Errata

Document Title: Designing a Custom Interface for a Logic Analyzer Using User Definable Design Tools (AN 1244-2)

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HP References in this Application Note

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Designing a Custom Interface for a Logic Analyzer Using HP User Definable Design Tools
Introduction

Today more microprocessors, microcontrollers, DSP chips and buses are in use than ever before. Most of those in mainstream use are supported with preprocessor interfaces and inverse assemblers from Hewlett-Packard or HP's third-party program, the Preprocessor Connection. Preprocessors make the physical connection to a logic analyzer easy. Inverse assemblers convert binary data into microprocessor mnemonics. If the processor or bus you are using is not directly supported, components and tools are available to develop a custom logic analyzer interface. You can even write a custom inverse assembler.

Making the Physical Connection to Your Processor

One of the more challenging tasks in collecting data with a logic analyzer is simply connecting to the device under test. Hewlett-Packard and its third-party companies help you connect to a large variety of package types and sizes.

<table>
<thead>
<tr>
<th>Adaptor Description</th>
<th>Model Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generic 132-pin PQFP/COFP to PGA</td>
<td>HP E3417A</td>
</tr>
<tr>
<td>68EC020 PGA to 68EC20 PGA</td>
<td>HP E3400A</td>
</tr>
<tr>
<td>68EC020 PQFP/COFP to 68EC20 PGA</td>
<td>HP E3401A</td>
</tr>
<tr>
<td>68020 PQFP/COFP to PGA</td>
<td>HP E3404A</td>
</tr>
<tr>
<td>68030/EC030 PQFP/COFP to PGA</td>
<td>HP E3406A</td>
</tr>
<tr>
<td>68331/332 PQFP/COFP to PGA</td>
<td>HP E3407A</td>
</tr>
<tr>
<td>68302 PQFP/COFP to PGA</td>
<td>HP E3408A</td>
</tr>
<tr>
<td>68340 PQFP/COFP to PGA</td>
<td>HP E3409A</td>
</tr>
<tr>
<td>80186EA PQFP/COFP to PGA</td>
<td>HP E3412A</td>
</tr>
<tr>
<td>80186XL PQFP/COFP to PGA</td>
<td>HP E3413A</td>
</tr>
<tr>
<td>80186EB PQFP/COFP to PGA</td>
<td>HP E3414A</td>
</tr>
<tr>
<td>80560SA/SB PQFP/COFP to PGA</td>
<td>HP E3411A</td>
</tr>
</tbody>
</table>

Table 1. Package adaptors

Figure 1. A typical QFP-to- PGA adaptor
Package Adapters

Surface-mount package technology, with decreasing pin-to-pin geometries, has made probing difficult. Quad flat packages (QFPs) have become standard for many of today's designs. Table 1 lists several adapters for processor-specific and generic packages. Figure 1 shows an exploded view of one of the QFP-to-PLCC adapters. Emulation Technology, Inc. also markets adapters for a number of package styles. Their products are distributed internationally. Please telephone (408 982-0660) or send a fax (408 982-0664) for more information including the name of your local distributor.

Extenders

In some situations there is little room above or near the processor package to connect a probing interface. Probing extenders bring the signals out to a position where there is more room for interface hardware to connect. See table 2 for a list of available extenders. Figure 2 shows a typical extender.

<table>
<thead>
<tr>
<th>Extender Description</th>
<th>Model Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generic 13x13 (169-pin) PGA to PGA</td>
<td>E3421A</td>
</tr>
<tr>
<td>Generic 15x15 (225-pin) PGA to PGA</td>
<td>E3426A</td>
</tr>
<tr>
<td>68000 PLCC to PLCC</td>
<td>E3420A</td>
</tr>
<tr>
<td>68000 PGA to PGA</td>
<td>E3403A</td>
</tr>
<tr>
<td>68030 PGA to PGA</td>
<td>E3405A</td>
</tr>
<tr>
<td>68340 PGA to PGA</td>
<td>E3410A</td>
</tr>
<tr>
<td>68362 PGA to PGA</td>
<td>E3418A</td>
</tr>
<tr>
<td>80C186 PGA to PGA</td>
<td>E3422A</td>
</tr>
<tr>
<td>80186XL PGA to PGA</td>
<td>E3427A</td>
</tr>
<tr>
<td>8086SA/SA PLCC to PLCC</td>
<td>E3419A</td>
</tr>
</tbody>
</table>

Table 2. Flexible extenders for PGA and PLCC packages

Figure 2. Flexible extender
DIP Cables

Probe cables are also available for processors housed in the more traditional dual-in-line packages (DIPs). Hewlett-Packard has probe cables for socketed 40-, 48-, and 64-pin DIPs:

- 40-pin DIP   HP 10322A*
- 48-pin DIP   HP 10323A
- 64-pin DIP   HP 10324A

*also supports 24- and 28-pin DIPs

Rotators

A rotator may help if there is mechanical interference between the preprocessor and your target system (processor board) components. Rotators turn PGA pinouts by 90 degrees and add some vertical clearance. Emulation Technology, Inc. sells a number of PGA rotator devices, as shown in table 3. (See Package Adapters for information about contacting ET, Inc.). A typical rotator is shown in figure 3.

<table>
<thead>
<tr>
<th>Rotator Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>11 x 11 x 6 Generic PGA CW and CCW</td>
<td></td>
</tr>
<tr>
<td>13 x 13 x 7 Generic PGA CW and C</td>
<td></td>
</tr>
<tr>
<td>15 x 15 x 8 Generic PGA CW and CCW</td>
<td></td>
</tr>
<tr>
<td>17 x 17 x 3 Generic PGA CW and CCW</td>
<td></td>
</tr>
<tr>
<td>18 x 18 8 Generic PGA CW and CCW</td>
<td></td>
</tr>
<tr>
<td>29009 PGA 90-degree CW and CCW</td>
<td></td>
</tr>
<tr>
<td>680290 PGA 90-degree CW and CCW</td>
<td></td>
</tr>
<tr>
<td>68EC020 PGA 90-degree CW and CCW</td>
<td></td>
</tr>
<tr>
<td>680290 PGA 90-degree CW and CCW</td>
<td></td>
</tr>
<tr>
<td>68EC030 PGA 90-degree CW and CCW</td>
<td></td>
</tr>
<tr>
<td>68040 PGA 90-degree CW only</td>
<td></td>
</tr>
<tr>
<td>68302 PGA 90-degree CW and CCW</td>
<td></td>
</tr>
<tr>
<td>800285 PGA 90-degree CW and CCW</td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Rotators available from Emulation Technology.

Figure 3. Rotator
The HP E2445A User-Definable Interface

Once a connection has been made to the processor package or bus, signals must be routed into the logic analyzer. It may be necessary to latch or buffer the signals for state (synchronous) analysis. In all cases, these electrical signals must be conditioned before they enter the analyzer. And, a mechanical transition is typically made to the 40-pin woven cable connectors used on most Hewlett-Packard logic analyzers. The HP E2445A User-Definable Interface (UDI) is designed as a platform for these tasks. Up to 96 signals can be monitored - 48 of which can be double-probed for simultaneous state and timing measurements. The UDI is best suited for 8- and 16-bit processor support but can be used for other applications, such as a standard bus. It consists of a wire-wrap board, an interface board, and a user's guide.

Wire-wrap Board

Figure 4 shows the UDI wire-wrap board. This board provides connector space for target system signals and any required active circuitry in the area just to the left of and on the right side of the break-away boundary. Power and ground buses are included on the board for active circuitry. As an example, you can put 40-pin connectors for the DIP interface cables here. You can also mount a PGA connector in this area for direct (socketed) processor connection or connection via a QFP-to-PGA adapter. Target system signals are then wire-wrapped to the three 40-pin connectors located on the left-most side of the wire-wrap board (figure 4). The PGA socket connects to the logic analyzer interface board (figure 5), which will be discussed next.

Wire-wrap posts on the PGA and 40-pin connectors are joined by traces on the wire-wrap board. Signals can be routed to the PGA connector via the posts on the 40-pin connectors.

![Wire-wrap board diagram]

Figure 4. Wire-wrap board included in the E2445A kit.
**Interface Board**

The interface board (see figures 5 and 6) provides connections to the logic analyzer. Three connectors feed a total of 48 terminated signals to woven logic analyzer cables. An additional 48 non-terminated signals are routed via three more connectors. So, up to 96 separate signals can be sent to the logic analyzer. Termination adapters, flying lead sets or termination SIPs on the wire-wrap board are used to condition the non-terminated signals. Three more connectors, making 9 connectors in total, are available to double-probe signals for simultaneous state and timing analysis. These connectors are non-terminated and provide the same 48 signals as the three terminated connectors.

![Figure 5. Interface board included in the E2445A kit](image)

**User's Guide**

The HP E2445A comes with a comprehensive user's guide. The guide includes detailed product information, connection methods, and Hewlett-Packard preprocessor design examples. The HP design examples detail clocking, buffering, and latching schemes for some advanced processor interfaces. Trouble-shooting tips are also outlined in an appendix.
Interface Parts

Both Hewlett-Packard and 3M offer wire-wrap parts kits for microprocessor interfaces. The HP 10321A kit includes sockets, connectors, capacitors, etc. The kit from 3M has similar components. Individual components can be ordered from Hewlett-Packard and the following companies:

3M: Phone 512 984-2459, Fax 512 984-6720
McKenzie Technology: Phone 510 651-2700, Fax 510 651-1020
Samtec: Phone 812 944-6733, Fax 812 948-5047

Also see the Hewlett-Packard Logic Analyzer Accessories Guide (p/n 5091-1808E) available from your local HP sales representative.

The HP 10391B Inverse Assembler Development Package

An inverse assembler takes the un-modified data stored in the logic analyzer and converts it into user-defined mnemonics based on the values of the individual signals. In most cases, the mnemonics are selected to resemble the original microprocessor mnemonics. An inverse assembler is very useful when the individual signals have different meanings according to the context. Hewlett-Packard offers a software package for the development of inverse assemblers. The HP 10391B software runs on IBM-compatible personal computers that have a DOS operating system. Inverse assemblers are written using a language resembling microprocessor assembly code. Then the inverse assembler program is transferred via RS-232 to the logic analyzer, loaded for use, and stored on a disk with a corresponding instrument configuration file for later reloading. The HP 10391B package comes with software and a manual which includes programming examples.

Minimizing Intrusion Effects

Additional information regarding the minimization of intrusion effects when probing a target system can be found in Application Note 1244-1.

Your Logic Analysis Safety Net

Hewlett-Packard and its 3rd-party Preprocessor Connection group offer over 160 processor and bus support solutions. Just in case your processor or bus isn't covered, there are interface tools and development packages designed to make a custom job easier. Contact your local Hewlett-Packard Test and Measurement sales representative to find out more about these products.
For more information, call your local HP sales office listed in your telephone directory, or an HP regional office listed below:

**United States:**
Hewlett-Packard Company  
2101 Gaither Road  
Rockville, MD 20850  
(301) 258-2000

Hewlett-Packard Company  
5201 Tullview Drive  
Rolling Meadows, IL 60008  
(708) 255 9800

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(714) 999 6700

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