------------------------------------
        362  F30F1    C1     BMOV    20,24
        363  F30F2    24     ( EXTENSION )
        364  F30F3    20     ( EXTENSION )
        365  F30F4    A1     LD      **,#1234
        366  F30F5    34     ( EXTENSION )
        367  F30F6    12     ( EXTENSION )
        368  07000    45     ( READ )
        369  07001    67     ( READ )
        370  07002    45     ( WRITE )
        371  07002    67     ( WRITE )
    ........................................
    ........................................
        467                  ( WRITE )
        468  F30F8    72     ANDB    AB,#A1
        469  F30F9    A1     ( EXTENSION )
        470  F30FA    AB     ( EXTENSION )
        471  F30FB    89     CMP.........
        472  F30F1    28     ( EXTENSION )
    ........................................
    ........................................
```

Sample 368 to sample 467 consist of a series of READs and WRITEs. This is because of the block move instruction BMOV. The operand "72h" of the instruction "LD  72,#1234h" comes in sample 468. Because there is more than a 30-sample gap between address F30F6 and address F30F7, the software does not consider sample 468 (address F30F7) to be part of the instruction at sample 365. It is therefore assumed as: "The operand is missing and a fresh instruction starts at sample 468". That is why the instruction at sample 365 is displayed as "LD   **,#1234", and sample 468 as "ANDB XXXX". That is why the disassembly from sample 468 is incorrect.

To avoid this, mark sample 469 as "Opcode", and then the disassembly will be synchronized. If sample 469 in this example was marked as "Opcode" the following display would be seen:

```
Sample   Address  Data   Mnemonics
-----------------------------------------
.........................................
.........................................
   469  F30F8    A1      LD    28,#89ABh
   470  F30F9    AB      ( EXTENSION )
   471  F30FA    89      ( EXTENSION )
   472  F30FB    28      ( EXTENSION )
.........................................
.........................................
```

## Configuring the Probe Adapter

The probe adapter has a jumper to select between Write Strobe mode (WR_STB) and Standard Write Control mode (STD). The Write Strobe mode uses signals WRL* and WRH*. The Standard Write Control mode uses signals WR* and BHE*.

- To use the probe adapter in the Write Strobe mode (WR_STB), connect (use a shorting jumper) pins 1 and 2 on connector J120.

- To use the probe adapter in the Standard Write Control mode (STD), connect (use a shorting jumper) pins 2 and 3 on connector J120.

## Connecting to a System Under Test

Before you connect to your 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 probe adapter dimensions.

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.

**With a Probe Adapter**    To connect the logic analyzer to a SUT using the probe adapter and test clip, 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 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.

**3.** Connect the P6434 probes to the probe adapter as shown in Figure 1–1. Match the channel groups and numbers on the probe labels to the corresponding connectors on the probe adapter.

⚠ *CAUTION. Incorrect handling of the P6434 probe while connecting it to the probe adapter can result in damage to the probe or to the mating connector on the probe adapter*

*To avoid damaging the probe and probe adapter, always position the probe perpendicular to the mating connector and gently connect the probe.*

**4.** Position the probe tip perpendicular to the mating connector and gently connect the probe as shown in Figure 1–1.

**5.** When connected, push down the latch releases on the probe to set the latch.
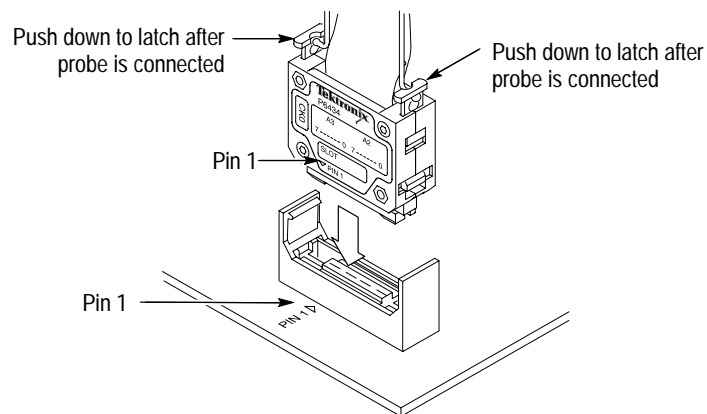
**Figure 1–1: Connecting P6434 probes to the probe adapter**

**6.** Line up the pin 1 indicator on the probe adapter circuit board (a white triangle) with the pin 1 indicator on the QFP test clip as shown in Figure 1–2.
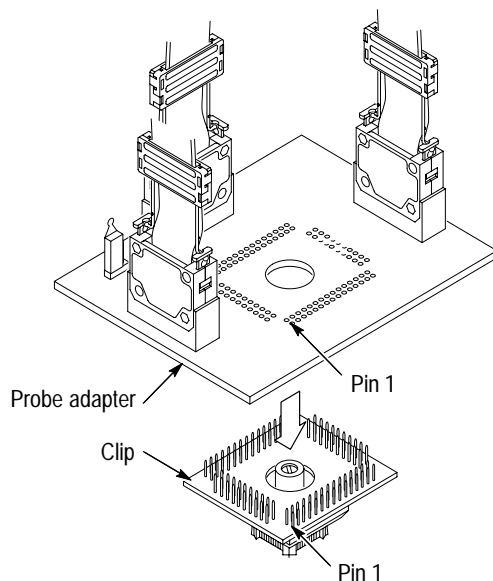


**Figure 1–2: Connecting the QFP test clip to the probe adapter**

**7.** Inspect the microcontroller on you SUT for bent or broken leads. Verify that the leads on the microcontroller are clean and free from dirt, dust, or any foreign material.

**8.** Inspect the pins of the QFP test clip for bent or broken contacts. Verify that the leads on the test clip are clean and free from dirt, dust or any foreign material.

**9.** Place the probe adapter onto the SUT as shown in Figure 1–3.

*CAUTION. The test clip was designed to be used on one and only one micropro-cessor. Because of the tight tolerances required for QFP test clip connectivity, the test clip that attaches to the microprocessor has a soft plastic collar that conforms to the unique shape of the target microprocessor.*

*To avoid faulty and unreliable connections, it is HIGHLY recommended that the test clip IS NOT used on any other microprocessor then the one it was originally connected to.*
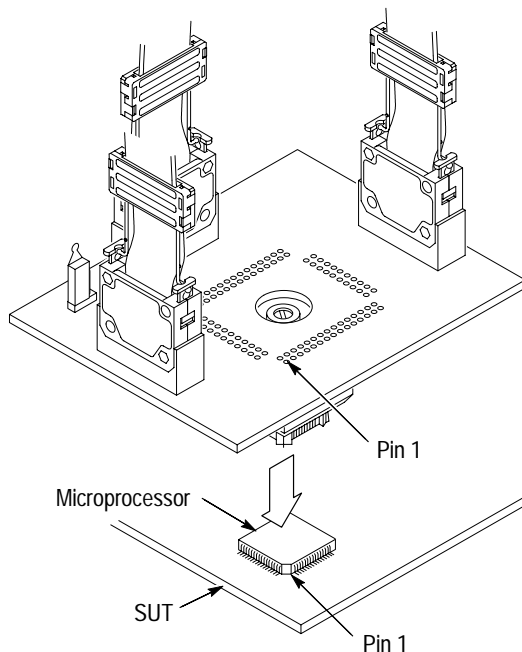
**Figure 1–3: Placing the probe adapter onto the SUT**

⚠ *CAUTION. The probe adapter board might slip off or slip to one side of the microprocessor because of the extra weight of the probes. This can damage the microprocessor and the SUT.*

*To prevent this from occurring, stabilize the probe adapter by placing a non-conductive object (such as non-conductive foam) between the probe adapter and the SUT.*

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

*Center the clip on the microprocessor and apply an equal downward force on all four sides of the clip. It is important to keep the QFP test clip parallel to the microprocessor to avoid damage to the SUT or QFP test clip. Do not apply leverage to the probe adapter when installing or removing it.*

**Removing the Probe Adapter**

To remove the probe adapter from your SUT, follow these steps:

**10.** Gently lift and pull the probe adapter off of the microcontroller.

⚠️ *CAUTION. The test clip was designed to be used on one and only one micropro-cessor. Because of the tight tolerances required for QFP test clip connectivity, the test clip that attaches to the microprocessor has a soft plastic collar that conforms to the unique shape of the target microprocessor.*

*To avoid faulty and unreliable connections, it is HIGHLY recommended that the test clip IS NOT used on any other microprocessor then the one it was originally connected to.*

# Alternate Microprocessor Connections

You can connect to other signals that are not required by the support so that you can analyze other signal activity in your system. These signals might or might not be accessible on the probe adapter board. The following paragraphs and tables list signals that are or are not 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 1–10. 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.

**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 MCS296 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, and the module. To prevent static damage, handle them only in a static-free environment.*

*Always wear a grounding wrist strap, heel 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.

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⚠

**CAUTION.** *Failure to place the SUT on a horizontal surface before connecting the test clip might permanently damage the pins on the microprocessor.*

3. Place the SUT on a horizontal static-free surface.

4. Use the channel assignment tables to connect the channel probes to the MCS296 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.

# Channel Assignments

The following channel assignment tables show the probe section and channel assignments, and the signal to which each channel connects.

Channel assignments shown in Table 1–1 through Table 1–13 use the following conventions:

- 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.

- An asterisk (*) following a signal name indicates an active low signal.

- An equals sign (=) following a signal name indicates that it is double probed.

- The module in the higher-numbered slot is referred to as the HI module and the module in the lower-numbered slot is referred to as the LO module.

   The TLA 704 has the lower numbered slots on the top and the TLA 711 has the lower numbered slots on the left.

By default the Address channel group assignments are displayed in hexadecimal.

**Table 1–1: Address channel group assignments**

| Bit order | Section:channel | MCS296 signal name |
|-----------|-----------------|--------------------|
| 19 | A2:3 | A19 |
| 18 | A2:2 | A18 |
| 17 | A2:1 | A17 |
| 16 | A2:0 | A16 |
| 15 | A1:7 | A15 |
| 14 | A1:6 | A14 |
| 13 | A1:5 | A13 |

**Table 1–1: Address channel group assignments  (cont.)**

| Bit order | Section:channel | MCS296 signal name |
|---|---|---|
| 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 |

By default the Data channel group assignments are displayed in hexadecimal.

**Table 1–2: Data group channel assignments**

| Bit order | Section:channel | MCS296 signal name |
|---|---|---|
| 15 | D1:7 | AD15 |
| 14 | D1:6 | AD14 |
| 13 | D1:5 | AD13 |
| 12 | D1:4 | AD12 |
| 11 | D1:3 | AD11 |
| 10 | D1:2 | AD10 |
| 9 | D1:1 | AD9 |
| 8 | D1:0 | AD8 |
| 7 | D0:7 | AD7 |
| 6 | D0:6 | AD6 |
| 5 | D0:5 | AD5 |
| 4 | D0:4 | AD4 |
| 3 | D0:3 | AD3 |
| 2 | D0:2 | AD2 |
| 1 | D0:1 | AD1 |
| 0 | D0:0 | AD0 |

By default the Control group channel assignments are displayed symbolically.

**Table 1–3: Control channel group assignments**

| Bit order | Section:channel | MCS296 signal name |
|---|---|---|
| 3 | C2:0 | WR* |
| 2 | C2:2 | BHE* |
| 1 | C2:1 | RD* |
| 0 | C2:3 | INST |

By default the MemRegn channel group assignments are not visible.

**Table 1–4: MemRegn group channel assignments**

| Bit order | Section:channel | MCS296 signal name |
|---|---|---|
| 5 | A3:1 | CS0* |
| 4 | A3:2 | CS1* |
| 3 | A3:3 | CS2* |
| 2 | A3:4 | CS3* |
| 1 | A3:5 | CS4* |
| 0 | A3:6 | CS5* |

By default the Port1 channel group assignments are not visible.

**Table 1–5: Port1 group channel assignments**

| Bit order | Section:channel | MCS296 signal name |
|---|---|---|
| 7 | C2:4 | P1_0 † |
| 6 | C2:5 | P1_1 † |
| 5 | C2:6 | P1_2 † |
| 4 | C2:7 | P1_3 † |
| 3 | C3:0 | P1_4 † |
| 2 | C3:1 | P1_5 † |
| 1 | C3:2 | P1_6 † |
| 0 | C3:3 | P1_7 † |

† **Signal not required for clocking or disassembly.**

By default the Port4 channel group assignments are not visible.

**Table 1–6: Port4 group channel assignments**

| Bit order | Section:channel | MCS296 signal name |
|---|---|---|
| 3 | A2:7 | P4_3 † |
| 2 | A2:6 | P4_2 † |
| 1 | A2:5 | P4_1 † |
| 0 | A2:4 | P4_0 † |

† **Signal not required for clocking or disassembly.**

By default the Port2 group channel assignments are not visible.

**Table 1–7: Port2 channel group assignments**

| Bit order | Section:channel | MCS296 signal name |
|---|---|---|
| 6 | D2:7 | P2_6 † |
| 5 | D2:6 | P2_5 † |
| 4 | D2:5 | P2_4 † |
| 3 | D2:4 | P2_3 † |
| 2 | D2:3 | P2_2 † |
| 1 | D2:2 | P2_1 † |
| 0 | D2:1 | P2_0 † |

† **Signal not required for clocking or disassembly.**

By default the Port3 group channel assignments are not visible.

**Table 1–8: Port3 channel group assignments**

| Bit order | Section:channel | MCS296 signal name |
|---|---|---|
| 1 | D3:7 | P3_7† |
| 0 | D3:6 | P3_6 † |

† **Signal not required for clocking or disassembly.**

By default the Misc group channel assignments are not visible.

**Table 1–9: Misc channel group assignments**

| Bit order | Section:channel | MCS296 signal name |
|-----------|-----------------|--------------------|
| 5 | C3:4 | READY † |
| 4 | C3:6 | RESET* † |
| 3 | D2:0 | ALE |
| 2 | C3:5 | NMI † |
| 1 | A3:7 | CLKOUT † |
| 0 | C3:7 | ONCE † |

† **Signal not required for clocking or disassembly.**

The probe section and channel assignments for the clock probes are not part of any group.

**Table 1–10: Clock channel assignments**

| Section:channel | MCS296 signal name |
|-----------------|--------------------|
| CK:2 | WR_D* |
| CK:1 | RD* = |
| CK:0 | ALE = |

**Signals Not On the Probe Adapter**

The probe adapter does not provide access to the following signals:

| | | |
|---|---|---|
| PLLEN1 | PLLEN2 | |
| XTAL1 | XTAL2 | RPD |

# CPU To Mictor Connections

To probe the microprocessor you will need to make connections between the CPU and the Mictor pins of the P6434 Mass Termination Probe. Refer to the P6434 Mass Termination Probe manual, Tektronix part number 070-9793-xx, for more information on mechanical specifications. Table 1–11 through Table 1–13 show the CPU pin to Mictor pin connections.

Tektronix uses a counter-clockwise pin assignment. Pin-1 is located at the top left, and pin-2 is located directly below it. Pin-20 is located on the bottom right, and pin-21 is located directly above it.

AMP uses an odd side-even side pin assignment. Pin-1 is located at the top left, and pin-3 is located directly below it. Pin-2 is located on the top right, and pin-4 is located directly below it.

---

*NOTE. When designing Mictor connectors into your SUT, always follow the Tektronix pin assignment.*

---
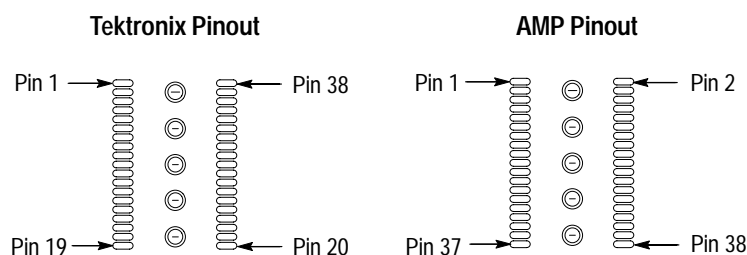


**Figure 1–4: Pin assignments for a Mictor connector (component side)**

Without the TMS 144 MCS296 probe adapter the MCS296 support will only function for the following two modes:

- 8-bit operation in Write Strobe mode and Standard Write Control mode.

- 16-bit operation in Standard Write Control mode.

---

*CAUTION. To protect the CPU and the inputs of the module, it is recommended that a 180Ω resistor is connected in series between each ball pad of the CPU and each pin of the Mictor connector. The resistor must be no farther away from the ball pad of the CPU than 1/2-inch.*

---

**Table 1–11: CPU to Mictor connections for Mictor A pins**

| Tektronix-Mictor A pin number | AMP Mictor A pin number | LA channel | MCS296 signal name | MCS296 pin number |
|---|---|---|---|---|
| 1 | 1 | NC | NC | NC |
| 2 | 3 | NC | NC | NC |
| 3 | 5 | CLOCK:0 | ALE = | 74 |
| 4 | 7 | A3:7 | CLKOUT | 54 |
| 5 | 9 | A3:6 | CS5* | 25 |
| 6 | 11 | A3:5 | CS4* | 24 |

**Table 1–11: CPU to Mictor connections for Mictor A pins (cont.)**

| Tektronix-Mictor A pin number | AMP Mictor A pin number | LA channel | MCS296 signal name | MCS296 pin number |
|---|---|---|---|---|
| 7 | 13 | A3:4 | CS3* | 22 |
| 8 | 15 | A3:3 | CS2* | 21 |
| 9 | 17 | A3:2 | CS1* | 20 |
| 10 | 19 | A3:1 | CS0* | 19 |
| 11 | 21 | A3:0 | Unused | Unused |
| 12 | 23 | A2:7 | PORT4:3 | 43 |
| 13 | 25 | A2:6 | PORT4:2 | 42 |
| 14 | 27 | A2:5 | PORT4:1 | 41 |
| 15 | 29 | A2:4 | PORT4:0 | 40 |
| 16 | 31 | A2:3 | A19 | 78 |
| 17 | 33 | A2:2 | A18 | 79 |
| 18 | 35 | A2:1 | A17 | 82 |
| 19 | 37 | A2:0 | A16 | 83 |
| 20 | 38 | A0:0 | A0 | 6 |
| 21 | 36 | A0:1 | A1 | 7 |
| 22 | 34 | A0:2 | A2 | 10 |
| 23 | 32 | A0:3 | A3 | 11 |
| 24 | 30 | A0:4 | A4 | 12 |
| 25 | 28 | A0:5 | A5 | 13 |
| 26 | 26 | A0:6 | A6 | 14 |
| 27 | 24 | A0:7 | A7 | 15 |
| 28 | 22 | A1:0 | A8 | 66 |
| 29 | 20 | A1:1 | A9 | 65 |
| 30 | 18 | A1:2 | A10 | 64 |
| 31 | 16 | A1:3 | A11 | 63 |
| 32 | 14 | A1:4 | A12 | 62 |
| 33 | 12 | A1:5 | A13 | 61 |
| 34 | 10 | A1:6 | A14 | 60 |
| 35 | 8 | A1:7 | A15 | 59 |
| 36 | 6 | CLOCK:1 | RD* = | 76 |
| 37 | 4 | NC | NC | NC |
| 38 | 2 | NC | NC | NC |
| 39 | 39 | GND | GND | GND |
| 40 | 40 | GND | GND | GND |
| 41 | 41 | GND | GND | GND |

**Table 1–11: CPU to Mictor connections for Mictor A pins (cont.)**

| Tektronix-Mictor A pin number | AMP Mictor A pin number | LA channel | MCS296 signal name | MCS296 pin number |
|---|---|---|---|---|
| 42 | 42 | GND | GND | GND |
| 43 | 43 | GND | GND | GND |

**Table 1–12: CPU to Mictor connections for Mictor D pins**

| Tektronix-Mictor D pin number | AMP Mictor D pin number | LA channel | MCS296 signal name | MCS296 pin number |
|---|---|---|---|---|
| 1 | 1 | NC | NC | NC |
| 2 | 3 | NC | NC | NC |
| 3 | 5 | NC | NC | NC |
| 4 | 7 | D3:7 | PORT3:7 | 28 |
| 5 | 9 | D3:6 | PORT3:6 | 26 |
| 6 | 11 | D3:5 | Not Used | Not Used |
| 7 | 13 | D3:4 | Not Used | Not Used |
| 8 | 15 | D3:3 | Not Used | Not Used |
| 9 | 17 | D3:2 | Not Used | Not Used |
| 10 | 19 | D3:1 | Not Used | Not Used |
| 11 | 21 | D3:0 | Not Used | Not Used |
| 12 | 23 | D2:7 | PORT2:6 | 52 |
| 13 | 25 | D2:6 | PORT2:5 | 51 |
| 14 | 27 | D2:5 | PORT2:4 | 50 |
| 15 | 29 | D2:4 | PORT2:3 | 49 |
| 16 | 31 | D2:3 | PORT2:2 | 48 |
| 17 | 33 | D2:2 | PORT2:1 | 47 |
| 18 | 35 | D2:1 | PORT2:0 | 46 |
| 19 | 37 | D2:0 | ALE | 74 |
| 20 | 38 | D0:0 | AD0 | 1 |
| 21 | 36 | D0:1 | AD1 | 100 |
| 22 | 34 | D0:2 | AD2 | 99 |
| 23 | 32 | D0:3 | AD3 | 98 |
| 24 | 30 | D0:4 | AD4 | 97 |
| 25 | 28 | D0:5 | AD5 | 96 |
| 26 | 26 | D0:6 | AD6 | 95 |
| 27 | 24 | D0:7 | AD7 | 94 |

**Table 1–12: CPU to Mictor connections for Mictor D pins (cont.)**

| Tektronix-Mictor D pin number | AMP Mictor D pin number | LA channel | MCS296 signal name | MCS296 pin number |
|---|---|---|---|---|
| 28 | 22 | D1:0 | AD8 | 92 |
| 29 | 20 | D1:1 | AD9 | 90 |
| 30 | 18 | D1:2 | AD10 | 89 |
| 31 | 16 | D1:3 | AD11 | 88 |
| 32 | 14 | D1:4 | AD12 | 87 |
| 33 | 12 | D1:5 | AD13 | 86 |
| 34 | 10 | D1:6 | AD14 | 85 |
| 35 | 8 | D1:7 | AD15 | 84 |
| 36 | 6 | CLOCK:2 | WR* = | 77 |
| 37 | 4 | NC | NC | NC |
| 38 | 2 | NC | NC | NC |
| 39 | 39 | GND | GND | GND |
| 40 | 40 | GND | GND | GND |
| 41 | 41 | GND | GND | GND |
| 42 | 42 | GND | GND | GND |
| 43 | 43 | GND | GND | GND |

**Table 1–13: CPU to Mictor connections for Mictor C pins**

| Tektronix-Mictor C pin number | AMP Mictor C pin number | LA channel | MCS296 signal name | MCS296 pin number |
|---|---|---|---|---|
| 1 | 1 | NC | NC | NC |
| 2 | 3 | NC | NC | NC |
| 3 | 5 | CLOCK:3 | Unused | Unused |
| 4 | 7 | C3:7 | ONCE | 70 |
| 5 | 9 | C3:6 | RESET* | 3 |
| 6 | 11 | C3:5 | NMI | 4 |
| 7 | 13 | C3:4 | READY | 72 |
| 8 | 15 | C3:3 | PORT1:7 | 39 |
| 9 | 17 | C3:2 | PORT1:6 | 37 |
| 10 | 19 | C3:1 | PORT1:5 | 35 |
| 11 | 21 | C3:0 | PORT1:4 | 34 |
| 12 | 23 | C2:7 | PORT1:3 | 33 |
| 13 | 25 | C2:6 | PORT1:2 | 32 |

**Table 1–13: CPU to Mictor connections for Mictor C pins (cont.)**

| Tektronix-Mictor C pin number | AMP Mictor C pin number | LA channel | MCS296 signal name | MCS296 pin number |
|---|---|---|---|---|
| 14 | 27 | C2:5 | PORT1:1 | 31 |
| 15 | 29 | C2:4 | PORT1:0 | 29 |
| 16 | 31 | C2:3 | INST | 73 |
| 17 | 33 | C2:2 | BHE* | 75 |
| 18 | 35 | C2:1 | RD* | 76 |
| 19 | 37 | C2:0 | WR* | 77 |
| 20 | 38 | C0:0 | Unused | Unused |
| 21 | 36 | C0:1 | Unused | Unused |
| 22 | 34 | C0:2 | Unused | Unused |
| 23 | 32 | C0:3 | Unused | Unused |
| 24 | 30 | C0:4 | Unused | Unused |
| 25 | 28 | C0:5 | Unused | Unused |
| 26 | 26 | C0:6 | Unused | Unused |
| 27 | 24 | C0:7 | Unused | Unused |
| 28 | 22 | C1:0 | Unused | Unused |
| 29 | 20 | C1:1 | Unused | Unused |
| 30 | 18 | C1:2 | Unused | Unused |
| 31 | 16 | C1:3 | Unused | Unused |
| 32 | 14 | C1:4 | Unused | Unused |
| 33 | 12 | C1:5 | Unused | Unused |
| 34 | 10 | C1:6 | Unused | Unused |
| 35 | 8 | C1:7 | Unused | Unused |
| 36 | 6 | NC | NC | NC |
| 37 | 4 | NC | NC | NC |
| 38 | 2 | NC | NC | NC |
| 39 | 39 | GND | GND | GND |
| 40 | 40 | GND | GND | GND |
| 41 | 41 | GND | GND | GND |
| 42 | 42 | GND | GND | GND |
| 43 | 43 | GND | GND | GND |

# Operating Basics

# Setting Up the Support

The information in this section is specific to the operations and functions of the TMS 144 MCS296 support on any Tektronix logic analyzer for which it can be purchased.

Before you acquire and display disassembled data, you will 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.

## How Data is Acquired

This part of this chapter explains how the module acquires MCS296 signals using the TMS 144 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.

## Clocking

### Custom Clocking

A special clocking program is loaded to the module every time you load the MCS296 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 MCS296 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 2–1 and Figure 2–2 show the sample points and the master sample point for the MCS296 bus timing.
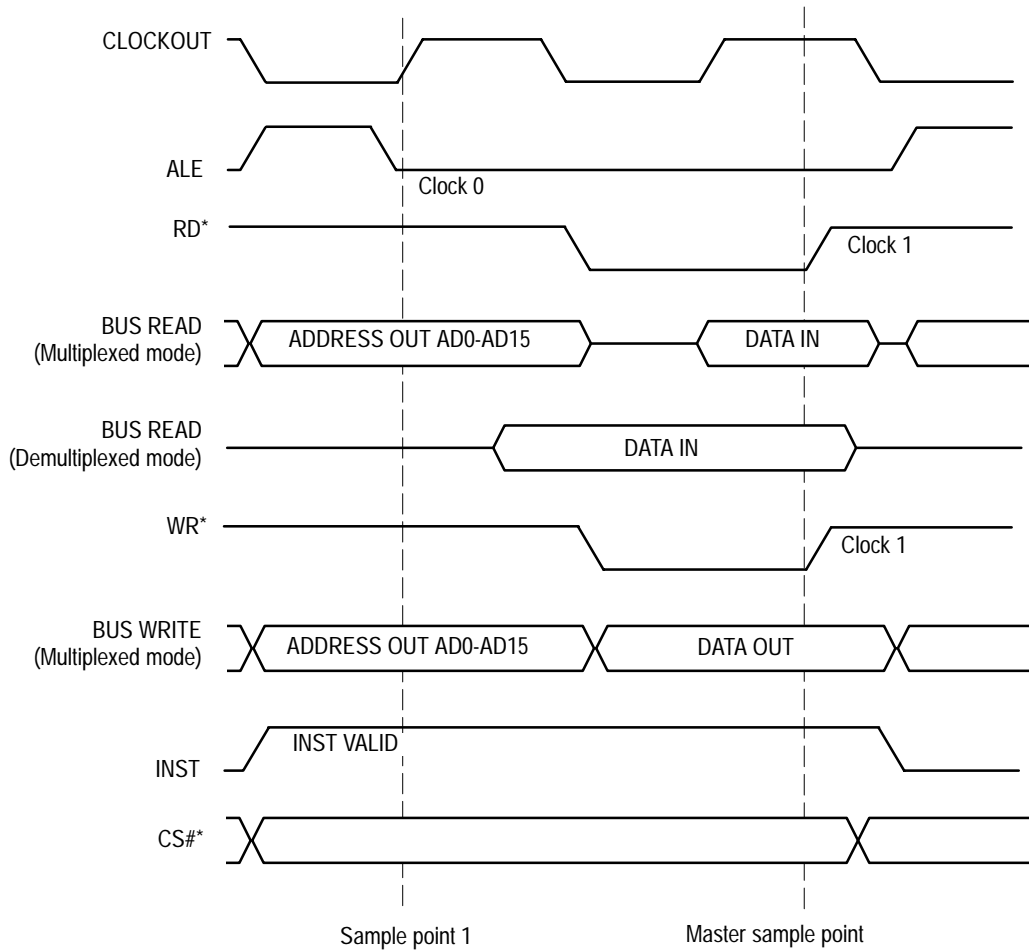


**Figure 2–1: MCS296 bus timing in multiplexed mode**
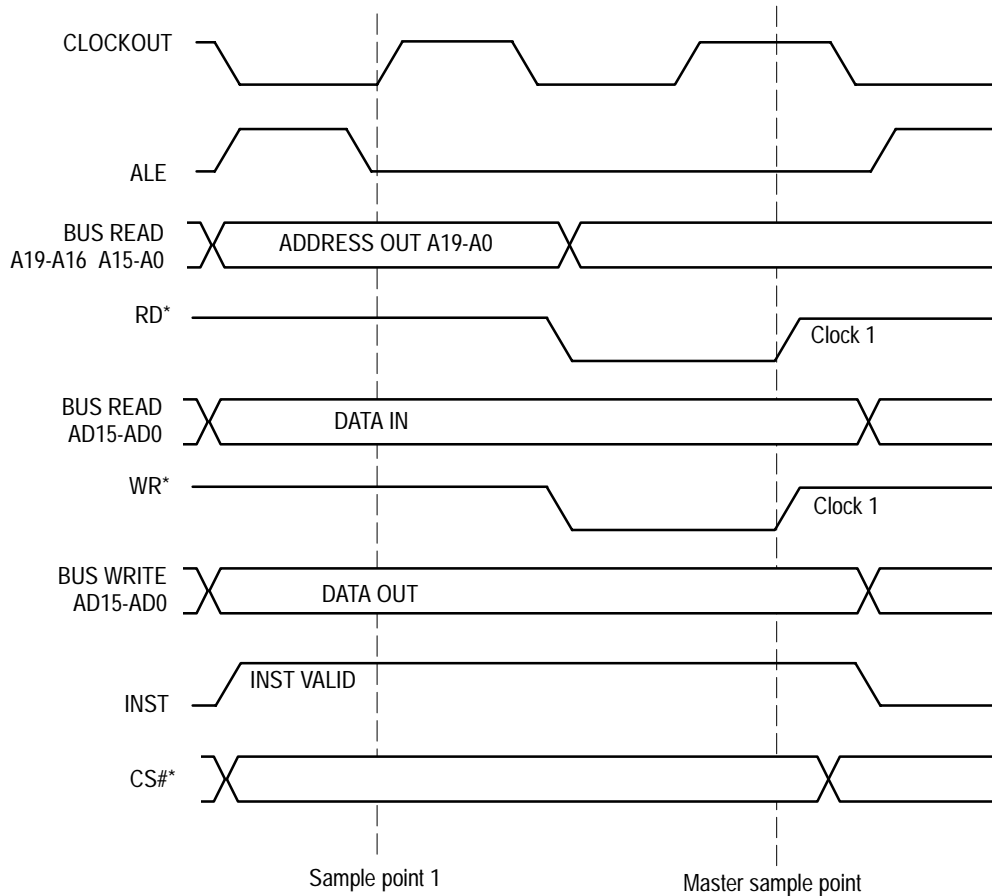
**Figure 2–2: MCS296 bus timing in demultiplexed mode**

**Clocking Options**     When "Custom" is selected, the Custom Clocking Options menu will have the sub-title "MCS296 Microprocessor Clocking Support" added to it. Custom clocking supports both multiplexed and demultiplexed operations of the MCS296.

# Symbols

The TMS 144 support supplies one symbol table file. The MCS296_Ctrl file replaces specific Control channel group values with symbolic values when Symbolic is the radix for the channel group.

Symbol tables are generally not for use in timing or MCS296_T support disassembly.

Table 2–1 lists the name, bit pattern, and meaning for the symbols in the file MCS296_Ctrl, the Control channel group symbol table.

**Table 2–1: Control group symbol table definitions**

| Symbol | Control group value<br>WR*  BHE*  RD*  INST | Description |
|---|---|---|
| FETCH | 1  X  0  1 | Opcode Fetch |
| WRITE | 0  0  1  0 | Data write |
| WRITE_HI | 1  0  1  0 | Data write – High Byte valid in 16-bit WRITE STROBE mode |
| WRITE_LO | 0  1  1  0 | Data write – Low Byte valid in 16-bit WRITE STROBE mode |
| READ | 1  X  0  0 | Data read |

# Acquiring and Viewing Disassembled Data

## Acquiring Data

Once you load the MCS296 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 2–8.*

---

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

If a channel group is not visible, you must use the Disassembly property page to make the group visible.

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

**Table 2–2: Meaning of special characters in the display**

| Character or string displayed | | Description |
|---|---|---|
| # | | Indicates an immediate value |
| > | | There is insufficient room on the screen to show all available data. |
| >> <br> m | On the TLA 700 Series <br> On the DAS 9200 Series | This instruction fetch cycle has been manually marked by the user. |

**Table 2–2: Meaning of special characters in the display (cont.)**

| Character or string displayed | Description |
|---|---|
| t | Indicates the number shown is in decimal, such as #12t |
| **** | 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 lists these cycle type labels and gives a definition of the cycle they represent.

**Table 2–3: Cycle type definitions**

| Cycle type | Description |
|---|---|
| ( FLUSH ) | A fetch cycle computed to be an opcode flush |
| ( EXTENSION ) | A fetch cycle computed to be an opcode extension |
| ( UNKNOWN ) | This combination of control bits is unexpected and/or unrecognized |
| **ILLEGAL INSTRUCTION** | Not a valid instruction |
| ( READ ) | A read from external memory that is not tied to any of the chip selects |
| ( WRITE ) | Any write to external memory that is not tied to any of the chip selects |
| ( CS0_WRITE ) | Write to external memory that is tied to chip select CS0* |
| ( CS1_WRITE ) | Write to external memory that is tied to chip select CS1* |
| ( CS2_WRITE ) | Write to external memory that is tied to chip select CS2* |
| ( CS3_WRITE ) | Write to external memory that is tied to chip select CS3* |
| ( CS4_WRITE ) | Write to external memory that is tied to chip select CS4* |
| ( CS5_WRITE ) | Write to external memory that is tied to chip select CS5* |
| ( CS0_READ ) | Read from external memory that is tied to chip select CS0* |
| ( CS1_READ ) | Read from external memory that is tied to chip select CS1* |
| ( CS2_READ ) | Read from external memory that is tied to chip select CS2* |
| ( CS3_READ ) | Read from external memory that is tied to chip select CS3* |
| ( CS4_READ ) | Read from external memory that is tied to chip select CS4* |
| ( CS5_READ ) | Read from external memory that is tied to chip select CS5* |
| ( CS#_ERROR-READ ) | For a read cycle if more then one chip select signal is asserted |

**Table 2–3: Cycle type definitions (cont.)**

| Cycle type | Description |
|---|---|
| ( CS#_ERROR-WRITE ) | For a write cycle if more then one chip select signal is asserted |
| ( INTERRUPT VECTOR ) | Display interrupt vector cycle |
| **UNIMPLEMENTED OPCODE** | Reserved opcodes |

Figure 2–3 shows an example of the Hardware display.

```
   1        2      3      4                          5         6

Sample   Address  Data  Mnemonics                 Control   Timestamp
----------------------------------------------------------------------------
   344   F3137    --FC  ( EXTENSION )              FETCH     100 ns
   345   F3138    --5E  MULUB   20,28,[1C]+        FETCH     100 ns
   346   F3139    --1D  ( EXTENSION )              FETCH     100 ns
   347   F313A    --28  ( EXTENSION )              FETCH     100 ns
   348   F313B    --20  ( EXTENSION )              FETCH     100 ns
   349   F313C    --5E  MULUB   FC,2C,[1C]         FETCH     100 ns
   350   F313D    --1C  ( EXTENSION )              FETCH     100 ns
   351   0F0F0    --1C  ( READ )                   READ      300 ns
   352   F313E    --2C  ( EXTENSION )              FETCH     150 ns
   353   F313F    --FC  ( EXTENSION )              FETCH     100 ns
   354   F3140    --A1  LD      1C,#F0F0           FETCH     100 ns
   355   F3141    --F0  ( EXTENSION )              FETCH     100 ns
   356   0F0F1    --F0  ( READ )                   READ      300 ns
   357   F3142    --F0  ( EXTENSION )              FETCH     150 ns
   358   F3143    --1C  ( EXTENSION )              FETCH     100 ns
   359   F3144    --5F  MULUB   24,28,02[1C]       FETCH     100 ns
   360   F3145    --1C  ( EXTENSION )              FETCH     100 ns
   361   F3146    --02  ( EXTENSION )              FETCH     100 ns
   362   F3147    --28  ( EXTENSION )              FETCH     100 ns
   363   F3148    --24  ( EXTENSION )              FETCH     100 ns
   364   F3149    --5F  MULUB   20,2C,0074[1C]     FETCH     100 ns
   365   F314A    --1D  ( EXTENSION )              FETCH     100 ns
```

**Figure 2–3: Hardware display format**

1 **Sample Column.** Lists the memory locations for the acquired data.

2 **Address Group.** Lists data from channels connected to the MCS296 data channels.

3 **Data.** Lists data from channels connected to the Pg_Data MCS296 Data bus.

4 **Mnemonic Column.** Lists the disassembled instructions and cycle types.

5 **Control.** Lists the Control function.

6 **Timestamp.** Lists the Timestamp function.

**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. Read extensions will be used to disassemble the instruction, but will not be displayed as a separate cycle in the Software display format. Data reads and writes are not displayed.

**Control Flow Display Format**

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

Instructions that unconditionally generate a change in the flow of control in the MCS296 microprocessor are as follows:

| | | | |
|------|------|------|------|
| EBR | BR | EJMP | LJMP |
| SJMP | TIJMP | RST | |

Instructions that conditionally generate a change in the flow of control in the MCS296 microprocessor are as follows:

| | | | | |
|------|------|------|------|------|
| DJNZ | DJNZW | JBC | JC | JE |
| JGE | JGT | JH | JLE | JLT |
| JNC | JNE | JNH | JNST | JVT |
| JNV | JNVT | JST | JV | JBS |

**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 unconditionally generate a subroutine call or a return in the MCS296 microprocessor are as follows:

| | | |
|-------|-------|-------|
| RETI | RET | ECALL |
| SCALL | LCALL | TRAP |

# 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 MCS296 support to do the following tasks:

■ Change how data is displayed across all display formats

- Change the interpretation of disassembled cycles

- Display exception vectors

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

**Optional Display Selections**

You can make optional selections for acquired disassembled data. In addition to the common selections (described in the information on basic operations), you can change the displayed data in the following ways:

- Specify memory mode selection

- Specify EPORT3:0 configuration range

- Specify buswidth selection for chip select 0–5

- Specify buswidth for the region outside of chip selects 0–5

- Specify the Vector Base Register value

- Specify the address of the Trap vector

**Memory Mode.** Specify the Memory mode selection.

> Mode:          1 MB mode     (default setting)
>                     64 KB mode

**EPORT3:0 Configuration.** Specify the EPORT3:0 range.

> EPORT3–0     Config (0h – Fh) : 0xF       (default setting)

The valid value for the EPORT3:0 range is 0 to 0xF. The four bits here represent the four pins of the EPORT3:0, in that exact order. A bit value of 1 indicates that the pin is functioning as an Address signal. A bit value of 0 indicates that the pin is functioning as a Port signal.

Example: A value of 0xE (1110) represents the three pins of EPORT3–1 and are functioning as Address signals A19–A17, and pin EPORT0 is functioning as an I/O signal.

**Buswidth Selection, CS0–CS5 Region.** Specify the Buswidth selection for chip selects 0 through 5.

> CS0–5   BW  (0/1/2) : 0x000000            (default setting)

The valid value for the Buswidth selection is in the range of 0 to 0x222222. The six characters represent the six pins of CS0–5 in that exact order. The values of the selections are as follows:

At each position a value of 0 represents that the region specified by that chip select signal is configured for an 8-bit bus width.

At each position a value of 1 represents that the region specified by that chip select signal is configured for an 16-bit bus width.

At each position a value of 2 represents that the region specified by that chip select signal is an I/O.

Example: A Buswidth selection of 0x001122 represents:

| | |
|---|---|
| 22 | CS5* and CS4* are functioning as I/O signals. |
| 11 | CS3* and CS2* are functioning as chip select signals with a bus width of 16. |
| 00 | CS1* and CS0* are functioning as chip select signals with a bus width of 8. |

Any value other then 0, 1, or 2 is invalid. If you try to enter a value other then 0, 1, or 2 the software will reject the entry and replace the entry with a default setting of 0.

**Buswidth Selection, Other Region.** To specify a buswidth for the region outside of the chip selects CS0–5, select Other regions.

Other region  BW  :   8           (default setting)
                            : 16


**Vector Base Register.** Select the Vector base register.

VBR  :  0xF2000                (default setting)


**Trap Vector.** You can specify the address of the trap vector

Trap Vector          :   F2010    (default setting)


**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:

For single byte fetch:

- OPCODE – Mark the sequence as an opcode fetch

- EXTENSION – Mark the sequence as an Extension cycle

- FLUSH – Mark the sequence as a Flush cycle

- UNDO MARK – Remove all marks from the current sequence

For double byte fetch:

- ANY OPCODE – The high byte is not marked. The low order byte of the cycle will be disassembled as the beginning of an instruction.

- OPCODE EXTENSION – The low byte extension and high byte opcode are executed.

- EXTENSION EXTENSION – Low byte and high byte extension.

- OPCODE FLUSH – The low byte of a cycle is not executed while the high byte is.

- FLUSH EXTENSION – The extension of a cycle is executed, howerver the high byte is not.

- FLUSH FLUSH – Mark the sequence as a Flush cycle

- UNDO MARK – Remove all marks from the current sequence

Information on basic operations contains more details on marking cycles.

**Displaying Exception Vectors**

When a standard interrupt occurs, there is a change in the flow of the program. The vector base register is variable in the MCS296 and can also operate in a programmable mode. Therefore the software can not identify individual interrupt sources; interrupts are simply displayed as ( INTERRUPT VECTOR ). The last instruction cycles are fetched but not executed before the instruction vector is executed, and is then displayed as ( FLUSH ). The message ( READ ) is then displayed on the vector read cycle.

The exception vector table must reside in external memory in order for the exception cycles to be visible to the support disassembler software.

Table 2–4 lists the MCS296 exception labels for interrupt controller service.

**Table 2–4: Exception labels for interrupt controller service**

| Interrupt source – interrupt controller | Interrupt name |
|---|---|
| Timer 1 overflow | INT00 |
| Timer 2 overflow | INT01 |
| Reserved | INT02 |
| EXTINT 0 Pin | INT03 |
| EXTINT 1 Pin | INT04 |
| SIO transmit | INT05 |
| SIO reveive | INT06 |
| EPAO | INT07 |
| Software TRAP instruction | ––––– |

Table 2–4: Exception labels for interrupt controller service (cont.)

| Interrupt source – interrupt controller | Interrupt name |
|---|---|
| Unimplemented Opcode | ––––– |
| EPA1 | INT08 |
| EPA2 | INT09 |
| EPA3 | INT10 |
| EPA Overrun Error in Module 0 and/or Module 1 | INT11 |
| EPA Overrun Error in Module 2 and/or Module 3 | INT12 |
| EXTINT 2 Pin | INT13 |
| EXTINT 3 Pin | INT14 |
| NMI | INT15 |

# 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 MCS296 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.

# Specifications

# Specifications

This chapter contaires information regarding the specifications of the support.

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

The probe adapter consists of a circuit board and a test QFP test clip for a MCS296 microprocessor. The probe adapter connects to the microprocessor in the SUT. Signals from the microprocessor-based system flow through the probe adapter to the P6434 probes and through the probe cables to the logic analyzer.

## Specifications

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

**Table 3–1: Electrical specifications**

| Characteristics | Requirements |
|---|---|
| SUT DC power requirements | |
|     Voltage | 4.75-5.25 VDC |
|     Current | I max (calculated)   25.8 mA |
| SUT clock | |
|     Clock rate | Maximum of 50 MHz |
| Minimum setup time required | |
|     TLA 700 | 2.5 ns |
|     DAS 9200 | 5 ns |
| Minimum hold time required | |
|     TLA 700 | 0 ns |
|     DAS 9200 | 0 ns |

**Table 3–1: Electrical specifications (cont.)**

| Characteristics | Requirements | |
|---|---|---|
| Typical signal loading | | |
| TLA 700 MICTOR load (ML) | 20 KΩ in parallel with 2 pF | |
| TLA 700 podlet load (CL) | 20 KΩ in parallel with 2 pF | |
| DAS 9200 MICTOR load (ML) | 100 KΩ in parallel with 12 pF | |
| DAS 9200 podlet load (CL) | 100 KΩ in parallel with 10 pF | |
| **Characteristics** | **Specification** | |
| Measured typical SUT signal loading | **AC load** | **DC load** |
| BHE*/WRH* | 12 pF | 3 74F08 |
| WR*/WRL* | 12 pF | 3 74F08 |
| INST | 10 pF | 2 74F08 |
| ALE | 13 pF | 2 Mictor |
| RD* | 16 pF | 2 Mictor |
| AD15-AD0 | 12 pF | 1 Mictor |
| A19-A0 | 16 pF | 1 Mictor |
| ONCE, RESET*, CLOCKOUT, NMI, READY, P1:7–0, P2:6–0, P3:7–6, P4:3–0, CS5*–CS0* | 17 pF | 1 Mictor |

Table 3–2 lists 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 MCS296 microprocessor thermal considerations. Forced air cooling might be required across the CPU.**

Figure 3–1 shows the dimensions of the probe adapter.



86 mm
(3.400 in)

16 mm
(.650 in)

Pin 1

37 mm
(1.450 in)

109 mm
(4.300 in)

9mm (.350 in)
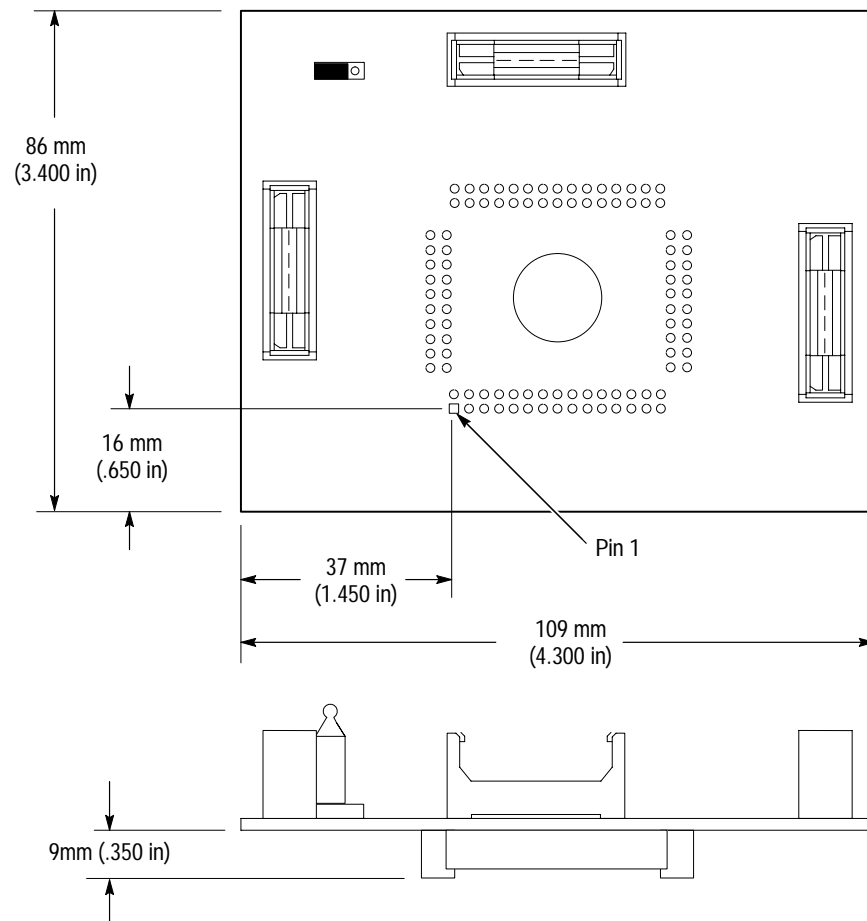
**Figure 3–1: Dimensions of the probe adapter**

**WARNING**

*The following servicing instructions are for use only by qualified personnel. To avoid injury, do not perform any servicing other than that stated in the operating instructions unless you are qualified to do so. Refer to all Safety Summaries before performing any service.*

# Maintenance

# Maintenance

## Probe Adapter Circuit Description

The MCS296 probe adapter uses a 74F08 gate to derive signal WR_D* by combining signals WR*/WRL* and BHE*/WRH*. The 74F08 gate is also used to add a delay to the INST signal.

## Replacing Signal Leads

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

# Replaceable Electrical Parts

# Replaceable Electrical Parts

This chapter contains a list of the replaceable electrical components for the TMS 144 MCS296 microprocessor support.

## 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.

## Parts list column descriptions

| Column | Column name | Description |
|---|---|---|
| 1 | Component number | The component number appears on diagrams and circuit board illustrations, located in the diagrams section. Assembly numbers are clearly marked on each diagram and circuit board illustration in the *Diagrams* section, and on the mechanical exploded views in the *Replaceable Mechanical Parts* list section. The component number is obtained by adding the assembly number prefix to the circuit number (see Component Number illustration following this table).

The electrical parts list is arranged by assemblies in numerical sequence (A1, with its subassemblies and parts, precedes A2, with its subassemblies and parts).

Chassis-mounted parts have no assembly number prefix, and they are located at the end of the electrical parts list. |
| 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 entry indicates the part is good for all serial numbers. |
| 5 | 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. |
| 6 | Mfr. code | This indicates the code number of the actual manufacturer of the part. |
| 7 | 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.

**Component Number**

Component number

A23A2R1234     A23          A2          R1234

Assembly number    Subassembly number    Circuit number
                   (optional)

**Read: Resistor 1234 (of Subassembly 2) of Assembly 23**

**List of Assemblies**

A list of assemblies is located at the beginning of the electrical parts list. The assemblies are listed in numerical order. When a part's complete component number is known, this list will identify the assembly in which the part is located.

**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<br>PO BOX 3608 | HARRISBURG, PA 17105–3608 |
| 05276 | ITT POMONA ELECTRONICS | 1500 E NINTH ST | POMONA, CA 91766–3835 |
| 22526 | BERG ELECTRONICS INC | 825 OLD TRAIL ROAD | ETTERS, PA 17319 |
| 26742 | METHODE ELECTRONICS INC | BACKPLAIN DIVISION<br>7444 WEST WILSON AVE | CHICAGO, IL 60656–4548 |
| 60381 | PRECISION INTERCONNECT CORP. | 16640 SW 72ND AVE | PORTLAND, OR 97224 |
| 80009 | TEKTRONIX INC | 14150 SW KARL BRAUN DR<br>PO BOX 500 | BEAVERTON, OR 97077–0001 |

## Replaceable electrical parts list

| Component number | Tektronix part number | Serial no. effective | Serial no. discont'd | Name & description | Mfr. code | Mfr. part number |
|---|---|---|---|---|---|---|
| – | 010–0618–00 | | | PROBE ADAPTER:296SA/196NU/196NP,QFP–100, SOLDERED,TMS144,11 | 80009 | 010–0618–00 |
| – | 103–0390–00 | | | ADAPTER:CONN ADAPTER,100 PIN EIAJ PQFP TEST CLIP,32/92DM82,1S | 05276 | 5643 |
| – | 105–1089–00 | | | LATCH ASSY:LATCH HOUSING ASSY,VERTICAL MOUNT,0.48 H X 1.24 L,W/PCB SINGLE CLIP,P6434 | 60381 | 105–1089–00 |
| – | 131–2515–00 | | | CONN,BOX:PCB,FEMALE,STR,2 X 10,0.1 CTR,0.340 H X 0.120 TAIL,10 GOLD, | 00779 | 86418–1 |
| – | 131–4057–00 | | | CONN,BOX:PCB,FEMALE,STR,2 X 15,0.1 CTR,0.276 H X 0.118 TAIL,30 GOLD,0.070 DIA PTH,DUAL E | 22526 | 68682–315 |
| – | 131–4356–00 | | | CONN,SHUNT:SHUNT/SHORTING,FEMALE,1 X 2,0.1 CTR,0.63 H,BLK,W/HANDLE,JUMPER, | 26742 | 9618–302–50 |
| – | 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 |
| – | 131–6134–01 | | | CONN,RCPT:SMD,MICTOR,PCB,STR,38 POS,FEMALE,0.025 CTR,0.240 H,W/0.108 PCB HOLD DOWNS.PALLAD | 00779 | 767054–1 |
| – | 671–4271–00 | | | CIRCUIT BD ASSY:296SA/196NU/196NP,QFP–100,SOLDERED,679–4271–00 TESTED,389–2501–00 WIRED,TMS144,1 | 80009 | 671–4271–00 |

# Diagrams and Circuit Board Illustrations

This section contains the troubleshooting procedures, block diagrams, circuit board illustrations, component locator tables, waveform illustrations, and schematic diagrams.

## Symbols

Graphic symbols and class designation letters are based on ANSI Standard Y32.2-1975. Abbreviations are based on ANSI Y1.1-1972.

Logic symbology is based on ANSI/IEEE Standard 91-1984 in terms of positive logic. Logic symbols depict the logic function performed and can differ from the manufacturer's data.

The tilde (~) preceding a signal name indicates that the signal performs its intended function when in the low state.

Other standards used in the preparation of diagrams by Tektronix, Inc., include the following:

- Tektronix Standard 062-2476 Symbols and Practices for Schematic Drafting

- ANSI Y14.159-1971 Interconnection Diagrams

- ANSI Y32.16-1975 Reference Designations for Electronic Equipment

- MIL-HDBK-63038-1A Military Standard Technical Manual Writing Handbook

## Component Values

Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors:  Values one or greater are in picofarads (pF).
Values less than one are in microfarads (μF).

Resistors:  Values are in Ohms (Ω).

## Graphic Items and Special Symbols Used in This Manual

Each assembly in the instrument is assigned an assembly number (for example A5). The assembly number appears in the title on t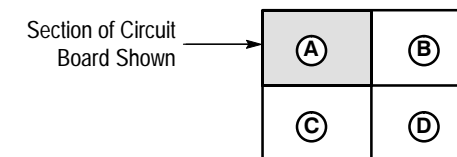he diagram, in the lookup table for the schematic diagram, and corresponding component locator illustration. The Replaceable Electrical Parts list is arranged by assembly in numerical sequence; the components are listed by component number.
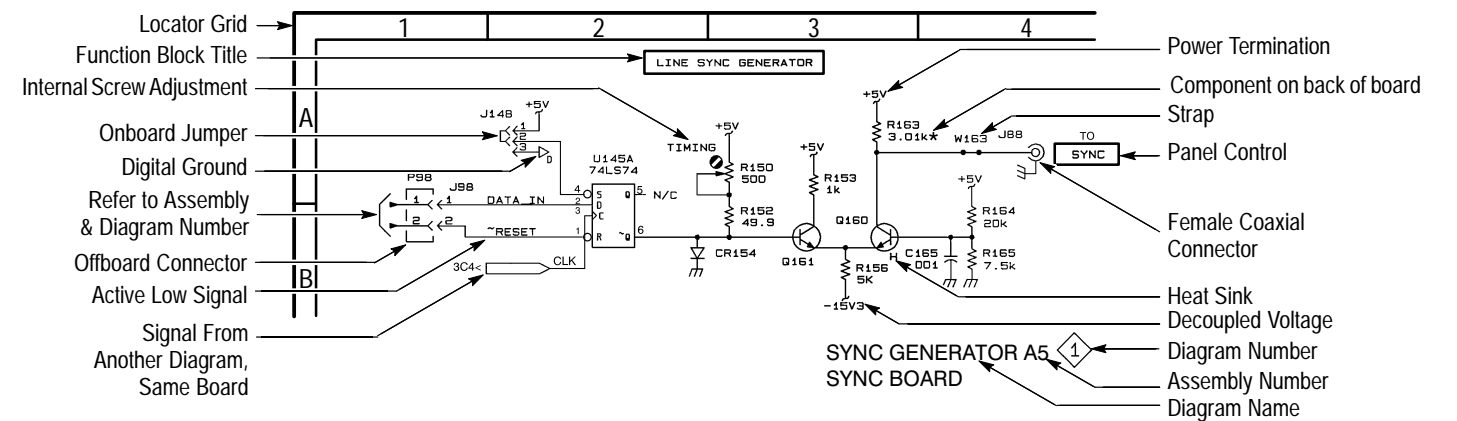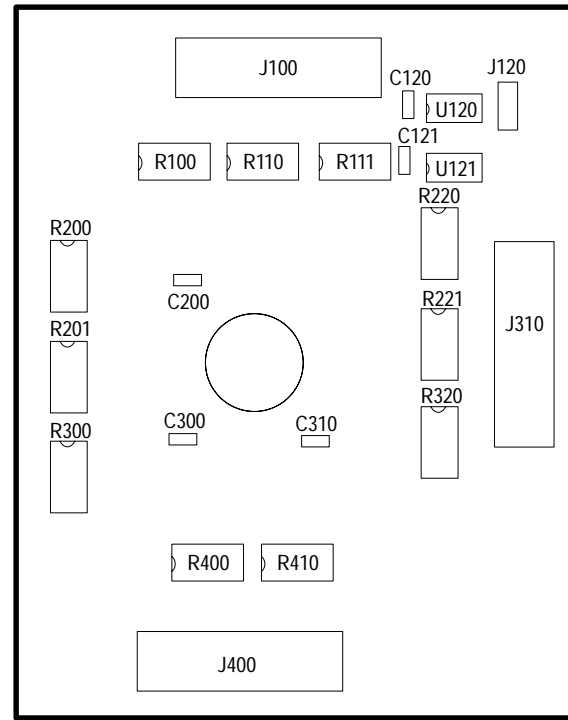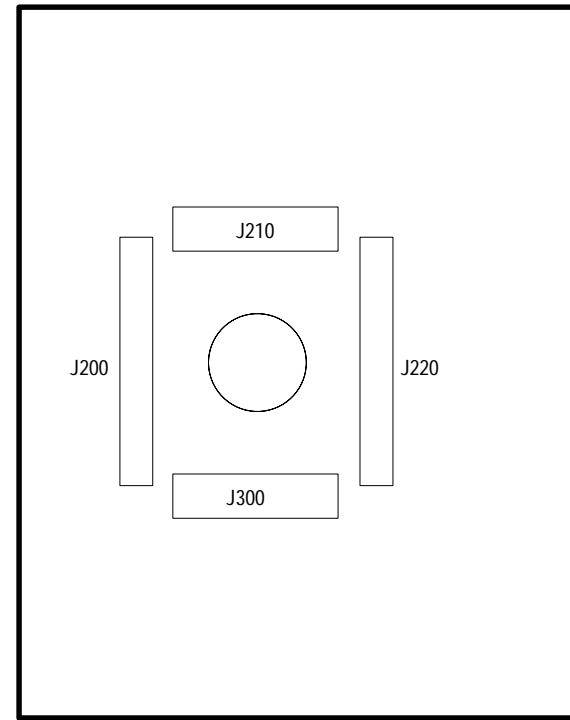


## Component Locator Diagrams

The schematic diagram and circuit board component location illustrations have grids marked on them. The component lookup tables refer to these grids to help you locate a component. The circuit board illustration appears only once; its lookup table lists the diagram number of all diagrams on which the circuitry appears.

Some of the circuit board component location illustrations are expanded and divided into several parts to make it easier for you to locate small components. To determine which part of the whole locator diagram you are looking at, refer to the small locator key shown below. The gray block, within the larger circuit board outline, shows where that part fits in the whole locator diagram. Each part in the key is labeled with an identifying letter that appears in the figure titles under component locator diagrams.
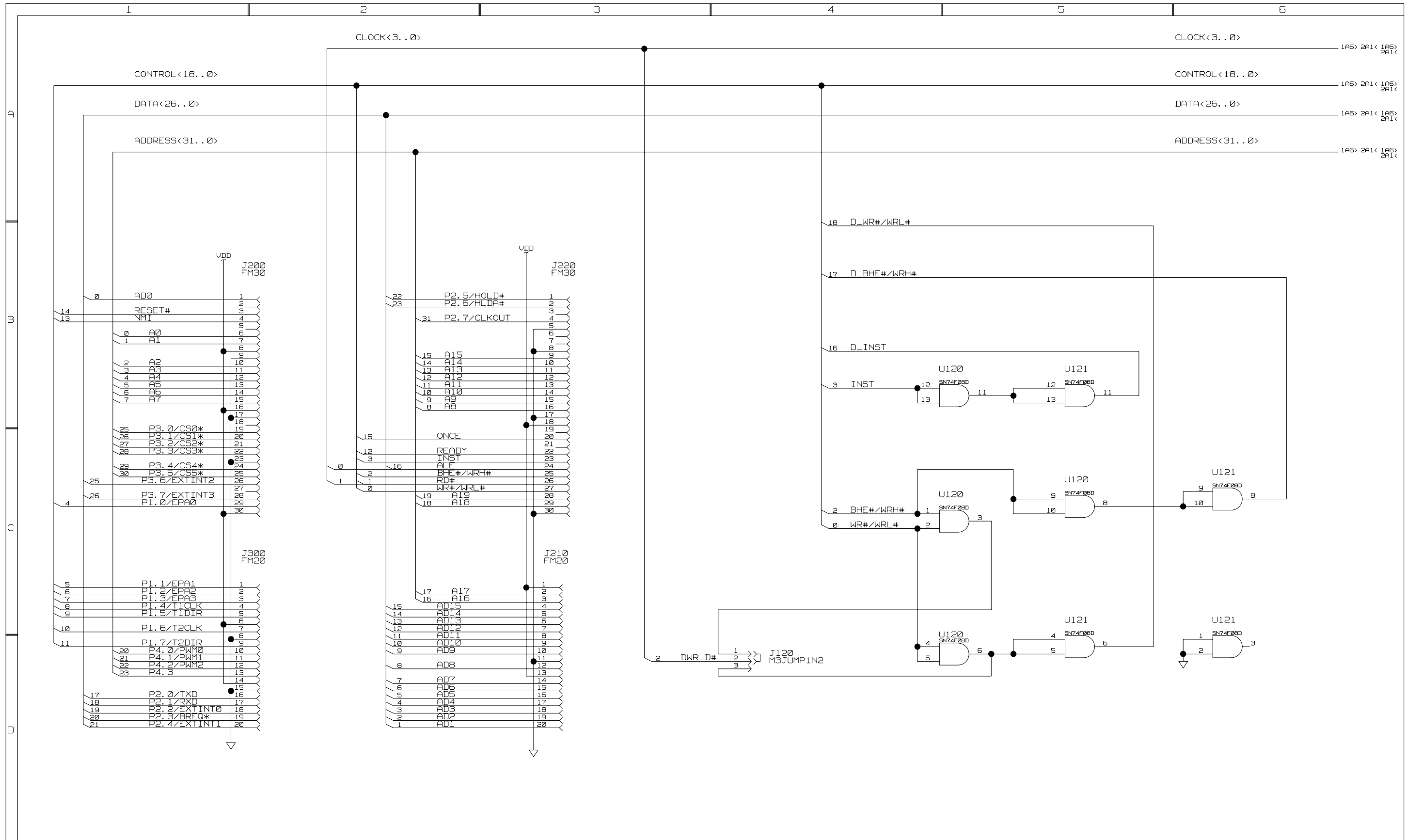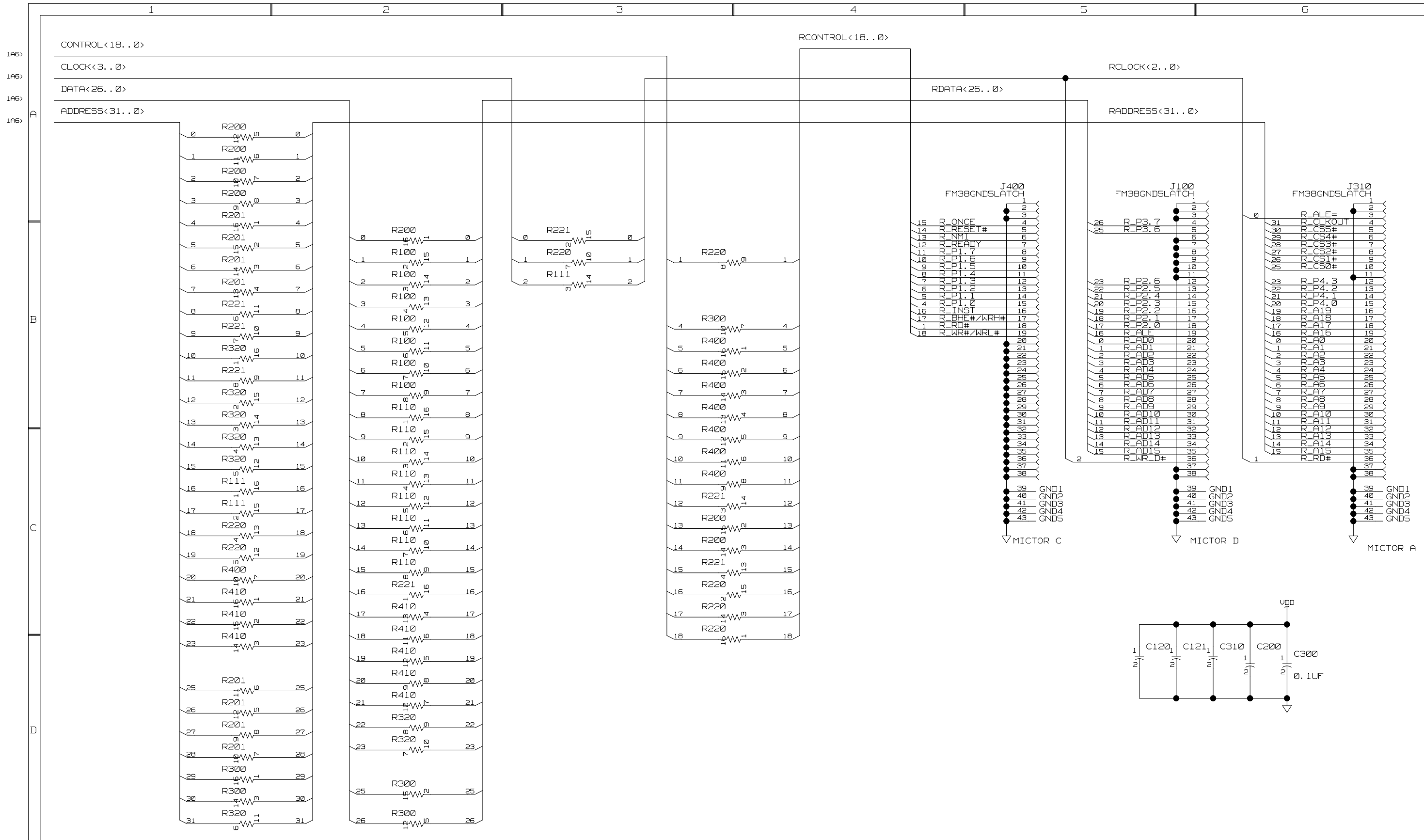
**Front**

**Back**

CLOCK<3..0>
CONTROL<18..0>
DATA<26..0>
ADDRESS<31..0>

CLOCK<3..0>
CONTROL<18..0>
DATA<26..0>
ADDRESS<31..0>

1A6> 2A1< 1A6>
2A1<
1A6> 2A1< 1A6>
2A1<
1A6> 2A1< 1A6>
2A1<
1A6> 2A1< 1A6>
2A1<

A

18    D_WR#/WRL#

17    D_BHE#/WRH#

16    D_INST

B

VDD                          VDD
J200                         J220
FM30                         FM30

| 0 | AD0 | 1 |
| 14 | RESET# | 2 |
| 13 | NMI | 3 |
| | | 4 |
| | | 5 |
| 0 | A0 | 6 |
| 1 | A1 | 7 |
| | | 8 |
| 2 | A2 | 9 |
| 3 | A3 | 10 |
| 4 | A4 | 11 |
| 5 | A5 | 12 |
| 6 | A6 | 13 |
| 7 | A7 | 14 |
| | | 15 |
| | | 16 |
| | | 17 |
| | | 18 |
| 25 | P3.0/CS0* | 19 |
| 26 | P3.1/CS1* | 20 |
| 27 | P3.2/CS2* | 21 |
| 28 | P3.3/CS3* | 22 |
| | | 23 |
| 29 | P3.4/CS4* | 24 |
| 30 | P3.5/CS5* | 25 |
| 25 | P3.6/EXTINT2 | 26 |
| | | 27 |
| 26 | P3.7/EXTINT3 | 28 |
| | P1.0/EPA0 | 29 |
| | | 30 |

| 22 | P2.5/HOLD# | 1 |
| 23 | P2.6/HLDA# | 2 |
| | | 3 |
| 31 | P2.7/CLKOUT | 4 |
| | | 5 |
| | | 6 |
| | | 7 |
| | | 8 |
| 15 | A15 | 9 |
| 14 | A14 | 10 |
| 13 | A13 | 11 |
| 12 | A12 | 12 |
| 11 | A11 | 13 |
| 10 | A10 | 14 |
| 9 | A9 | 15 |
| 8 | A8 | 16 |
| | | 17 |
| | | 18 |
| 15 | ONCE | 19 |
| | | 20 |
| 12 | READY | 21 |
| 3 | INST | 22 |
| 0 | 16  ALE | 23 |
| 2 | 1  BHE#/WRH# | 24 |
| | RD# | 25 |
| 1 | 0  WR#/WRL# | 26 |
| 19 | A19 | 27 |
| 18 | A18 | 28 |
| | | 29 |
| | | 30 |

C

J300                         J210
FM20                         FM20

| 5 | P1.1/EPA1 | 1 |
| 6 | P1.2/EPA2 | 2 |
| 7 | P1.3/EPA3 | 3 |
| 8 | P1.4/T1CLK | 4 |
| 9 | P1.5/T1DIR | 5 |
| | | 6 |
| 10 | P1.6/T2CLK | 7 |
| | | 8 |
| 11 | P1.7/T2DIR | 9 |
| 20 | P4.0/PWM0 | 10 |
| 21 | P4.1/PWM1 | 11 |
| 22 | P4.2/PWM2 | 12 |
| 23 | P4.3 | 13 |
| | | 14 |
| | | 15 |
| 17 | P2.0/TXD | 16 |
| 18 | P2.1/RXD | 17 |
| 19 | P2.2/EXTINT0 | 18 |
| 20 | P2.3/BREQ* | 19 |
| 21 | P2.4/EXTINT1 | 20 |

| 17 | A17 | 1 |
| 16 | A16 | 2 |
| | | 3 |
| 15 | AD15 | 4 |
| 14 | AD14 | 5 |
| 13 | AD13 | 6 |
| 12 | AD12 | 7 |
| 11 | AD11 | 8 |
| 10 | AD10 | 9 |
| 9 | AD9 | 10 |
| | | 11 |
| 8 | AD8 | 12 |
| | | 13 |
| | | 14 |
| 7 | AD7 | 15 |
| 6 | AD6 | 16 |
| 5 | AD5 | 17 |
| 4 | AD4 | 18 |
| 3 | AD3 | 19 |
| 2 | AD2 | 20 |
| 1 | AD1 | |

U120  SN74F08D
U121  SN74F08D

3    INST        U120  12  SN74F08D  11    U121  12  SN74F08D  11
                       13                          13

2    BHE#/WRH#   U120  1  SN74F08D  3
0    WR#/WRL#          2

U120  9  SN74F08D  8
      10

U121  9  SN74F08D  8
      10

2    DWR_D#    J120
               M3JUMP1N2

U120  4  SN74F08D  6
      5

U121  4  SN74F08D  6
      5

U121  1  SN74F08D  3
      2

D

PROJECT_NAME=TMS144

UC, DISCRETE LOGIC A01          1

CONTROL<18..0>

RCONTROL<18..0>

CLOCK<3..0>

RCLOCK<2..0>

DATA<26..0>

RDATA<26..0>

ADDRESS<31..0>

RADDRESS<31..0>

1A6>
1A6>
1A6>
1A6>

A
B
C
D

J400
FM38GND5LATCH

| | |
|---|---|
| 15 | R_ONCE |
| 14 | R_RESET# |
| 13 | R_NMI |
| 12 | R_READY |
| 11 | R_P1.7 |
| 10 | R_P1.6 |
| 9 | R_P1.5 |
| 8 | R_P1.4 |
| 7 | R_P1.3 |
| 6 | R_P1.2 |
| 5 | R_P1.1 |
| 4 | R_P1.0 |
| 3 | R_INST |
| 16 | R_BHE#/WRH# |
| 1 | R_RD# |
| 18 | R_WR#/WRL# |

39 GND1
40 GND2
41 GND3
42 GND4
43 GND5

MICTOR C

J100
FM38GND5LATCH

| | |
|---|---|
| 26 | R_P3.7 |
| 25 | R_P3.6 |
| 23 | R_P2.6 |
| 22 | R_P2.5 |
| 21 | R_P2.4 |
| 19 | R_P2.3 |
| 18 | R_P2.2 |
| 17 | R_P2.1 |
| 16 | R_P2.0 |
| 0 | R_AD0 |
| 1 | R_AD1 |
| 2 | R_AD2 |
| 3 | R_AD3 |
| 4 | R_AD4 |
| 5 | R_AD5 |
| 6 | R_AD6 |
| 7 | R_AD7 |
| 8 | R_AD8 |
| 9 | R_AD9 |
| 10 | R_AD10 |
| 11 | R_AD11 |
| 12 | R_AD12 |
| 13 | R_AD13 |
| 14 | R_AD14 |
| 15 | R_AD15 |
| 2 | R_WR_D# |

39 GND1
40 GND2
41 GND3
42 GND4
43 GND5

MICTOR D

J310
FM38GND5LATCH

| | |
|---|---|
| 0 | R_ALE= |
| 31 | R_CLKOUT |
| 30 | R_CS5# |
| 29 | R_CS4# |
| 28 | R_CS3# |
| 27 | R_CS2# |
| 26 | R_CS1# |
| 25 | R_CS0# |
| 23 | R_P4.3 |
| 22 | R_P4.2 |
| 21 | R_P4.1 |
| 20 | R_P4.0 |
| 19 | R_A19 |
| 18 | R_A18 |
| 17 | R_A17 |
| 16 | R_A16 |
| 0 | R_A0 |
| 1 | R_A1 |
| 2 | R_A2 |
| 3 | R_A3 |
| 4 | R_A4 |
| 5 | R_A5 |
| 6 | R_A6 |
| 7 | R_A7 |
| 8 | R_A8 |
| 9 | R_A9 |
| 10 | R_A10 |
| 11 | R_A11 |
| 12 | R_A12 |
| 13 | R_A13 |
| 14 | R_A14 |
| 15 | R_A15 |
| 1 | R_RD# |

39 GND1
40 GND2
41 GND3
42 GND4
43 GND5

MICTOR A

VDD

C120  C121  C310  C200  C300
0.1UF

# Replaceable Mechanical Parts

# Replaceable Mechanical Parts

This chapter contains a list of the replaceable mechanical components for the TMS 144 MCS296 microprocessor support.

## 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 |
| 05276 | ITT POMONA ELECTRONICS | 1500 E NINTH ST | POMONA, CA 91766–3835 |
| 22526 | BERG ELECTRONICS INC | 825 OLD TRAIL ROAD | ETTERS, PA 17319 |
| 26742 | METHODE ELECTRONICS INC | BACKPLAIN DIVISION 7444 WEST WILSON AVE | CHICAGO, IL 60656–4548 |
| 60381 | PRECISION INTERCONNECT CORP. | 16640 SW 72ND AVE | PORTLAND, OR 97224 |
| 80009 | TEKTRONIX INC | 14150 SW KARL BRAUN DR PO BOX 500 | BEAVERTON, OR 97077–0001 |

## Replaceable parts list

| Fig. & index number | Tektronix part number | Serial no. effective | Serial no. discont'd | Qty | Name & description | Mfr. code | Mfr. part number |
|---|---|---|---|---|---|---|---|
| 1–0 | 671–4271–00 | | | 1 | CIRCUIT BD ASSY: 296SA/196NU/196NP, QFP–100, SOLDERED, 679–4271–00 TESTED, 389–2501–00 WIRED, TMS144, 1 | 80009 | 671–4271–00 |
| –1 | 103–0390–00 | | | 1 | ADAPTER: CONN ADAPTER, 100 PIN EIAJ PQFP TEST CLIP, 32/92DM82,1S | 05276 | 5643 |
| –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 | 131–4356–00 | | | 1 | CONN, SHUNT: SHUNT/SHORTING, FEMALE, 1 X 2, 0.1 CTR, 0.63 H, BLK, W/HANDLE, JUMPER | 26742 | 9618–302–50 |
| –4 | 131–6134–01 | | | 3 | CONN, RCPT: SMD, MICTOR, PCB, STR, 38 POS, FEMALE, 0.025 CTR, 0.240 H, W/0.108 PCB HOLD DOWN | 00779 | 767054–1 |
| –5 | 105–1089–00 | | | 3 | LATCH ASSY: LATCH HOUSING ASSY, VERTICAL MOUNT, 0.48 H X 1.24 L, W/PCB SINGLE CLIP, P6434 | 60381 | 105–1089–00 |
| –6 | 131–4057–00 | | | 1 | CONN, BOX: PCB, FEMALE, STR, 2 X 15, 0.1 CTR, 0.276 H X 0.118 TAIL, 30 GOLD, 0.070 DIA PT | 22526 | 68682–315 |
| –7 | 131–2515–00 | | | 1 | CONN, BOX: PCB, FEMALE, STR, 2 X 10, 0.1 CTR, 0.340 H X 0.120 TAIL, 10 GOLD | 00779 | 86418–1 |
| | 010–0618–00 | | | 1 | PROBE ADAPTER: 296SA/196NU/196NP, QFP–100, SOLDERED, TMS144, 11 | 80009 | 010–0618–00 |
| | 070–9803–00 | | | 1 | MANUAL, TECH: INSTRUCTION, MICROPROCESSOR SUPPORT, PKG INSTALLATION, TLA700 SERIES, LOGIC ANALYZER | TK2548 | 070–9803–00 |
| | 071–0067–00 | | | 1 | MANUAL, TECH: INSTRUCTION, MCS296, TMS144 | TK2548 | 071–0067–00 |
| | | | | | **OPTIONAL ACCESSORIES** | | |
| | 070–9802–00 | | | 1 | MANUAL, TECH: BASIC OPS MICRO SUP ON DAS/TLA 500 SERIES LOGIC ANALYZERS | 80009 | 070–9802–00 |
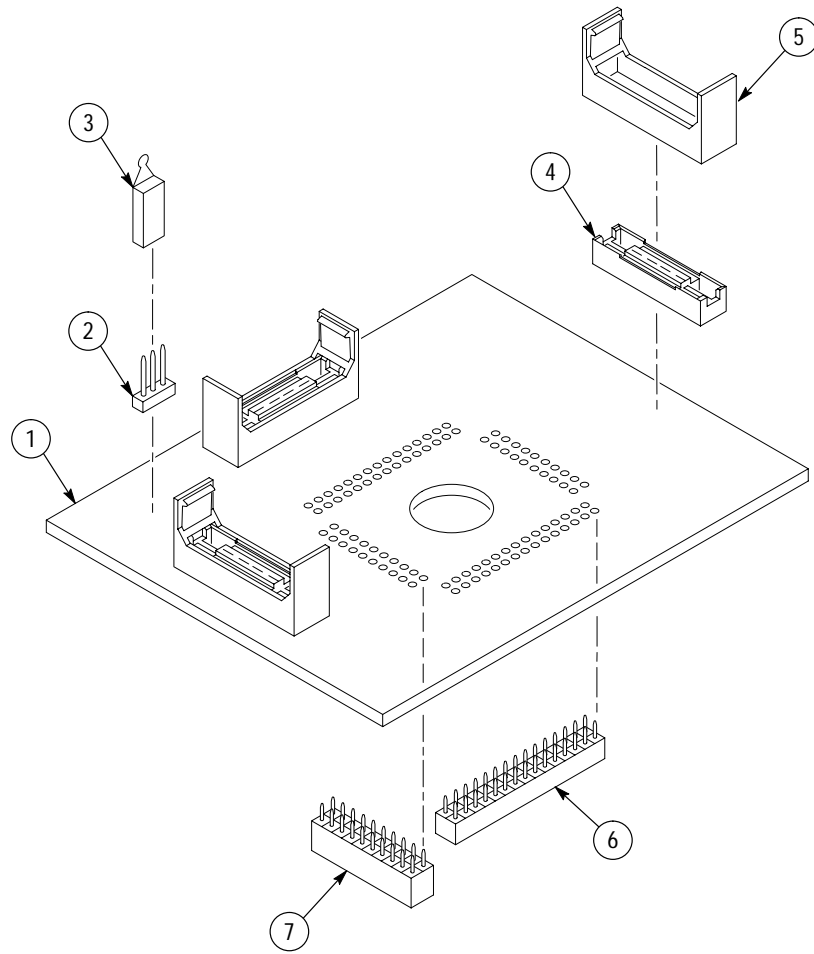
**Figure 6–1: MCS296 probe adapter exploded view**

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