SERVICE MANUAL

HP 16515A 1 GHz Timing Analyzer Master Card
And
HP 16516A 1 GHz Timing Analyzer Expansion Card
CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau’s calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Hewlett-Packard product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER’S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

CWA388
SAFETY CONSIDERATIONS

GENERAL - This is a Safety Class I instrument (provided with terminal for protective earthing).

OPERATION - BEFORE APPLYING POWER verify that the power transformer primary is matched to the available line voltage, the correct fuse is installed, and Safety Precautions are taken (see the following warnings). In addition, note the instrument’s external markings which are described under “Safety Symbols.”

WARNING

• Servicing instructions are for use by service-trained personnel. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so.

• BEFORE SWITCHING ON THE INSTRUMENT, the protective earth terminal of the instrument must be connected to the protective conductor of the (mains) powercord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two-conductor outlet is not sufficient protection.

• If this instrument is to be energized via an auto-transformer (for voltage reduction) make sure the common terminal is connected to the earth terminal of the power source.

• Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury.

• Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

• Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short circuited fuseholders. To do so could cause a shock or fire hazard.

• Do not operate the instrument in the presence of flammable gasses or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

• Do not install substitute parts or perform any unauthorized modification to the instrument.

• Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

• Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible, and when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

• Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

SAFETY SYMBOLS

Instruction manual symbol. The product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the product.

Indicates hazardous voltages

Earth terminal (sometimes used in manual to indicate circuit common connected to grounded chassis).

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood or met.
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1-1. INTRODUCTION

This service manual contains information for testing and servicing the HP 16515A/16A 1 GHz Timing Analyzer Module. Also included are installation procedures and a list of recommended test equipment. This manual is divided into six sections as follows:

I - General Information
II - Installation
III - Performance Tests
IV - Adjustments
V - Replaceable Parts
VI - Service

Information for operating, programming, and interfacing the HP 16515A/16A 1 GHz Timing Analyzer Module is contained in the HP 16515A/16A 1 GHz Timing Analyzer Operating and Programming Manual supplied with each module.

The General Information Section includes safety requirements, a product description, and a list of accessories supplied. Also included are tables listing specifications and operating characteristics, and a list of recommended test equipment.

Listed on the title page of this manual is a Microfiche part number. This number can be used to order 4 X 6 inch microfilm transparencies of the manual. Each microfiche contains up to 96 photoduplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement as well as pertinent Service Notes.

To complete the service documentation for your system, place this service manual in the 3-ring binder with your Logic Analysis System Service Manual.

1-2. MODULES COVERED BY THIS MANUAL

The information covered in this manual is for the HP 16515A/16A 1 GHz Timing Analyzer Module. If either card has changed, a new card number will be assigned and the manual will be accompanied by a Manual Changes Supplement. This supplement explains the changes and how to adapt the manual to the newer card.

In addition to the change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes Supplement.

1-3. SAFETY REQUIREMENTS

Specific warnings, cautions, and instructions are placed wherever applicable throughout the manual. These must be observed during all phases of operation, service, and repair of the module. Failure to comply with them violates safety standards of design, manufacture, and intended use of this module. Hewlett-Packard assumes no liability for the failure of the customer to comply with these safety requirements.
1-4. PRODUCT DESCRIPTION

The HP 16515A/16A 1 GHz Timing Analyzer Module is a high speed timing analyzer with a minimum configuration of 16 channels and is expandable to 32 channels when a HP 16516A Expansion Card is added. The module has passive probing, intermodule triggering and arming capabilities. Some of the main features are:

- 1 GHz timing, providing up to 1 ns single shot resolution.
- 16 channels per HP 16515A Master Card, 16 channels per HP 16516A Expansion Card, and a maximum of 80 channels per HP 16500A.
- 8 Kbits memory per channel.
- Pattern, pattern duration, edge, arm trigger between modules via Intermodule Bus.
- Small lightweight probing.

1-5. ACCESSORIES SUPPLIED

The following accessories are supplied with the HP 16515A/16A 1 GHz Timing Analyzer Module. Quantity one unless shown otherwise.

**HP 16515A:**
- Operating manual set
- Service manual
- Probe Lead Set Kit (HP 16515-69502) Qty 2
- Probe Assembly (HP 16515-61604) Qty 16
- Grabbers, Set of 20 (HP 5959-0288) Qty 2
- Label Set (HP 16500-94303)

**HP 16516A:**
- Probe Lead Set Kit (HP 16515-69502) Qty 2
- Probe Assembly (HP 16515-61604) Qty 16
- Grabbers, Set of 20 (HP 5959-0288) Qty 2
- Intercard Connect Cable (HP 16516-61601)
- Screws M3 X 0.5 (HP 0515-1246) Qty 6
- Label Set (HP 16500-94303)

1-6. SPECIFICATIONS AND OPERATING CHARACTERISTICS

Module specifications and operating characteristics are listed in Table 1-1. Specifications are the performance standards against which the module is tested.

The operating characteristics are not specifications, but are typical operating characteristics included as additional information for the user.

1-7. RECOMMENDED TEST EQUIPMENT

Equipment required to test and maintain the HP 16515A/16A 1 GHz Timing Analyzer Module is listed in Table 1-2. Other equipment may be substituted if it meets or exceeds the critical specifications listed in the table.
# HP 16515A/16A Specifications and Operating Characteristics

## HP 16515A/16A Specifications

### PROBES

- **Minimum Swing:**
  - 500 mV peak-to-peak.

- **Threshold Accuracy:**
  - ± 150 mV ± 3.0% over the range 0 volts to + 5 volts.
  - ± 150 mV ± 2.0% over the range -3.5 volts to 0 volts.

- **Dynamic Range:**
  - ± 7.0 volts

## HP 16515A/16A Operating Characteristics

### PROBES

- **Input RC:**
  - 10 kΩ ± 2% shunted by approximately 3 pF at the probe tip.

- **Minimum Input Overdrive:**
  - 250 mV or 30% of the input amplitude, whichever is greater, above the pod threshold.

- **Maximum Input Voltage:**
  - ± 40 volts.

- **Threshold setting:**
  - Threshold levels may be defined for each pod individually.

- **Threshold Range:**
  - -3.5 to + 5.0 volts in 0.1 volt increments.

- **TTL Threshold Preset:**
  - + 1.5 volts.

- **ECL Threshold Preset:**
  - -1.3 volts.
Table 1-1. HP 16515A/16A Specifications And Operating Characteristics (cont.).

<table>
<thead>
<tr>
<th>ACQUISITION MEMORY</th>
</tr>
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<tbody>
<tr>
<td>Memory Depth:</td>
</tr>
<tr>
<td>• 8192 samples/channel.</td>
</tr>
<tr>
<td>Data Channels:</td>
</tr>
<tr>
<td>• 2 eight channel pods (16515A).</td>
</tr>
<tr>
<td>• 4 eight channel pods (16515A/16516A).</td>
</tr>
<tr>
<td>Sample Period:</td>
</tr>
<tr>
<td>• 1 ns to 1.6 ms dependent on s/Div and delay settings.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TIME INTERVAL ACCURACY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timebase Accuracy:</td>
</tr>
<tr>
<td>• ± 0.01% of the time interval reading plus:</td>
</tr>
<tr>
<td>• ± 500 ps at 250 MHz to 1 GHz sample rate.</td>
</tr>
<tr>
<td>• ± 2 ns ≤ 125 MHz sample rate.</td>
</tr>
<tr>
<td>Time Interval Accuracy:</td>
</tr>
<tr>
<td>• ± Sample Period ± Timebase Accuracy ± (2 ns within pod or 2.5 ns between pods)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TRIGGER</th>
</tr>
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<tbody>
<tr>
<td>Asynchronous Pattern:</td>
</tr>
<tr>
<td>• Trigger on an asynchronous pattern less than or greater than specified duration, or trigger on a not-equal-to pattern greater than the specified duration. Pattern is the logical AND of specified Low, High, or Don’t Care for each assigned channel. If pattern is valid but duration is invalid, there is a 2.6 ns reset time before the instrument is ready to look for the pattern again.</td>
</tr>
<tr>
<td>Greater Than Duration:</td>
</tr>
<tr>
<td>• Trigger occurs at pattern valid followed by duration expired.</td>
</tr>
</tbody>
</table>
Table 1-1. HP 16515A/16A Specifications And Operating Characteristics (cont.)

<table>
<thead>
<tr>
<th>Range:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• 2 ns to 507 sample periods for patterns specified within a pod.</td>
<td></td>
</tr>
<tr>
<td>7 ns to 507 sample periods for patterns specified across pods on the same board.</td>
<td></td>
</tr>
<tr>
<td>10 ns to 507 sample periods for patterns specified across boards (16515A and 16516A) within a module.</td>
<td></td>
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<table>
<thead>
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<tr>
<td>• 4 sample periods.</td>
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</table>

<table>
<thead>
<tr>
<th>Accuracy:</th>
<th></th>
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<tr>
<td>• ± 2 ns (2 ns setting)</td>
<td></td>
</tr>
<tr>
<td>± 1 sample period ± :</td>
<td></td>
</tr>
<tr>
<td>2 ns for patterns specified within a pod.</td>
<td></td>
</tr>
<tr>
<td>6 ns specified across pods on the same board.</td>
<td></td>
</tr>
<tr>
<td>8 ns specified across boards within a module.</td>
<td></td>
</tr>
<tr>
<td>(for all other settings)</td>
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<table>
<thead>
<tr>
<th>Less Than Duration:</th>
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<tbody>
<tr>
<td>• Trigger occurs at the end of the pattern. Patterns specified within a pod must be valid for at least 1.5 ns. Patterns specified across pods on same board must be valid for at least 11 ns. Patterns may not be specified across boards (16515A/16516A).</td>
<td></td>
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<table>
<thead>
<tr>
<th>Range:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• 16 ns to 507 sample periods for patterns specified within a pod.</td>
<td></td>
</tr>
<tr>
<td>20 ns to 507 sample periods for patterns specified across pods on same board.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resolution:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• 4 sample periods.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Accuracy:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• ± 1 sample period ± :</td>
<td></td>
</tr>
<tr>
<td>3 ns for patterns specified within a pod and 7 ns for patterns specified across pods on same board.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Edge Trigger:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Trigger on edge following valid duration of asynchronous pattern. Trigger is the OR of specified rising or falling edges. Less than duration forces edge triggering off.</td>
<td></td>
</tr>
<tr>
<td>• Minimum pulse width: 1.5 ns.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Delay From Trigger To BNC Output Port:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Less than 50 ns from the probe tip.</td>
<td></td>
</tr>
</tbody>
</table>
### DISPLAY FUNCTIONS

**Data Display/Entry.**

**Labels**
- Channels may be grouped together and given a 6 character name. Up to twenty labels may be assigned with up to 32 channels per label. Primary use is for naming groups of channels such as address, data, and control busses.

**Bases:**
- Binary, Octal, Decimal, Hexadecimal, ASCII (display only), user-defined symbols.

**Activity Indicators:**
- Provided in the Format Menu for identifying the current state of input lines as high, low, or changing.

**Timing Waveform:**
- Interleaved, time-correlated listing of timing waveforms and waveforms from other measurement modules (i.e., another timing analyzer or oscilloscope). Pattern readout of timing waveform at X or O marker in the selected base.

### WAVEFORM DISPLAY

**Sec/div:**
- 1 ns to 1 s adjustable, with 3 digit resolution.

**Delay:**
- -12.5 s to +53.5 ks.

**Accumulate:**
- Waveform display is not erased between successive acquisitions.

**Overlay Mode:**
- Multiple channels can be displayed on one waveform display line. Primary use is to view summary of bus activity.

**Maximum Number Of Displayed Waveforms:** 24

### Marker Functions

**Time Interval:**
- The X and O markers, shown as dashed lines on the display, measures the time interval between one point on a timing waveform and trigger, two points on the same timing waveform, or two points on different waveforms.
Patterns:
- The X and O markers can be used to locate the 0 to 8192 occurrence of a specified pattern before or after trigger. The O marker can also be used to locate the 0 to 8192 occurrences of a pattern before or after the X marker.

Statistics:
- X to O marker statistics are calculated for repetitive acquisitions. Patterns must be specified for both markers, and statistics are updated only when both patterns can be found in an acquisition. Statistics are minimum X to O time, maximum X to O time, average X to O time, and count of valid runs and total runs.

Trigger:
- Displayed as a vertical dashed line in the timing waveform display. Actual location of trigger in memory may vary from marker by ± 4 samples (16515A) and ± 6 samples (16515A/16516A).

**ACQUISITION FUNCTIONS**

Run:
- Starts acquisition of data in specified trace mode. Single mode acquires data once while repetitive mode repeats single mode acquisitions until STOP is touched or until time interval between two specified patterns is less than or greater than a specified value, or within or outside a specified range.

Stop:
- In single trace mode, or the first run of a repetitive acquisition, STOP halts acquisition and displays the current acquisition data. For subsequent runs in repetitive mode, STOP halts acquisition of data and does not change current display.

Arming:
- By the Run Field or from any other module or the external port-in via the Intermodule Bus.

- These characteristics are true for input signal, $V_{H} = -0.90$ volts, $V_{L} = -1.70$ volts, threshold = -1.3 volts, slew rate = 1 V/ns.
**OPERATING ENVIRONMENT**

Temperature:
- Instrument, 0° to 55°C (+32° to 131°F).
  - Probe lead sets and cables, 0° to 65°C (+32° to 149°F).

Humidity:
- Instrument, up to 95% relative humidity at +40°C (+104°F).

Altitude:
- To 4600 m (15,000 ft).

**Vibration**

Operating:
- Random vibration 5-500 Hz, 10 minutes per axis, ~0.3 g (rms).

Non-operating:
- Random vibration 5-500 Hz, 10 minutes per axis, ~2.41 g (rms); and swept sine resonant search, 5-500 Hz, 0.75 g (0-peak), 5 minute resonant dwell @ 4 resonances per axis.
Table 1-2. Recommended Test Equipment

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Critical Specification</th>
<th>Recommended Model</th>
<th>Use*</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC VOLTMETER</td>
<td>3 1/2 DIGIT RESOLUTION</td>
<td>HP 3488A</td>
<td>P,T</td>
</tr>
<tr>
<td>PULSE GENERATOR</td>
<td>RINGING ≤ ± 10 % AMPLITUDE ± 10 mV</td>
<td>HP 8161A</td>
<td>P</td>
</tr>
<tr>
<td>OSCILLOSCOPE</td>
<td>300 MHz BANDWIDTH</td>
<td>HP 54201</td>
<td>T</td>
</tr>
<tr>
<td>POWER SUPPLY</td>
<td>+ 5.30 V TO - 3.72 V OUTPUT; CURRENT 0-0.4 AMP</td>
<td>HP 6216B</td>
<td>P</td>
</tr>
<tr>
<td>FUNCTION GENERATOR</td>
<td>SQUARE WAVE ± 7 VOLTS AMPLITUDE; 10 MHz</td>
<td>HP 8116A</td>
<td>P,T</td>
</tr>
<tr>
<td>50 OHM FEEDTHRU</td>
<td></td>
<td>HP 10100C</td>
<td>P,T</td>
</tr>
<tr>
<td>BNC TEE</td>
<td>1 MALE, 2 FEMALE</td>
<td>HP 1250-0781</td>
<td>P</td>
</tr>
<tr>
<td>BNC Cable</td>
<td>(M-M) 48 INCH QTY 2</td>
<td>HP 10503A</td>
<td>P,T</td>
</tr>
<tr>
<td>ADAPTER</td>
<td>BNC (F) TO DUAL BANANA QTY 2</td>
<td>HP 1251-2277</td>
<td>P</td>
</tr>
<tr>
<td>GRABBER SET</td>
<td>QTY 1 SET</td>
<td>HP 5959-0288</td>
<td>P,T</td>
</tr>
<tr>
<td>PROBE LEAD SET</td>
<td>QTY 1 SET</td>
<td>HP 16515-69502</td>
<td>P,T</td>
</tr>
<tr>
<td>EXTENDER BOARD</td>
<td>NO SUBSTITUTE</td>
<td>HP 16500-69004</td>
<td>T</td>
</tr>
<tr>
<td>TEST CONNECTOR</td>
<td>BNC (F) PANEL MOUNT</td>
<td>HP 1250-1032</td>
<td>P,T</td>
</tr>
</tbody>
</table>

* A = Adjustments   P = Performance Tests   T = Troubleshooting
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## INSTALLATION

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<td>2-8</td>
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</table>
2-1. INTRODUCTION
This section explains, how to initially inspect the HP 16515A/16A 1 GHz Timing Analyzer Module, how to prepare it for use, storage and shipment. Also included are procedures for module installation.

2-2. INITIAL INSPECTION
Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the module has been checked mechanically and electrically. The contents of the shipment should be as listed in the "ACCESSORIES SUPPLIED" paragraph located in Section I.

Procedures for checking electrical performance are in Section III. If the contents of the container are incomplete, there is mechanical damage or defect, or the instrument does not pass the performance tests, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping material so the carrier can inspect it. The Hewlett-Packard office will arrange for repair or replacement at Hewlett-Packard's option without waiting for claim settlement.

2-3. PREPARATION FOR USE

WARNING
Read the Safety Considerations in the front of this manual and the Safety Requirements in Section I before installing or operating this module.

2-4. POWER REQUIREMENTS
All power supplies required for operating the HP 16515A/16A 1 GHz Timing Analyzer Module are supplied to the module through the backplane connector.

2-5. SAFETY REQUIREMENTS
Specific warnings, cautions, and instructions are placed wherever applicable throughout the manual. These must be observed during all phases of operation, service, and repair of the module. Failure to comply with them violates safety standards of design, manufacture, and intended use of this module. Hewlett-Packard assumes no liability for the failure of the customer to comply with these safety requirements.

2-6. PROBE ASSEMBLY INSTALLATION
The HP 16515A/16A 1 GHz Timing Analyzer Module comes with probe assemblies installed by the factory. If a probe assembly is to be replaced, refer to "PROBE ASSEMBLY REPLACEMENT" in Section VI of this manual.
2-7. MODULE INSTALLATION

WARNING

Do not install, remove or replace the module in the instrument unless the instrument power is turned off.

The HP 16515A 1 GHz Timing Master Card will take up one slot in the card cage. The HP 16516A Expansion Card will require one additional slot directly above the master card. If you are installing the HP 16515A/16A 1 GHz Timing Analyzer Module (one master card or one master card and one expansion card), follow this procedure. If you are adding an expansion card to a master card, follow the procedure "ADDING AN EXPANSION CARD" in paragraph 2-8.

CAUTION

The effects of ELECTROSTATIC DISCHARGE can damage electronic components. Use grounded wriststraps and mats when performing any kind of service to this module.

INSTALLATION CONSIDERATIONS:

- A two card module must remain screwed together and installed in two adjacent slots.
- A one card module may be installed in any available slot.
- If previously installed modules prevent proper installation, they must be repositioned in the card cage.
- Cards or filler panels below the empty slots intended for the module installation do not have to be removed.

PROCEDURE:

1. Turn instrument power switch off, unplug power cord and disconnect any input or output connections.

2. Starting from the top, loosen thumb screws on filler panel(s) and card(s).

   Note

   Two card 1 GHz Timing Modules are screwed together. To prevent binding when loosening or tightening thumb screws, use sequence shown in figure 2-2.
3. Starting **from the top**, begin pulling card(s) and filler panel(s) out half way. See figure 2-1.

![Diagram of card installation](image)

**CAUTION**

All multi-card modules will be cabled or screwed together. Care should be taken to pull these cards out together. Refer to the appropriate service books for any specific precautions during installation.

4. If the module consists of one master card, this card can be installed in any available slot. If the module consists of two cards, pick two adjacent slots. Remove the filler panel(s).

5. Slide card(s) approximately half way into the slot(s) that you are using for this installation.
6. Firmly seat bottom card(s) into backplane connector. Keep applying pressure to the center of card(s) endplate while tightening thumb screws finger tight.

**Note**

*If there are two cards in the timing module, follow the sequence in figure 2-2 for tightening or loosening the thumbscrews.*

2-2. **Tightening Or Loosening Sequence**

7. Repeat step 6 for all cards and filler panels in a bottom to top order. See figure 2-3.

2-3. **Endplate Overhang**

8. Any filler panels that are not used should be kept for future use. Filler panels must be installed in all unused card slots for correct air circulation.
2-8. ADDING AN EXPANSION CARD
This procedure should be used if you are adding an HP 16516A 1 GHz Timing Analyzer Expansion Card to a previously installed HP 16515A 1 GHz Timing Analyzer Master Card.

CAUTION

The effects of ELECTROSTATIC DISCHARGE can damage electronic components. Use grounded wriststraps and mats when performing any kind of service to this module.

INSTALLATION CONSIDERATIONS:
• Cards must be screwed together and installed in two adjacent slots.
• If previously installed modules prevent proper installation, they must be repositioned in the card cage.
• Cards or filler panels below the empty slots intended for the module installation do not have to be removed.

PROCEDURE:
1. Turn instrument power switch off, unplug power cord and disconnect any input or output connections.
2. Starting from the top, loosen thumb screws on filler panel(s) and card(s).

Note

Two card 1 GHz Timing Modules are screwed together. To prevent binding when loosening or tightening thumb screws, use sequence shown in figure 2-4.

3. Starting from the top, begin pulling card(s) and filler panel(s) out half way. See figure 2-5.
CAUTION

All multi-card modules will be cabled or screwed together. Care should be taken to pull these cards out together. Refer to the appropriate service books for any specific precautions during installation.

2-5. Endplate Overhang

4. Pull the timing analyzer master card completely out.

5. Lay timing analyzer master card on an antistatic mat. See figure 2-6.

6. Connect intercard cable to the timing analyzer master card making sure to use the correct cable end. See figure 2-7.
7. Fasten the timing analyzer expansion card to the timing analyzer master card using a No. 10 torx ® driver and the six (6) screws furnished with the timing analyzer expansion card. See figure 2-8.

8. Connect other end of intercard cable to expansion card.

9. Go to step 4 of paragraph 2-7, "MODULE INSTALLATION", and continue from that point.
2-9. OPERATING ENVIRONMENT

The operating environment is listed in table 1-1. Note the non-condensing humidity limitation. Condensation within the instrument can cause poor operation or malfunction. Protection should be provided against internal condensation. The HP 16515A/16A will operate at all specifications within the temperature and humidity range given in table 1-1. However, reliability is enhanced by operating the instrument within the following ranges.

- Temperature: +20° to +35° C (+68° to +95° F)
- Humidity: 20% to 80% non-condensing

2-10. STORAGE

The module may be stored or shipped in environments within the following limits:

- Temperature: -40° C to +75° C
- Humidity: Up to 90% at 65° C
- Altitude: Up to 15,300 meters (50,000 Feet)

The module should also be protected from temperature extremes, which cause condensation on the module.

2-11. PACKAGING

Follow these general instructions for repacking the module with commercially available materials.

- Wrap module in anti-static plastic.
- Use a strong shipping container. A double-wall carton made of 350 lb. test material is adequate.
- Use a layer of shock-absorbing material 70-to-100 mm (3-to-4 inch) thick around all sides of the module to provide firm cushioning and prevent movement inside the container.
- Seal shipping container securely.
- Mark shipping container FRAGILE to ensure careful handling.
- In any correspondence, refer to module by model number and board number.

2-12. TAGGING FOR SERVICE

If the module is to be shipped to a Hewlett-Packard office for service or repair, attach a tag with your name and address, the complete board number, and a description of the service required.
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## PERFORMANCE TESTS

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<td>3-9</td>
<td>Dynamic Range Test</td>
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</tr>
</tbody>
</table>
3-1. INTRODUCTION

The procedures in this section test the HP 16515A/16A 1 GHz Timing Analyser's electrical performance using the specifications listed in Section I as the performance standards. All tests can be performed without access to the interior of the instrument. At the end of this section is a form that can be used as a record of performance test results.

3-2. RECOMMENDED TEST EQUIPMENT

Equipment recommended for performance tests is listed in table 1-2. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended models.

3-3. TEST RECORD

Results of performance tests may be tabulated on the Performance Test Record (table 3-1) at the end of the procedures. The test record lists all of the tested specifications and their acceptable limits. The results recorded on the test record may be used for comparison in periodic maintenance and troubleshooting or after repairs have been made.

3-4. PERFORMANCE TEST INTERVAL

Periodic performance verification of the HP 16515A/16A 1 GHz Timing Analyzer is required at two year intervals. The instrument's performance should be verified after it has been serviced, or if improper operation is suspected. Further checks requiring access to the interior of the instrument are included in the adjustment section, but are not required for the performance verification.

3-5. PERFORMANCE TEST PROCEDURES

All performance tests should be performed at the instrument's environmental operating temperature and after a 15-minute warm up period.

3-6. TEST CONNECTOR

The performance tests and troubleshooting procedures require connecting pulse generator outputs to probe assembly inputs. Figure 3-1 is a test connector that may be built to allow testing of multiple channels (up to eight at one time). The test connector consists of a BNC connector and two lengths of wire. Connecting more than eight channels to the test connector at a time will induce loading of the circuit and true signal representation will degrade. Test results may not be accurate if more than eight channels are connected to the test connector.

The Hewlett-Packard part number for the BNC connector in figure 3-1 is 1250-1032. An equivalent part may be used in place of the Hewlett-Packard part.

3-1. Test Connector
3-7. Minimum Swing Voltage Test

Description:
This test verifies the minimum swing voltage specification of the input probes and probe hybrid of the HP 16515A and HP 16516A. A square wave input will swing about an ECL level with a precise amplitude of 500 mV. A visual account of approximately one pulse per division with no missing pulses indicates a passed test. One probe (8 channels) is tested at a time.

Specification:
Minimum Swing: 500 mV peak to peak.

Equipment:
Pulse Generator ................................................................................................................................... HP 8161A
DC Voltmeter ....................................................................................................................................... HP 3468A
50 Ohm Feedthru ................................................................................................................................ HP 10100C
BNC Tee.............................................................................................................................................. HP 1250-0781
BNC Cable (2) ...................................................................................................................................... HP 10503A
Adapter ................................................................................................................................................ HP 1251-2277
Test Connector see figure 3-1

Procedure:
1. Connect the HP 16515A/16A to test equipment as shown in figure 3-2.

   Note
   In this setup, eight channels are connected. All ground leads must be grounded to ensure accurate test results.

2. Turn instrument power on.
3. Set pulse generator for the output in figure 3-3.
3-3. Pulse Generator Output

Settings for HP 8161A:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Output A</th>
<th>Output B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period (PER)</td>
<td>100 ns</td>
<td>—</td>
</tr>
<tr>
<td>Width (WID)</td>
<td>50 ns</td>
<td>50 ns</td>
</tr>
<tr>
<td>Leading Edge (LEE)</td>
<td>1.3 ns</td>
<td>1.3 ns</td>
</tr>
<tr>
<td>Trailing Edge (TRE)</td>
<td>1.3 ns</td>
<td>1.3 ns</td>
</tr>
<tr>
<td>High Level (HIL)</td>
<td>-1.05 V</td>
<td>-1.05 V</td>
</tr>
<tr>
<td>Low Level (LOL)</td>
<td>-1.55 V</td>
<td>-1.55 V</td>
</tr>
<tr>
<td>Delay (DEL)</td>
<td>0 ns</td>
<td>0 ns</td>
</tr>
<tr>
<td>Output Mode</td>
<td>ENABLE</td>
<td>DISABLE</td>
</tr>
<tr>
<td>Output</td>
<td>COMPL</td>
<td>—</td>
</tr>
</tbody>
</table>

Input Mode is set to GATE.

4. Adjust High Level (HIL) of pulse, if necessary, until voltmeter reads -1.05 V.

5. Change channel A output to NORM, then adjust Low Level (LOL) of pulse, if necessary, until voltmeter reads -1.55 V.

6. Set pulse generator Input Mode to NORM.

7. Turn instrument power off and connect HP 16515A/16A to test equipment as shown in figure 3-4.
8. Turn instrument power on.

9. From the startup screen shown in figure 3-5, touch the following fields in the ordered sequence below:
   a. System
   b. 1 GHz Timing (If multiple timing modules, select the one to be tested.)

![System Configuration Print]

3-5. Startup Screen

10. In the Format screen, touch pod threshold field as shown in figure 3-6, then touch ECL. Repeat for all pods.

![1 GHz Timing E Format Print Run]

3-6. Pod Threshold Field In Format Screen

Note

*The labels default to A and B. For illustration purposes, these were set to A = MASTER and B = EXPNDR.*

11. From the Format screen touch Format, then touch Trace.
12. Set Trace screen as shown in figure 3-7.

![Trace screen diagram]

3-7. Trace Screen

13. From the Trace screen, touch Trace, then touch Waveforms.

14. In the Waveforms screen, shown in figure 3-8, set the s/Div to 100 ns.

![Waveforms screen diagram]

3-8. Waveforms Screen

15. Touch Run, then drag finger to Single. See figure 3-9.

![Run-Single field diagram]
16. The resulting waveforms should look like figure 3-10. Adjust the delay to line up pulse edge with center screen graticule. There should be approximately 1 pulse per division with no missing pulses.

3-10. Test Waveforms

17. Disconnect probe assemblies from master pod 1 and connect master pod 2.

18. Repeat steps 15 and 16 for pod 2 probe assemblies.

19. If there is an HP 16516A 1 GHz Timing Analyzer Expansion Card in the module, continue with steps 20 through 23.

20. In the Waveforms screen touch the input Label field as shown in figure 3-11.

3-11. Input Label Field
21. In the Waveforms screen touch the following fields in the ordered sequence below:

   a. **Action Insert** (toggles to Replace)
   
   b. **EXPNDR** (or B if labels are left at default)
   
   c. **Done**

   **Note**

   *The labels default to A and B. For illustration purposes, these were set to A = MASTER and B = EXPNDR.*

22. Connect expander pod 1 probe assemblies and repeat steps 15 and 16.

23. Connect expander pod 2 probe assemblies and repeat steps 15 and 16.
3-8. Threshold Accuracy Test

Description:

This test verifies the threshold accuracy within the two ranges stated in the specification. Threshold levels set at specified limits are applied. A passed test will show the correct logic state for the dc level input with respect to the programmed threshold. One pod (8 channels) is tested at a time.

Specification:

± 150 mV ± 3.0% over the range of 0 V to + 5 V.
± 150 mV ± 2.0% over the range -3.5 V to 0 V.

Equipment:

Power Supply .................................................................................................................................................. HP 6216B
DC Voltmeter ................................................................................................................................................ HP 3468A
BNC Tee ..................................................................................................................................................... HP 1250-0781
Adapter (2) ........................................................................................................................................... HP 1251-2277
BNC Cable (2) ...................................................................................................................................... HP 10503A
Test Connector see figure 3-1

Procedure:

1. Connect the HP 16515A/16A and test equipment as in figure 3-12.

Note

In this setup, eight channels are connected at a time. All ground leads must be grounded to ensure accurate test results.

3-12. Test Equipment Setup
2. Turn instrument power on.

3. From the startup screen shown in figure 3-5 of previous test, touch the following fields in the ordered sequence below:
   a. **System**
   b. **1 GHz Timing** (If multiple HP 16515A/16A modules, pick the one to test.)

4. In the Format screen, touch pod threshold field for the pod under test. See figure 3-13.

   ![Pod Threshold Field](image)

   **3-13. Pod Threshold Field**

   **Note**

   *The labels default to A and B. For illustration purposes, these were set to A = MASTER and B = EXPNDR.*

5. Touch **User Defined** and using keypad, set threshold to **+ 5 Volts**, then touch **DONE**.

6. From the Format screen, touch **Format**, then touch **Trace**.

7. Set Trace screen as shown in figure 3-14.

   ![Trace Screen](image)

   **3-14. Trace Screen**
8. From the Trace screen touch Trace, then touch Waveforms.

9. In the Waveforms screen set the s/Div to 50 ns.

10. Set power supply to output $+5.30$ Volts.

11. Touch Run then drag finger to Single.

12. Data displayed on Waveforms screen will be all high for probes under test. See figure 3-15.

13. Adjust power supply for an output of $+4.70$ Volts, then touch Run.

14. Data displayed on Waveforms screen will be all low for probes under test. See figure 3-16.

15. Touch Waveforms, then touch Format. In the Format screen, select pod threshold field for the pod under test, then touch User Defined threshold and set to $-3.5$ Volts.

16. Adjust power supply for an output of $-3.28$ Volts.
17. Touch **Format** then touch **Waveforms**.

18. In the Waveforms screen, touch **Run**.

19. Data displayed on the Waveforms screen will be all high for probes under test as in previous figure 3-15.

20. Adjust power supply for an output of -3.72 Volts, then touch **Run**.

21. Data displayed on the Waveforms screen will be all low for probes under test as in previous figure 3-16.

22. Disconnect master pod 1 probes and connect master pod 2 probes to test connector.

23. Touch **Waveforms**, then touch **Format** and repeat steps 4 through 21 for master pod 2.

24. If there is an HP 16516A 1 GHz Timing Analyzer Expansion Card in the module, continue with steps 25 through 27.

25. In the Waveforms screen, touch the Label field as shown in figure 3-17.

![Waveforms screen with Label field](image)

**3-17. Label Field**

26. In the Waveforms Selection screen, touch the following fields in the ordered sequence below:
   
   a. **Action Insert** (toggles to Replace)
   
   b. **Expndr** (or B if label field is left at default)
   
   c. **Done**

27. Touch **Waveforms**, then touch **Format** and repeat steps 4 through 21 for expansion pod 1 and expansion pod 2.
3-9. Dynamic Range Test

Description:

This test verifies the dynamic range of each pod by ensuring that probe assemblies do not saturate. A square wave with dc levels set at specified limits is applied. A visual account of one positive pulse per division at a duty cycle of approximately 50 ns ± 4 ns indicates a passed test.

Specification:

Dynamic Range: ± 7 Volts.

Equipment:

Function Generator .................................................................................................................................................. HP 8116A
BNC Cable ......................................................................................................................................................... HP 10503A
50 Ohm Feedthru ........................................................................................................................................ HP 10100C
Test Connector see figure 3-1

Procedure:

1. Connect the HP 16515A/16A and test equipment as in figure 3-18.

Note

In this setup, eight channels are connected at a time. All ground leads must be grounded to ensure accurate test results.

![Diagram of test equipment setup](image)
2. Set function generator output for a 10 MHz square wave as shown in figure 3-19.

3-19. Square Wave Pulse

Setting for HP 8116A:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode</td>
<td>NORM</td>
</tr>
<tr>
<td>Waveform</td>
<td>Square Wave</td>
</tr>
<tr>
<td>Frequency</td>
<td>10 MHz</td>
</tr>
<tr>
<td>Duty Cycle</td>
<td>50 %</td>
</tr>
<tr>
<td>High Level (HIL)</td>
<td>+ 7 Volts</td>
</tr>
<tr>
<td>Low Level (LOL)</td>
<td>+ 3 Volts</td>
</tr>
<tr>
<td>Output Mode</td>
<td>ENABLE</td>
</tr>
</tbody>
</table>

3. Turn instrument power on.

4. From the startup screen shown in figure 3-5 in previous test, touch the following fields in the ordered sequence below:

a. System

b. 1 GHz Timing (if multiple timing modules, pick the one to test)
5. In the Format screen, touch pod threshold field for pod under test. See figure 3-20.

6. Touch User Defined and set threshold, using pop-up keypad, to + 5 Volts, then touch DONE.

7. From the Format screen, touch Format, then touch Trace.

8. Set Trace screen as shown in figure 3-21.

9. From the Trace screen touch Trace, then touch Waveforms.
10. In the Waveforms screen set the s/Div to 100 ns.

11. Touch Run then drag finger to Single. See figure 3-22.

3-22. Run-Single Field

12. The resulting waveforms should look like figure 3-23. Adjust the delay to line up pulse edge with center screen graticule. There should be 1 pulse per division at a duty cycle of approximately 50%.

3-23. Waveform Data

Note

Nonsaturated input channels will display a positive pulse width of 50 ns ± 4 ns.
13. Adjust function generator LOL to -7 volts and the HIL to 0 volts.

14. Touch Waveforms, then touch Format.

15. In the Format screen, touch the pod threshold field for pod under test and select User Defined. Set threshold for -3.5 Volts.

16. Touch Format, then touch Waveforms.

17. In the waveforms screen touch Run.

18. The resulting waveform should look like the previous figure 3-23.

19. Disconnect master pod 1 probes and connect master pod 2 probes to the test connector.

20. Touch Waveforms, then touch Format. Reset function generator as in step 2 and repeat steps 5 through 18.

21. If there is an HP 16516A Expansion Card in the module, continue with steps 22 through 24.

22. In the Waveforms screen, touch the Label field as shown in figure 3-24.

23. In the Waveforms Selection screen, touch the following fields in the ordered sequence below:
   a. Action Insert (toggles to Replace)
   b. Expndr (or B if label field is left at default)
   c. Done

24. Touch Waveforms, then touch Format. Reset function generator as in step 2 and repeat steps 5 through 20 for expansion pod 1 and expansion pod 2.
<table>
<thead>
<tr>
<th>Paragraph</th>
<th>Test</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-7</td>
<td>Minimum Swing Voltage</td>
<td>Passed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Failed</td>
</tr>
<tr>
<td></td>
<td>Master Pod 1 (0-7)</td>
<td>□□□□□□□□□□□□</td>
</tr>
<tr>
<td></td>
<td>Master Pod 2 (8-15)</td>
<td>□□□□□□□□□□□□</td>
</tr>
<tr>
<td></td>
<td>Expndr Pod 1 (0-7)</td>
<td>□□□□□□□□□□□□</td>
</tr>
<tr>
<td></td>
<td>Expndr Pod 2 (8-15)</td>
<td>□□□□□□□□□□□□</td>
</tr>
<tr>
<td>3-8</td>
<td>Threshold Accuracy</td>
<td>Passed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Failed</td>
</tr>
<tr>
<td></td>
<td>Threshold setting: + 5 Volts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Master Pod 1 (0-7)</td>
<td>□□□□□□□□□□□□</td>
</tr>
<tr>
<td></td>
<td>Master Pod 2 (8-15)</td>
<td>□□□□□□□□□□□□</td>
</tr>
<tr>
<td></td>
<td>Expndr Pod 1 (0-7)</td>
<td>□□□□□□□□□□□□</td>
</tr>
<tr>
<td></td>
<td>Expndr Pod 2 (8-15)</td>
<td>□□□□□□□□□□□□</td>
</tr>
<tr>
<td></td>
<td>Threshold setting: - 3.5 Volts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Master Pod 1 (0-7)</td>
<td>□□□□□□□□□□□□</td>
</tr>
<tr>
<td></td>
<td>Master Pod 2 (8-15)</td>
<td>□□□□□□□□□□□□</td>
</tr>
<tr>
<td></td>
<td>Expndr Pod 1 (0-7)</td>
<td>□□□□□□□□□□□□</td>
</tr>
<tr>
<td></td>
<td>Expndr Pod 2 (8-15)</td>
<td>□□□□□□□□□□□□</td>
</tr>
</tbody>
</table>
Table 3-1. Performance Test Record

<table>
<thead>
<tr>
<th>Paragraph</th>
<th>Test</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-9</td>
<td>Dynamic Range</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Master Pod 1 (0-7)</td>
<td>Passed</td>
</tr>
<tr>
<td></td>
<td>Master Pod 2 (8-15)</td>
<td>Passed</td>
</tr>
<tr>
<td></td>
<td>Expndr Pod 1 (0-7)</td>
<td>Passed</td>
</tr>
<tr>
<td></td>
<td>Expndr Pod 2 (8-15)</td>
<td>Passed</td>
</tr>
</tbody>
</table>
4-1. ADJUSTMENT AND CALIBRATION

This section normally provides information on when to calibrate, how to calibrate, and how to adjust the module. The HP 16515A/16A Timing Analyzer Module has no adjustments and requires no calibration.
# TABLE OF CONTENTS

## REPLACEABLE PARTS

5-1. Introduction ........................................................................................................................... 5-1  
5-2. Abbreviations ........................................................................................................................ 5-1  
5-3. Replaceable Parts List ........................................................................................................... 5-1  
5-4. Ordering Information ......................................................................................................... 5-1  
5-5. Exchange Assemblies ......................................................................................................... 5-1  
5-6. Direct Mail order System ................................................................................................. 5-2
5-1. INTRODUCTION

This section contains parts and ordering information for the HP 16515A/16A 1 GHz Timing Analyzer Module. Table 5-1 lists the reference designators and abbreviations used throughout this manual. Table 5-2 lists all replaceable parts by reference designator.

5-2. ABBREVIATIONS

Table 5-1 lists abbreviations used throughout the manual. In some cases two forms of the abbreviations are used, one in all capital letters, the other partially or not capitalized. This was done because the abbreviations in the parts list are always all capitals. However, in other parts of the manual other abbreviation forms are used with both lower and uppercase letters.

5-3. REPLACEABLE PARTS LIST

Table 5-2 lists replaceable parts and is organized as follows:

- Electrical assemblies in alphanumerical order by reference designation.
- Chassis-mounted parts in alphanumerical order by reference designation.
- Electrical assemblies and their components in alphanumerical order by reference designation.

The information given for each part consists of the following:

- Complete reference designation.
- Hewlett-Packard part number.
- Total quantity (Qty) per instrument.

5-4. ORDERING INFORMATION

To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number, check digit, indicate the quantity required, and address the order to the nearest Hewlett-Packard office.

To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, the description and function of the part, and number of parts required. Address the order to the nearest Hewlett-Packard office.

5-5. EXCHANGE ASSEMBLIES

Exchange assemblies are available when a repairable assembly is returned to Hewlett-Packard. These assemblies have been set up on an Exchange program. This allows the customer to exchange the faulty assembly with one that has been repaired, calibrated, and performance verified by the factory. The cost is significantly less than that of a new assembly.

Exchange assemblies are listed in a separate section in the replaceable parts table. They have a part number in the form XXXXX-695XX (where the new parts would be XXXXX-665XX). Before ordering an exchange assembly, check with your local parts or repair organization for procedures.
5-6. DIRECT MAIL ORDER SYSTEM

Within the USA, Hewlett Packard can supply parts through direct mail order. The advantages are as follows:

- Direct ordering and shipment from Hewlett-Packard Parts Center in Mountain View, California.
- No maximum or minimum on any mail order (there is a minimum order for parts ordered through local Hewlett-Packard offices when orders require billing and invoicing).
- Prepaid transportation (there is a small handling charge for each order).
- No invoices - to provide these advantages, check or money order must accompany each order. Mail order forms and specific ordering information are available through your local Hewlett-Packard offices.
### Table 5-1. Reference Designator and Abbreviations

<table>
<thead>
<tr>
<th>DESIGNATOR</th>
<th>REFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>assembly</td>
</tr>
<tr>
<td>B</td>
<td>fan motor</td>
</tr>
<tr>
<td>BT</td>
<td>battery</td>
</tr>
<tr>
<td>C</td>
<td>capacitor</td>
</tr>
<tr>
<td>CR</td>
<td>diode/diode thyristor; varactor</td>
</tr>
<tr>
<td>DL</td>
<td>delay line</td>
</tr>
<tr>
<td>DS</td>
<td>annunciator/clip/LED</td>
</tr>
<tr>
<td>E</td>
<td>misc. electrical part</td>
</tr>
<tr>
<td>F</td>
<td>fuse</td>
</tr>
<tr>
<td>Q</td>
<td>transistor/SCR, triode thyristor</td>
</tr>
<tr>
<td>U</td>
<td>integrated circuit; microcircuit</td>
</tr>
<tr>
<td>V</td>
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</tr>
<tr>
<td>R</td>
<td>resistor</td>
</tr>
<tr>
<td>S</td>
<td>switch/jumper</td>
</tr>
<tr>
<td>T</td>
<td>transformer</td>
</tr>
<tr>
<td>P</td>
<td>electrical connector</td>
</tr>
<tr>
<td>MP</td>
<td>misc. mechanical part</td>
</tr>
<tr>
<td>TP</td>
<td>terminal board; test point</td>
</tr>
<tr>
<td>L</td>
<td>coil/inductor</td>
</tr>
<tr>
<td>S</td>
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</tr>
<tr>
<td>G</td>
<td>ground(ed)</td>
</tr>
<tr>
<td>M</td>
<td>mechanical part</td>
</tr>
<tr>
<td>O</td>
<td>operator</td>
</tr>
<tr>
<td>X</td>
<td>socket</td>
</tr>
<tr>
<td>Y</td>
<td>crystal unit/piece-electro or quartz</td>
</tr>
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</table>

### Abbreviations

- **A**: assembly
- **AD**: analog-to-digital
- **AC**: alternating current
- **AL**: aluminum
- **AM**: amplifier
- **AN**: analog
- **ANS**: American National Standards Institute
- **ASS**: assembly
- **AS**: astigmatism
- **AT**: attenuator
- **AW**: American wire gauge
- **BAL**: balance
- **BIN**: bin
- **BR**: bridge
- **BS**: bushing
- **BW**: bandwidth
- **C**: ceramic/cermet
- **CAL**: calibration/adjustment
- **CC**: carbon composition
- **CD**: conductor
- **CE**: ceramic
- **CF**: cubic feet/minute
- **CH**: choice
- **CM**: channel
- **CN**: contact
- **CR**: ceramic tube
- **CS**: clock
- **COS**: common-mode rejection
- **CT**: common terminal
- **CX**: cubic inch
- **D**: dial
- **DA**: digital-to-analog
- **DAC**: digital-to-analog converter
- **DAR**: differentiation
- **DAT**: data
- **DB**: double
- **DS**: dual in-line package
- **DC**: direct current
- **DCD**: direct current duty
- **DE**: degree
- **DEMUX**: demultiplexer
- **DET**: detector
- **DIA**: diameter
- **DIP**: dual in-line package
- **DIV**: division
- **DMA**: direct memory access
- **DP**: double-pole, double-throw
- **DRC**: DAC refresh controller
- **DRV**: driver

### Table

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- **DRV**: driver
5-1. Parts Identification
Table 5-2. Replaceable Parts List

<table>
<thead>
<tr>
<th>Reference Designator</th>
<th>HP Part Number</th>
<th>C D Qty</th>
<th>Description</th>
<th>Mfr Code</th>
<th>Mfr Part Number</th>
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<td>HP 16515A</td>
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<td></td>
<td></td>
<td></td>
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<td>A1</td>
<td>16515-66501</td>
<td>5 1</td>
<td>Board Assembly</td>
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<td></td>
</tr>
<tr>
<td>A2</td>
<td>16515-61604</td>
<td>9 16</td>
<td>Probe Assembly</td>
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<td></td>
</tr>
<tr>
<td>A3</td>
<td>5959-0288</td>
<td>4 2</td>
<td>Grabber Assembly Set Qty 20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E1</td>
<td>16515-66502</td>
<td>2 2</td>
<td>Probe Lead Set Kit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H1</td>
<td>16500-22401</td>
<td>5 2</td>
<td>Endplate Thumbscrew</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H2</td>
<td>0515-0430</td>
<td>3 3</td>
<td>M3 X 6 PH T10 Endplate Screw</td>
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<td></td>
</tr>
<tr>
<td>H3</td>
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<td>6 4</td>
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<td></td>
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<td>Ground Spring</td>
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<td>9 16</td>
<td>Probe Assembly</td>
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<td>4 2</td>
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<td>Ribbon Cable Assembly</td>
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6-1. INTRODUCTION

This section contains information for servicing the HP 16515A/16A 1 GHz Timing Analyzer Module. Included is a block level theory and procedures for module level self diagnostics and troubleshooting. If the module or a probe assembly is determined faulty, procedures are provided for module and probe assembly replacement.

6-2. SAFETY REQUIREMENTS

Specific warnings, cautions, and instructions are placed wherever applicable throughout the manual. These must be observed during all phases of operation, service, and repair of the module. Failure to comply with them violates safety standards of design, manufacture, and intended use of this module. Hewlett-Packard assumes no liability for the failure of the customer to comply with these safety requirements.

6-3. RECOMMENDED TEST EQUIPMENT

Table 1-2 lists recommended test equipment. Any equipment that satisfies the critical specification given in the table may be substituted for the recommended models.

6-4. MODULE BLOCK DIAGRAM AND THEORY OF OPERATION

The following paragraphs contain block level theory of operation. This theory is not intended for component level troubleshooting, rather it is to be used to help isolate a module failure to card level.

For component level troubleshooting, the HP 16515A/16A Service Data Supplement is required. This supplement contains schematics, component level theory of operation, component locators and a parts list for the HP 16515A/16A 1 GHz Timing Analyzer Module.

The HP 16515A 1 GHz Timing Analyzer Master Card is a one board, 16 channel timing analyzer. It can sample data at up to a 1 GHz rate and be expanded by 16 channels to a total of 32 channels when a HP 16516A 1 GHz Timing Expansion Card is added. See figure 6-1.

![Module Block Diagram](image-url)
HP 16515A Master Card

INTERFACE AND IMB

The microprocessor interface circuits include the system data transceiver, decoders for module control lines, a card ID latch, and intermodule bus (IMB) circuits. The IMB enables the timing analyzer module to trigger/arm other modules or be triggered/armed by the state of another module in the mainframe.

PROBES

The probes are a passive design. Each of the two probe pods contains 8 data input lines with grounding at the probe tips.

POD LOADING AND COMPARATORS

Input data from the probe pods are loaded by an RC network and compared to a pod threshold. The comparators then translate the input signals to ECL levels.

TIMEBASE, TRIGGER AND MEMORY

The timebase is comprised of three major interactive components. Collectively they generate sample clocks and control prestore and poststore delays.

The two 8 channel acquisition circuits are identical except for the operation of the trigger circuitry. One acquisition chip is the designated control chip. While pattern and edge detection is performed on unsampled data for each 8 channel data slice, the results are combined in the control chip. The control chip then performs duration count and final trigger detection for the module.

Data is sampled on both edges of the sample clock. The maximum sample clock rate of 500 MHz will in effect sample at 1 GHz. After sampling, the data is slowed down by a factor of four and is stored in memory.

![Figure 6-2. HP 16515A 1 GHz Timing Master Block Diagram](image-url)
HP 16516A Expansion Card

INTERFACE

The microprocessor interface circuits are minimal. They include a system data transceiver and a card ID latch. The clock and control lines are brought onto the expansion card through the intercard connect cable or decoded from the system backplane.

PROBES

The probes are identical to the master card probing scheme. Each probe pod contains 8 data input lines with grounding at the probe tip.

POD LOADING AND COMPARATORS

Input data from the probe pods are loaded by an RC network and compared to a pod threshold. The comparators then translate the input signals to ECL levels.

TRIGGER AND MEMORY

The two 8 channel acquisition circuits are identical. Pattern and edge detection are performed on unsampled data for each 8 channel data slice and the results are transmitted to the control chip on the master card.

Data is sampled on both edges of the sample clock. The maximum sample clock rate of 500 MHz will in effect sample at 1 GHz. After sampling, the data is slowed down by a factor of four and is stored in memory.

Figure 6-3. HP 16516A 1 GHz Timing Expansion Block Diagram
6-5. SELF TESTS

Self tests for the HP 16515A/16A 1 GHz Timing Analyzer Module will identify the improper operation of major functional areas in the module. They are not intended for component level diagnostics. If there are multiple timing modules, each must be selected for testing at the main Test System menu.

All self tests can be run without access to the interior of the instrument. If a failure is found, the troubleshooting flowchart in paragraph 6-6 will instruct you to change one or both cards in the module, a probe assembly, or the intercard cable.

The following procedure outlines how to access, run, and exit the self tests utilities. One test is used as an example in the procedure. Individual test definitions appear at the end of the test procedure.

CAUTION

The effects of ELECTROSTATIC DISCHARGE can damage electronic components. Use grounded wriststraps and mats when performing any kind of service to this instrument or the cards in it.

Self Test Access Procedure:

1. Disconnect all inputs and turn power switch on.

2. From the startup screen shown in figure 6-4, touch Configuration field, then touch Test.

![Figure 6-4. Startup Screen]
3. Touch box to load **Test System**. See figure 6-5.

4. From test screen in figure 6-6, touch **Test System**, then touch 1 GHz Timing. (If multiple 1 GHz Timing modules, select the one to be tested)
5. Figure 6-7 is the main self test menu. Self tests can be run individually by touching a specific test field, or altogether by touching "All 16515/16 Tests". When "All 16515/16 Tests" is run, the test status will change to "TESTED". When individual tests are run, the status will change to either "PASSED" or "FAILED".

![Main Test Menu Diagram](image)

Figure 6-7. Main Test Menu

6. Touch Fanout Test

7. An individual test run screen, see figure 6-8, will give the test name, a brief description of the test, number of test runs, and test failures for each slot/pod.

![Fanout Test Run Screen](image)

Figure 6-8. Fanout Test Run Screen

8. Touch Run, then drag finger to Single or Repetitive.

9. During the time a Single run or a Repetitive run is executing, the Run field will change to Stop.
10. To stop a Repetitive run, touch Stop. See figure 6-9. To exit the test touch Done.

11. Select the next test from the main test menu.

12. Repeat steps 8 through 11 until all tests are run.

13. To exit the self tests, touch the following fields in the numbered sequence below:
   
   1. 1 GHz Timing  
   2. Test System  
   3. Configuration  
   4. Exit Test  

14. Touch the box to Exit Test System. See figure 6-10.

Figure 6-9. Stop Field

Figure 6-10. Exit Test System
Test Descriptions:

Some individual self test screens show run/failure information for the mainframe slot followed by the pod number. An example of this is, mainframe slot D and pod 1 will show up on test screen as D1. Self test failures for circuits or components common to all probe pods will be registered under their own description as well as a slot/pod failure.

Fanout Test:

This is a functional test of the acquisition chips, memory chips, comparators and timebase system. At sample periods of 1 G, 125 M, 6.25 M, and 312.5 k samples/sec, the threshold is set to minimum and a full memory is acquired and read back. Then the threshold is set to maximum and the procedure is repeated. Memory chip failures are shown by physical location with the lower case letters a through d. Test information on memory chip location, timebase, and phaser is used by the HP service center for more detailed failure analysis.

Memory Test:

This test checks the memory chips on 16515A and eight on 16516A by clocking a checkerboard pattern into memory at a 1GHz rate. The CPU then reads the memory to verify the appropriate pattern stored. Memory chip failures are shown by physical location with the lower case letters a through d. Test information on memory chip location and the phase generator is used by the HP service center for more detailed failure analysis.

Pattern Trigger Test:

This test checks the pattern trigger capabilities and consists of three parts.

1. Each data channel in succession is programmed to detect a "1" while the other channels are "don't care".
2. Each data channel in succession is programmed to detect a "0" while the other channels are "don't care".
3. Data channel 0 of pod 1 is programmed to detect a "not equal 1" while the other channels are "don't care".

Failing channels are designated by a "#" (pound) while those passing will be indicated by a "." (dot). Status bit information and the trigger numbers next to the 16515 label are used by the HP service center for more detailed failure analysis.

Edge Trigger Test:

This test checks the edge trigger capabilities and consists of two parts.

1. Each data channel in succession is programmed to detect a rising edge, while the other channels are "don't care".
2. Each data channel in succession is programmed to detect a falling edge, while the other channels are "don't care".

Failing channels are designated by a "#" (pound) while those passing will be indicated by a "." (dot). Status bit information and the trigger numbers next to the 16515 label are used by the HP service center for more detailed failure analysis.
Duration Trigger Test:

This test checks the greater than and less than pattern duration circuitry and consists of two parts.

1. Data channel 0 of pod 1 is programmed to detect a "1" pattern of greater than 20 \(\mu s\) duration.

2. Data channel 0 of pod 1 is programmed to detect a "1" pattern of less than 20 \(\mu s\) duration.

Pvd (prestore valid) bit and Imc (low measurement complete) bit information is used by the HP service center for more detailed failure analysis.

Intermodule Bus Test:

This test exercises the intermodule bus interface. The timing analyzer is programmed to trigger on "don't care", armed by the IMB. The IMB is then triggered by the CPU. Pvd (prestore valid) bit and Imc (low measurement complete) bit information is used by the HP service center for more detailed failure analysis.

Pattern And Edge Test:

This test ensures that the pattern and edge detectors interact properly. Data channel 0 on pod 2 is programmed to detect a "1" pattern. Data channel 0 on pod 1 is programmed to detect a rising edge. The sample rate is set to 1 Gsamples/sec and duration is set to minimum. A trigger should occur on the second rising edge of channel 0 on pod 1. Lmc (low measurement complete) bit information is used by the HP service center for more detailed failure analysis.

Pattern Edge Duration Test:

This test ensures the pattern, edge, and duration interact properly. The triggers are programmed the same as in the pattern and edge test, with the greater than duration set to 20 \(\mu s\) and a sample rate of 80 ns. Pvd (prestore valid) bit and Imc (low measurement complete) bit information is used by the HP service center for more detailed failure analysis.

Timebase/Clock Test:

This test exercises the operation of the oscillator, timebase, and sync/mux chips. The test consists of two parts.

1. At a clock rate of 625 Hz, the high time and low time of the sample clock is recorded and the delta is compared to nominal.

2. The prestore counter is loaded with 30000 and the sample clock is set for 16 ns period. The time until the pvd (prestore valid) bit comes true is measured and compared to nominal.

All 16515/16 Tests:

When this test is selected, all tests are run automatically one time.

6-6. TROUBLESHOOTING

If self tests indicate a failure, begin at the START of the troubleshooting flow chart shown in figure 6-11. If you are troubleshooting a one card module (HP 16515A master), start on troubleshooting sheet 1. If you are troubleshooting a two card module (HP 16515A and HP 16516A), start on troubleshooting sheet 2. The flowchart will instruct you to replace a faulty card, probe assembly or cable, or refer you to other flow charts for a further isolation process.
HP 16515A STANDALONE MAIN TROUBLESHOOTING FLOWCHART

Troubleshooting Sheet 1

START

RUN MAINFRAME SELF TESTS

DO ALL MAINFRAME SELF TESTS PASS?

YES

REPAIR MAINFRAME. REFER TO HP 16500A MAINFRAME SERVICE BOOK

NO

RUN MODULE SELF TESTS WITH STANDALONE HP 16515A

YES

IS USER PROBLEM STILL PRESENT?

NO

DONE

YES

REPLACE HP 16515A MASTER

VERIFY GOOD PROBE ASSEMBLIES

REFER TO "TESTING PROBE ASSEMBLIES" TROUBLESHOOTING SHEET 18

ARE ALL PROBE ASSEMBLIES GOOD?

NO

REPLACE FAULTY PROBE ASSEMBLIES. REFER TO PARAGRAPH 6-8 "PROBE ASSEMBLY REPLACEMENT"

YES

IS USER PROBLEM STILL PRESENT?

NO

DONE

YES

CONTACT HP SERVICE CENTER

Figure 6-11. Troubleshooting Flowchart
Figure 6-11. Troubleshooting Flowchart
HP 16515A/16516A MAIN TROUBLESHOOTING FLOWCHART

**Troubleshooting Sheet 3**

- **B** FROM TROUBLESHOOTING SHEET 2
- **DOES STANDALONE HP 16515A PASS ALL TESTS?**
  - **YES** RECONNECT HP 16515A AND HP 16516A CARDS
  - **NO** RUN MODULE SELF TESTS INDIVIDUALLY
- **DOES HP 16515A FAIL ANY TESTS? SEE NOTE 1.**
  - **YES** REPLACE HP 16516A EXPANSION
  - **NO** RUN EDGE TRIGGER SELF TEST
  - **YES** GO TO TROUBLESHOOTING SHEET 4
- **DO ALL CHANNELS PASS ON HP 16516A EXPANSION?**
  - **YES** GO TO TROUBLESHOOTING SHEET 4
  - **NO** IS USER PROBLEM STILL PRESENT?
  - **YES** REPLACE HP 16516A EXPANSION
  - **NO** SEE NOTE 2. TO CHECK CONNECTIONS

**NOTE 1:** EACH SELF TEST SCREEN SHOWS INDIVIDUAL CARD AND POD FAILURES.

**NOTE 2:** DOUBLECHECK THESE CONNECTIONS
1. INTERCARD CABLE
2. PROBE ASSEMBLIES
3. CARDS SEATED PROPERLY IN BACKPLANE

**Figure 6-11. Troubleshooting Flowchart**
Figure 6-11. Troubleshooting Flowchart
HP 16515A/16516A MAIN TROUBLESHOOTING FLOWCHART

Troubleshooting Sheet 5

E FROM TROUBLESHOOTING SHEET 4

DO ALL MEMORY IC FAIL POD 2 ON HP 16516A EXPANSION?

YES H GO TO "TESTING CLOCKS" TROUBLESHOOTING SHEET 14

NO

REPLACE HP 16516A EXPANSION

IS USER PROBLEM STILL PRESENT?

NO DONE

YES

SEE NOTE 6 TO CHECK CONNECTIONS

A

GO TO TROUBLESHOOTING SHEET 2

NOTE 5:
ALL MEMORY IC LOCATIONS
a through d must pass or fail

NOTE 6:
DOUBLECHECK THESE CONNECTIONS
1. INTERCARD CABLE
2. PROBE ASSEMBLIES
3. CARDS SEATED PROPERLY IN BACKPLANE

Figure 6-11. Troubleshooting Flowchart
NOTE 7:
REFER TO PARAGRAPH 6-9 'EXTENDER BOARD INSTALLATION'
THE HP 16515A MASTER MUST BE INSTALLED BELOW EXTENDER BOARD
WITH THE INTERCARD CABLE DISCONNECTED.

TURN INSTRUMENT OFF AND PUT HP 16516A EXPANSION ON EXTENDER BOARD

CONNECT CHANNEL 0 POD 1 OF HP 16516A EXPANSION TO PULSE GENERATOR

PULSE GENERATOR A

50Q FEEDTHRU

TEST CONNECTOR

1 GND
1 POD 1 CHANNEL 0

SEE FIGURE 3-1 IN SECTION 3

Figure 6-11. Troubleshooting Flowchart
TESTING PATTERN LINES

Troubleshooting Sheet 7

NOTE 8: HP 16516A EXPANSION PODS CAN INDICATE FALSE LEVELS ON THE PROBE INPUTS, DUE TO INTERCARD CABL CABLE NOT BEING CONNECTED. DISRECEGARD THESE FALSE READINGS.

SET PULSE GENERATOR AS FOLLOWS:
1. 50% DUTY CYCLE
2. 2 MHz FREQUENCY
3. +5V HIGH
4. 0V LOW

TURN INSTRUMENT ON AND
SETUP FORMAT AND
TRACE SCREENS

SET FORMAT SCREEN:

SET TRACE SCREEN:

Figure 6-11. Troubleshooting Flowchart
TESTING PATTERN LINES

Troubleshooting Sheet 8

NOTE 9:
DOUBLE CHECK THESE CONNECTIONS
1. INTERCARD CABLE
2. PROBE ASSEMBLIES
3. CARDS SEATED PROPERLY IN BACKPLANE

PROBE PATTERN SIGNALS ON J17 PINS 17 AND 18

CORRECT SIGNALS
PINS 17,18

Freq: 2.886 MHz
Period: 499 ns

Graph:
125 mV/div -3513 mV
100 ns/div 0.000 s

1: Chan 1

DID SIGNALS LOOK LIKE ILLUSTRATION?

NO

REPLACE HP 16516A EXPANSION

IS USER PROBLEM STILL PRESENT?

NO

DONE

YES

TO TROUBLESHOOTING SHEET 9

A

GO TO TROUBLESHOOTING SHEET 2

SEE NOTE 9. TO CHECK CONNECTIONS

Figure 6-11. Troubleshooting Flowchart
TESTING PATTERN LINES

Troubleshooting Sheet 9

FROM TROUBLESHOOTING SHEET 8

CHECK INTERCARD CABLE FOR OPENS OR SHORTS

IS CABLE GOOD? YES

REPLACE HP '16515A MASTER'

NO

REPLACE CABLE

IS USER PROBLEM STILL PRESENT? NO

DONE

YES

SEE NOTE 10. TO CHECK CONNECTIONS

GO TO TROUBLESHOOTING SHEET 2

NOTE 10:
DOUBLE CHECK THESE CONNECTIONS
1. INTERCARD CABLE
2. PROBE ASSEMBLIES
3. CARDS SEATED PROPERLY IN BACKPLANE

Figure 6-11. Troubleshooting Flowchart
NOTE 11:
REFER TO PARAGRAPH 6-9
"EXTENDER BOARD INSTALLATION"
THE HP 16515A MASTER MUST
BE INSTALLED BELOW EXTENDER BOARD
WITH THE INTERCARD CABLE DISCONNECTED.

TURN INSTRUMENT OFF AND
PUT HP 16516A EXPANSION ON EXTENDER BOARD

CONNECT CHANNEL 0 POD 1 OF
HP 16516A EXPANSION TO
PULSE GENERATOR

PULSE GENERATOR A

500 FEEDTHRU

SEE FIGURE 3-1 IN SECTION 3

TEST CONNECTOR

1 GND
1 POD 1 CHANNEL 0

TO TROUBLESHOOTING SHEET 11

NOTE 11:
REFER TO PARAGRAPH 6-9
"EXTENDER BOARD INSTALLATION"
THE HP 16515A MASTER MUST
BE INSTALLED BELOW EXTENDER BOARD
WITH THE INTERCARD CABLE DISCONNECTED.

PUT HP 16516A EXPANSION ON
EXTENDER BOARD
TESTING EDGE LINES

Troubleshooting Sheet 11

NOTE 12:
HP 16516A EXPANSION PODS CAN INDICATE FALSE LEVELS ON THE PROBE INPUTS, DUE TO INTERCARD CABLE NOT BEING CONNECTED. DISREGARD THESE FALSE READINGS.

SET PULSE GENERATOR AS FOLLOWS:
1. 50% DUTY CYCLE
2. 2 MHz FREQUENCY
3. +5V HIGH
4. 0V LOW

TURN INSTRUMENT ON AND SETUP FORMAT AND TRACE SCREENS

SET FORMAT SCREEN:

1 GHz Timing E | Format | Print | Run
Pod E2 | Pod E1 | Pod D2 | Pod D1
TTL | TTL | TTL | TTL

Symbols

<table>
<thead>
<tr>
<th>Labell</th>
<th>Pod S</th>
<th>Pod T</th>
<th>Pod U</th>
<th>Pod V</th>
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</thead>
<tbody>
<tr>
<td>MASTER</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>EXPANDER</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Off</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

SET TRACE SCREEN:

1 GHz Timing E | Trace | Print | Run

Label | Name | Name | Name | Name | Name | Name
Hex | Hex | Hex | Hex | Hex | Hex | Hex
Find Pattern
Equil | FOFO | X | 10 ns | 10 ns |

Then find Edge

TOUCH RUN, THEN DRAG FINGER TO REPEETITIVE

TO TROUBLESHOOTING SHEET 12
TESTING EDGE LINES

Troubleshooting Sheet 12

NOTE 13:
DOUBLE CHECK THESE CONNECTIONS
1. INTERCARD CABLE
2. PROBE ASSEMBLIES
3. CARDS SEATED PROPERLY IN BACKPLANE

PROBE PATTERN SIGNALS ON J17 PINS 19 AND 20

CORRECT SIGNALS

- PIN 20
  Width: 1.8 ns
  V max: 16.9 mV
  V min: -483 mV

- PIN 19
  Width: 1.8 ns
  V max: -144 mV
  V min: -636 mV

125 mV/div -350 mV 5.00 ns/div -25.00 ns

DO SIGNALS LOOK LIKE ILLUSTRATION?

GO TO TROUBLESHOOTING SHEET 13

REPLACE HP 16516A EXPANSION

IS USER PROBLEM STILL PRESENT?

SEE NOTE 13. GO TO TROUBLESHOOTING SHEET 2

TO TROUBLESHOOTING SHEET 13

Figure 6-11. Troubleshooting Flowchart
TESTING EDGE LINES

Troubleshooting Sheet 13

FROM TROUBLESHOOTING SHEET 12

O

CHECK INTERCARD CABLE FOR OPENS OR SHORTS

IS CABLE GOOD?

REPLACE CABLE

NO

YES

REPLACE HP 16515A MASTER

IS USER PROBLEM STILL PRESENT?

NO

DONE

YES

SEE NOTE 14. TO CHECK CONNECTIONS

A

GO TO TROUBLESHOOTING SHEET 2

NOTE 14:
DOUBLE CHECK THESE CONNECTIONS
1. INTERCARD CABLE
2. PROBE ASSEMBLIES
3. CARDS SEATED PROPERLY IN BACKPLANE

Figure 6-11. Troubleshooting Flowchart
TESTING CLOCKS

Troubleshooting Sheet 14

FROM TROUBLESHOOTING SHEET 4,5

TURN INSTRUMENT OFF, REMOVE HP 16516A AND PUT HP 16515A MASTER ON EXTENDER BOARD

SEE NOTE 15

TURN INSTRUMENT ON AND SETUP FORMAT, TRACE, AND WAVEFORMS SCREENS AS FOLLOWS

SET FORMAT SCREEN:

1 GHz Timing E
Format

Ped E2
Ped E1
TTL
TTL

Label

Off

MASTER

Print
Run

Symbols

TO TROUBLESHOOTING SHEET 15

NOTE 15:
REFER TO PARAGRAPH 6-9 "EXTENDER BOARD INSTALLATION"
TESTING CLOCKS

Troubleshooting Sheet 15

FROM TROUBLESHOOTING SHEET 14

SET TRACE SCREEN:

1 GHz Timing E  Trace  Print  Run

Label  >  MASTER
Base  >  Memo
Find Pattern  FOFO
Equal  >
Then find Edge

SET WAVEFORMS SCREEN:

1 GHz Timing E  Waveforms  Print  Run
Accumulate Off
Sample period = 1.60 us
s/Div 1.00 ms Delay 0 s Markers Off

Then touch run, then drag finger to repetitive

TO TROUBLESHOOTING SHEET 16

Figure 6-11. Troubleshooting Flowchart
TESTING CLOCKS

Troubleshooting Sheet 16

NOTE 16:
DOUBLE CHECK THESE CONNECTIONS
1. INTERCARO CABLE
2. PROBE ASSEMBLIES
3. CARDS SEATED PROPERLY IN BACKPLANE

PROBE CLOCK SIGNALS ON J17, PINS 1-4

CORRECT SIGNALS PINS 1,2,3,4

Freq 1 = 312.5 kHz
Period = 3.200 us
V max = -55.6 mV
V min = -648 mV

Graph 1 125 mV/div -350 mV 500 ns/div -2.500 us

1: (Chan 1)

Figure 6-11. Troubleshooting Flowchart
TESTING CLOCKS

Troubleshooting Sheet 17

FROM TROUBLESHOOTING SHEET 16

CHECK INTERCARD CABLE FOR OPENS OR SHORTS

IS CABLE GOOD?

YES

REPLACE CABLE

REPLACE HP 16516A EXPANSION

NO

IS USER PROBLEM STILL PRESENT?

YES

SEE NOTE 17 TO CHECK CONNECTIONS

NO

DONE

GO TO TROUBLESHOOTING SHEET 2

NOTE 17:
DOUBLE CHECK THESE CONNECTIONS
1. INTERCARD CABLE
2. PROBE ASSEMBLIES
3. CARDS SEATED PROPERLY IN BACKPLANE

Figure 6-11. Troubleshooting Flowchart
TESTING PROBE ASSEMBLIES

Troubleshooting Sheet 18

1. FROM TROUBLESHOOTING SHEET 1.2
   TURN INSTRUMENT OFF AND REMOVE MODULE FROM MAINFRAME

2. IF TWO CARD MODULE, SEPARATE CARDS, THEN PLACE ON ANTISTATIC MAT

   USING OHM METER CHECK FOR OPENS

   CENTER CONDUCTOR (DATA)
   GROUND

   OHM METER PROBE
   CENTER CONDUCTOR (DATA)
   GROUND

CORRECT READINGS

1. GROUND PATH SHOULD BE 0 OHMS BETWEEN POINTS SHOWN IN ILLUSTRATION

2. CENTER CONDUCTOR (DATA) PATH SHOULD BE 10K OHMS ± 1% BETWEEN POINTS SHOWN IN ILLUSTRATION

RETURN TO TROUBLESHOOTING SHEET 1.2

Figure 6-11. Troubleshooting Flowchart
6-7. MODULE REPLACEMENT

**CAUTION**

The effects of ELECTROSTATIC DISCHARGE can damage electronic components. Use grounded wriststraps and mats when performing any kind of service to this module.

Installation Considerations:

- A two card module must remain screwed together and installed in two adjacent slots.
- A one card module may be installed in any available slot.
- If previously installed modules prevent proper installation, they must be repositioned in the card cage.
- Cards or filler panels below the slot(s) intended for module installation do not have to be removed.
- The probe assemblies do not have to be removed to install the module.

Procedure:

1. Turn instrument power switch off, disconnect power cord and any input or output connections.
2. Starting from the top, loosen thumb screws on filler panel(s) and card(s).

**Note**

Two card 1 GHz Timing Modules are screwed together. To prevent binding when loosening or tightening thumbscrews, use sequence shown in figure 6-12.

![Figure 6-12. Tightening Or Loosening Sequence](image)

3. Starting from the top, begin pulling card(s) and filler panel(s) out half way. See figure 6-13.
CAUTION

All multi-card modules will be cabled or screwed together. Care should be taken to pull these cards out together. Refer to the appropriate service manual for any specific precautions during installation.

Figure 6-13. Endplate Overhang

4. Pull the faulty timing module completely out.

5. If this is a two card module, lay cards on antistatic mat, disconnect intercard cable and using a No. 10 torx®, remove screws. See figure 6-14.

6. Replace faulty card with known good replacement card, reconnect intercard cable and screw module back together.

Figure 6-14. Screw Removal
7. To reinstall module, lay probe assemblies flat and pointing out to the rear of card. See figure 6-15.

8. Slide module half way into mainframe card slot(s).

9. Firmly seat bottom card into backplane connector. Keep applying pressure to the center of card endplate while tightening thumb screws finger tight.

   **Note**

   Two card 1 GHz Timing Modules are screwed together. To prevent binding when loosening or tightening thumbscrews, use sequence shown in figure 6-16.

10. Repeat for all cards and filler panels in a bottom to top order. See figure 6-17.
6-8. PROBE ASSEMBLY REPLACEMENT

CAUTION

The effects of ELECTROSTATIC DISCHARGE can damage electronic components. Use grounded wriststraps and mats when performing any kind of service to this instrument or the cards in it.

Installation Considerations:

- New probe assemblies must be completely discharged during installation.
- Two card modules must be separated before probe assemblies can be changed on the HP 16515A master.

Procedure:

1. Turn the instrument power switch off, unplug power cord and disconnect any input or output connections.
2. Starting from the top, loosen thumb screws on all filler panel(s) and card(s).

Note

Two card 1 GHz Timing Modules are screwed together. To prevent binding when loosening or tightening thumbscrews, use sequence shown in figure 6-18.

![Figure 6-18. Tightening Or Loosening Sequence](image)

Figure 6-18. Tightening Or Loosening Sequence
3. Starting from the top, begin pulling all filler panel(s) and card(s) out half way. See figure 6-19.

**CAUTION**

*All multi-card modules will be cabled or screwed together. Care should be taken to pull these cards out together. Refer to the appropriate service manual for any specific precautions during installation.*

*Figure 6-19. Endplate Overhang*

4. Pull timing module to be serviced completely out.

5. Lay card(s) on antistatic mat with probe assemblies flat and pointing out to rear of card. See figure 6-20.

*Figure 6-20. Cable Position*
6. If this is a two card module, and the bad probe assembly is on the HP 16515A Master, disconnect intercard cable and using a No. 10 torx ® driver, remove the six (6) screws holding cards together. See figure 6-21.

Figure 6-21. Screw Removal
7. Using a No. 10 torx ® driver, remove four screws that hold probe assembly retainer onto card. See figure 6-22.

![Probe Assembly Retainer and Cable](image)

**Figure 6-22. Cable And Retainer Removal**

8. Remove probe assembly(s) from card connector(s) by lifting up on strain relief tab, then pulling them straight back.

**CAUTION**

*The long lengths of coaxial cabling in the probe assemblies can build up an electrostatic potential that can damage the probe circuitry on the card. Discharge new probe assemblies completely by shorting the center conductor (data) and ground inputs together with grabbers while connecting to card.*

![Discharge Method](image)

9. Install new probe assembly(s). See figure 6-22, and read the above caution.

10. Install probe assembly retainer.

11. If this is a two card module, connect the intercard cable and screw module together.

12. At this point go to step 7 of paragraph 6-7, "MODULE REPLACEMENT", and continue installation of module.
6-9. EXTENDER BOARD INSTALLATION

**CAUTION**

The effects of ELECTROSTATIC DISCHARGE can damage electronic components. Use grounded wriststraps and mats when performing any kind of service to this instrument or the cards in it.

Installation Considerations:

- Any empty slot may be used in the card slot.
- When the HP 16516A Expansion Card is placed on the extender board, the HP 16515A Master must be installed directly below extender board.
- Cards or filler panels below the slot(s) intended for extender board installation do not have to be removed.

Procedure:

1. Turn instrument power switch off, unplug power cord and disconnect any input connections.

2. Starting from the top, loosen thumb screws on filler panel(s) and card(s).

**Note**

Two card 1 GHz Timing Modules are screwed together. To prevent binding when loosening or tightening thumbscrews, use sequence shown in figure 6-23.

![Sequence Diagram](image)

*Figure 6-23. Tightening Or Loosening Sequence*
3. Starting from the top, begin pulling filler panel(s) and card(s) out half way. See figure 6-24.

**Note**

All multi-card modules will be cabled or screwed together. Care should be taken to pull these cards out together. Refer to the appropriate service manual for any specific precautions.

![Diagram](image1)

**Figure 6-24. Endplate Overhang**

4. Pull timing module to be serviced completely out.

5. Lay module card(s) on antistatic mat with probe assemblies(s) flat and pointing out to rear of card. See figure 6-25.

![Diagram](image2)

**Figure 6-25. Cable Position**
6. If this is a two card module disconnect intercard cable and using a No. 10 torx®, remove the six (6) screws holding cards together. See figure 6-26.

![Figure 6-26. Screw Removal](image)

7. Slide extender board completely into card cage slot making sure it is firmly seated into the backplane connector. If the HP 16516A Expansion Card is placed on the extender board, the HP 16515A Master must be placed in the card slot directly below the extender board.

8. Plug the card to be serviced into the extender board. See figure 6-27.

![Figure 6-27. Installation Summary](image)