

## Errata

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# Service Guide

## HP 8110A 150 MHz Pulse Generator

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**HEWLETT  
PACKARD**

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## Safety

This is a Safety Class 1 instrument (provided with terminal for protective earthing). Before applying power, verify that the correct safety precautions are taken (see the following warnings). In addition, note the external markings on the instrument that are described under **Safety Symbols**. Do not operate the instrument with its covers removed. Replace fuse only with specified type.

## Warning

Before turning on the instrument, you must connect the protective earth terminal of the instrument to the protective earth conductor of the (mains) power cord. The mains plug must only be inserted in a socket outlet with a protective earth contact. Do not negate the protective action by using an extension power cord without a protective grounding conductor. Grounding one conductor of a two-conductor outlet is not sufficient protection.

Service instructions are for trained service personnel. To avoid dangerous electric shock, do not perform any service unless qualified to do so. Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

If you energize this instrument using an auto-transformer (for voltage reduction) make sure that the common terminal is connected to the earth terminal of the power source.

Whenever it is likely that the ground protection is impaired, you must make the instrument inoperative and secure it against any unintended operation.

Do not operate the instrument in the presence of flammable gases 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.

Capacitors inside the instrument may retain a charge even if the instrument is disconnected from its source of supply.

## Safety Symbols



Instruction Manual symbol: The instrument is marked with this symbol when it is necessary for you to refer to the instruction manual in order to protect against damage to the instrument.



Protected conductor symbol

## WARNING

The Warning symbol calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury or loss of life. Do not proceed beyond a Warning symbol until the indicated conditions are fully understood and met.

## CAUTION

The Caution symbol calls attention to a 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 equipment. Do not proceed beyond a Caution symbol until the indicated conditions are fully understood and met.

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### About this edition

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**About this book**

This book is a guide to servicing the HP 8110A with all possible modules installed:

| Module    | Description              | Quantity |
|-----------|--------------------------|----------|
| HP 81103A | 10 V/2 ns Output Channel | 2        |
| HP 81106A | PLL/External Clock       | 1        |
| HP 81107A | Multichannel Deskew      | 1        |

If your instrument does not have one or more of these modules installed, some of the described troubleshooting procedures will not be possible.

**Installing** Line voltage, fuse and other installation information.

**Specifications** The specifications of the HP 8110A and its modules.

**Testing the HP 8110A** Performance tests for checking the HP 8110A against its specifications.

**Troubleshooting** Techniques for finding the causes of malfunction in the HP 8110A.



**Disassembly and Reassembly**  
How to disassemble and reassemble the HP 8110A.





**Replaceable Parts** A list of all replaceable parts in the HP 8110A.

**Functional Description** A description of how the instrument works.

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## Installing the HP 8110A

---

### Initial Inspection

Inspect the shipping container for damage. If the container or cushioning material is damaged, keep it until the contents of the shipment have been checked for completeness and the instrument has been verified both mechanically and electrically.

#### Warning



**To avoid the hazard of electric shock, do not perform electrical tests when there are signs of shipping damage to any part of the instrument's outer covers or panels.**

---

If the contents are incomplete, or there is mechanical damage, or if the instrument does not pass the Performance Tests in Chapter 3, notify the nearest Hewlett-Packard office. Keep the shipping materials for inspection by the carrier. The HP office will arrange for repair or replacement without awaiting settlement.

---

### Power Requirements



#### Caution



**BEFORE APPLYING AC LINE POWER TO THE HP 8110A, ensure that the correct line fuse is installed in the fuse holder and the correct power cable is fitted.**

---

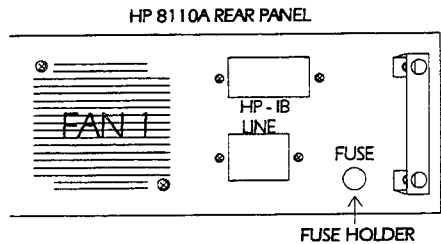
The HP 8110A can operate from any single-phase AC power source supplying 100 – 240 V in the frequency range from 50 to 60 Hz , or 100 – 120 V at 400 Hz. The maximum power consumption is 300 VA with all options installed.

**Table 1-1. Line Voltage and Fuse Selection**

| Line Voltage | Fuse Type   | HP Part Number |
|--------------|-------------|----------------|
| 100 – 240 V~ | T 3A, 250 V | 2110-0029      |

**Replacing the Fuse**

1. Remove the power cord.
2. Unscrew the fuse-holder at the rear of the instrument beside the power-inlet socket:



**Figure 1-1. Position of fuse-holder**

3. Replace the fuse with the equivalent part (See Table 1-1).
4. Refit the fuse-holder.

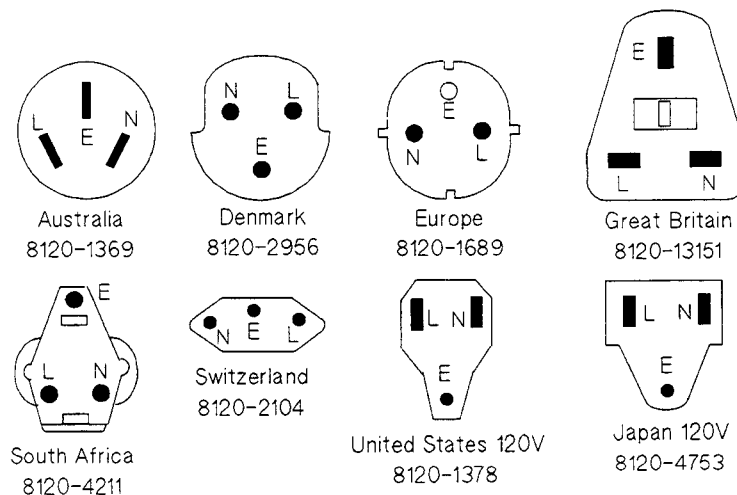
**Power Cable**

In accordance with international safety standards, this instrument is equipped with a three-wire power cable. When connected to an appropriate AC power receptacle, this cable grounds the instrument cabinet. The type of power cable shipped with each instrument depends on the country of destination. Refer to Figure 1-2 for the part numbers of the power cables available.

**Warning**



**To avoid the possibility of injury or death, the precautionary Warnings given on the inside front-cover of the manual must be followed before the instrument is switched on.**



**Figure 1-2. Power Cables - Plug Identification**

The following work should be carried out by a qualified electrician - all local electrical codes being strictly observed. If the plug on the cable does not fit the power outlet, or the cable is to be attached to a terminal block, cut the cable at the plug end and re-wire it.

The color coding used in the cable will depend on the cable supplied. If a new plug is to be connected, it must meet local safety requirements and include the following features:

- Adequate load-carrying capacity (see table of specifications).
- Ground connection.
- Cable clamp.

---

## **Ventilation Requirements**

The HP 8110A is fitted with two cooling fans. Make sure that there is adequate clearance of 3 inches (75 mm) at the rear and 1/2 inch (12 mm) at the top and bottom to ensure adequate airflow. If the airflow is restricted the internal operating temperature will be higher, reducing the instrument's reliability or causing the instrument's thermal-protection circuits to automatically switch off the instrument.

## **Thermal Protection**

### **Overheating Detection**

The HP 8110A monitors its internal temperature in the region of the power supply. If the temperature exceeds approximately 80°C, the power supply is switched off. The instrument will switch on again if the temperature falls below approximately 77°C.

### **Fan Failure**

If either of the fans is prevented from operating by a blockage, or the power supply to the fans is interrupted, the power supply is automatically switched off within 3 to 4 seconds. Note that after the fault condition has been fixed, the instrument must remain switched off for at least 2 minutes to allow the detection circuit to recover.



## Battery

### Warning



**This instrument contains a lithium battery. The battery is not user-replacable and replacement should only be carried out by qualified service personnel.**

**There is a danger of explosion if the battery is incorrectly replaced.**

---

The battery must be replaced with the same or equivalent type (HP Part No. 1420-0394). Discard used batteries according to local regulations.

---

## Rack Mounting Accessories

**Table 1-2. Rack Mounting Accessories**

| <b>Item</b>               | <b>HP Part Number</b> |
|---------------------------|-----------------------|
| Handle Kit                | 5062-3988             |
| Rack Mount Kit            | 5062-3974             |
| Rack Mount and Handle Kit | 5062-3975             |
| Rack Slide Kit            | 1434-0060             |

## Installing Upgrades



*ATTENTION! STATIC SENSITIVE DEVICES: You must perform upgrades only in Static Safe work areas.*

These instructions cover the installation of:

**Table 1-3.**

| Module    | Description              |
|-----------|--------------------------|
| HP 81103A | 10 V/2 ns Output Channel |
| HP 81106A | PLL/External Clock       |
| HP 81107A | Multichannel Deskew      |

## Contents of Your Upgrade Module(s)

If any items are missing contact your local Hewlett - Packard sales office.

### 10 V/2 ns Output Channel

**Table 1-4.**

| Item                           | Part Number   | Quantity |
|--------------------------------|---------------|----------|
| 10 V/2 ns Output Channel Board | 81103 - 66506 | 1        |
| Hex. Stand-off                 | 0380 - 1965   | 3        |
| Screw, M3 x 6                  | 0515 - 0886   | 3        |

### PLL/External Clock

**Table 1-5.**

| Item                          | Part Number   | Quantity |
|-------------------------------|---------------|----------|
| PLL/External Clock Board      | 81106 - 66515 | 1        |
| Cable Assy PLL/External Clock | 08110 - 61613 | 1        |
| Screw, M3 x 6                 | 0515 - 0886   | 4        |
| Nut, hex                      | 2950 - 0035   | 1        |
| Washer, lock                  | 2190 - 0383   | 1        |
| Washer, lock                  | 2190 - 0102   | 1        |

**Multichannel Deskew**

**Table 1-6.**

| Item                      | Part Number   | Quantity |
|---------------------------|---------------|----------|
| Multichannel Deskew Board | 81107 - 66525 | 1        |
| Screw, M3 x 6             | 0515 - 0886   | 2        |

---

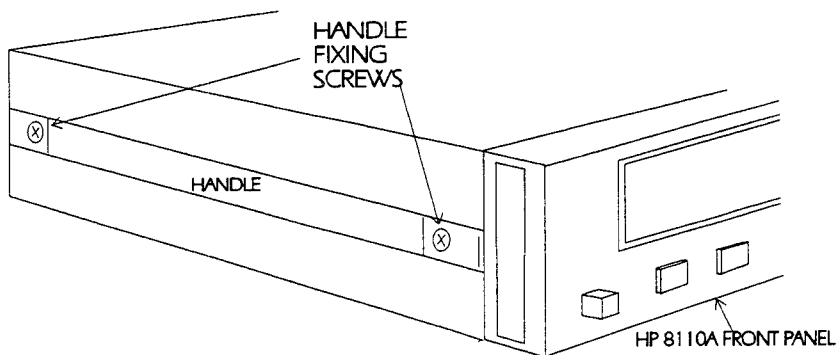
**The Tools You Need**

The following tools enable all fixings to be removed and replaced:

- Medium cruciform screwdriver (case handles, etc)
- Small cruciform screwdriver (PC boards, etc)
- 6mm diameter nut driver (stand-off pillars supporting Output board 2)
- 9/16 inch (0.564) diameter nut driver (BNC, hex nut).

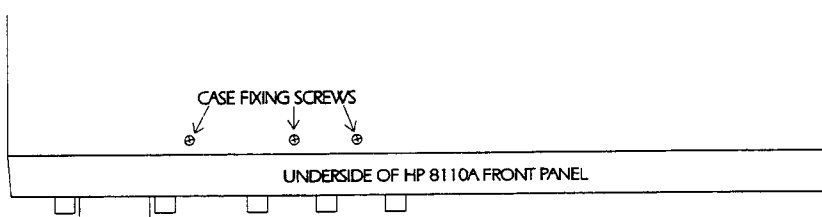
## Removing the Instrument Case

1. Remove the carrying handles from the case by removing 2 screws from each side of the case. Both sides have the same fixings:



**Figure 1-3. Removing the Carrying Handles**

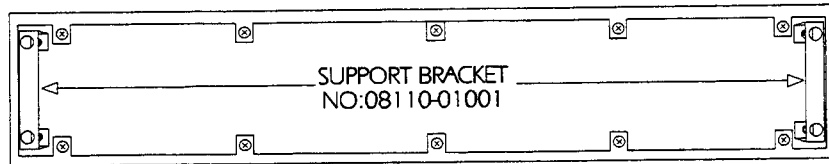
2. Remove the 3 screws securing the underside of the case to the chassis. Figure 1-4 shows their position behind the front panel the front panel:



**Figure 1-4.  
Underside View of Front Panel Showing Case Fixing Screws**

3. Remove the 10 screws securing the instrument case to the rear panel:





**Figure 1-5. Rear Panel Showing Case Fixing Screws**

4. Stand the instrument on the rear support brackets (shown in Figure 1-5) and slide the case back from the front panel by a firm movement
5. Lay the instrument on the workbench and completely remove the case by sliding it back over the chassis away from the front panel, or by pulling the chassis from the case.

## Inside the HP 8110A

Take a look at the following figure. It shows the top view of an instrument with the case removed, with a full complement of PC boards.

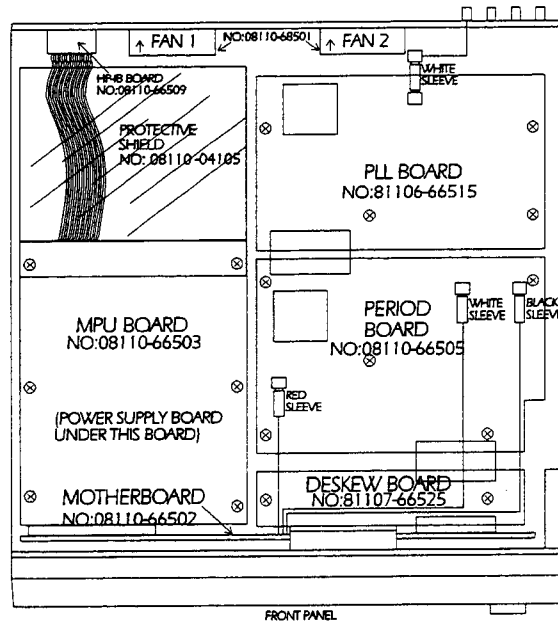


Figure 1-6. Top View of HP 8110A

This is an underside view of the instrument:

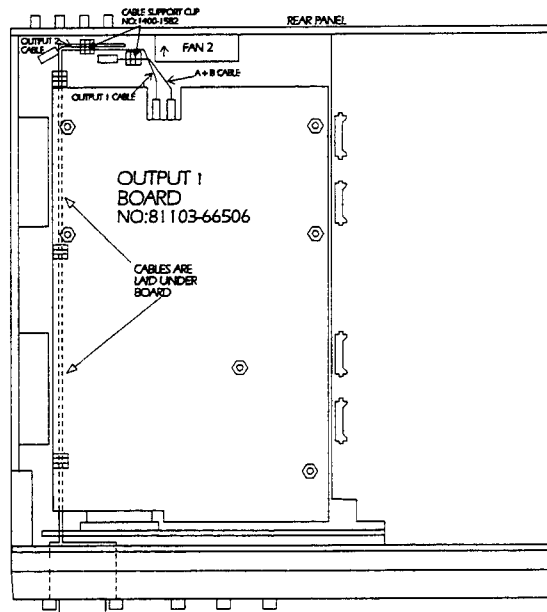


Figure 1-7. Underside View of HP 8110A

## Installing the 10 V/2 ns Output Channel (HP 81103A)

1. Replace the 3 screws securing Output Board 1, by the 3 hex. standoffs that you received with the second channel kit
2. Fit Output Board 2 onto its supports: lay the board on the standoffs close to the rear, then slide it into its supports and into the connector on the Motherboard
3. Secure the second output board using the 3 screws that you removed from Output Board 1, plus the 3 screws that you received with the second channel kit
4. Connect the short A+B cable to the connector marked **A+B**
5. Connect the output 2 cable to the connector marked **OUTPUT**  
Note that both of these cables are already fitted in the standard instrument
6. If there are no other boards to be installed, refit the instrument case
7. Perform a complete performance verification test on the upgraded unit.

---

## Installing the PLL/External Clock (HP 81106A)

1. Remove the plug from the **PLL Rev In/Clock In** hole on the rear panel of the HP 8110A
2. Place the larger-diameter washer on the BNC connector of the cable that you received with the second channel kit
3. Put the BNC connector through the hole in the rear panel, from the inside, making sure that the flat keyway on the BNC connector matches the flat keyway in the hole
4. Place the smaller-diameter washer on the BNC connector
5. Secure the BNC connector to the rear panel, using the hex. nut
6. Carefully slide the connector on the PLL/Clock board into the connector on the Period Board
7. Secure the PLL/Clock Board using the 4 screws
8. Connect the PLL/Clock In cable to the PLL/Clock Board connector marked **PLL REF/CLOCK IN**
9. If there are no other boards to be installed, refit the instrument case
10. Perform a complete performance verification test on the upgraded unit.

---

## Installing the Multichannel Deskew (HP 81107A)

There are two possibilities:

1. The unit is equipped with a Period Board only
2. The unit is equipped with a Period Board and a PLL/Clock Board.

In either situation:

1. Remove the PC Board securing screws:
  - a. Period Board - 5 screws
  - b. PLL/Clock Board - 4 screws
2. Slide the Period Board, or the connected Period and PLL/Clock In boards from the Motherboard connector
3. Carefully connect the Deskew Board to the connector from which you removed the Period Board
4. Carefully connect the joined Deskew, Period, and PLL/Clock In boards, to the Motherboard connector
5. Secure each board with screws:
  - a. Deskew Board - 2 screws
  - b. Period Board - 5 screws
  - c. PLL/Clock Board - 4 screws
6. If there are no other boards to be installed, refit the instrument case
7. Perform a complete performance verification test on the upgraded unit.

## How to Make a Firmware Update for HP 8110A

**Supported Hardware** HP 8110A serial number 3233Gxxxxx and higher

- Procedure**
1. Switch off the HP 8110A
  2. Put the Memory Card in the slot at the right-hand side of the front panel with the arrow on the card at the same side as the arrow on the front panel (the card will not fit if inserted the wrong way round)
  3. Simultaneously, press digit keys **1** and **3** with your right hand
  4. While holding both keys down, switch HP 8110A ON
  5. When  
    HP8110A Selftest  
    appears on the display in very large letters, release the keys
  6. After some seconds the message:  
    HP8110 Boot Program...  
    appears
  7. If the message does not appear, make sure that the Memory Card is inserted securely and that both keys are pressed WHILE you switch the instrument ON.  
    Now repeat the above steps 1 - 5
  8. If you get the message:  
    Firmware is not newer  
    then an update is unnecessary: Press the **NO** softkey
  9. You may get a message like:  
    There is 1 board unknown. Load anyway.  
    Press the **YES** softkey.  
    The EPROMs are now erased and re-loaded:
    - The first EPROMS will now be erased and this message is displayed:  
        Erase U6 and U7; please wait.
    - After one or two minutes you will hear a short beep and the next EPROMs will be erased:  
        Erase U8 and U9; please wait.
    - After another one or two minutes, you will hear a short beep and the final EPROMs will be erased:

Erase U41 and U42; please wait.

- After the next beep the following message is displayed:

Program all Flash Eeproms; please wait.

- After the final beep you get the message:

Loading Finished

- Ignore the message:

Reboot in 2 minutes

10. Switch OFF the HP 8110A
11. Extract the Memory Card containing the new firmware
12. Switch ON the HP 8110A
13. The power-on display will now show the new firmware revision and date

## Operating Environment

|                        |                        |
|------------------------|------------------------|
| Storage Temperature:   | -40°C to +70°C         |
| Operating Temperature: | 0°C to 55°C            |
| Humidity:              | 95% R.H. (0°C to 40°C) |

### Warning



- **The HP 8110A is not designed for outdoor use. Do not expose the HP 8110A to rain or other excessive moisture. Protect the HP 8110A from humidity and temperature changes which could cause condensation within the instrument.**
- **Do not operate the HP 8110A in the presence of flammable gases, fumes or powders. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.**



## Specifications

---

Specifications describe the instrument's warranted performance. Non-warranted values are described as typical. All specifications apply after a 30 minute warm-up phase with 50 Ohm source, a 50 Ohm load resistance and separate channels. They are valid from 0°C to 55°C ambient temperature.

---

### General

#### Environmental

|                        |   |
|------------------------|---|
| Operating temperature: | 0°C to +55°C                            |
| Storage temperature:   | -40°C to +70°C                          |
| Humidity:              | 95% r.h. up to 40°C ambient temperature |
| EMC:                   | conforms to EN50082-1, EN55011, Class A |
| Battery:               | Lithium (Panasonic CR2477-1HF)          |

**Safety** IEC1010, CSA1010

**Power requirements** 100-240 Vac,  $\pm 10\%$ , 50-60 Hz;  
 100-120 Vac,  $\pm 10\%$ , 400 Hz  
 Power consumption: 300 VA max.

#### Maximum Dimensions (H x W x D)

89 mm x 426 mm x 445 mm  
 (3.5 in x 17.0 in x 17.5 in)

#### Weight

##### Net

8.5 kg (18.7 lb) Single Channel  
 9.2 kg (20.2 lb) Dual Channel

##### Shipping

13.8 kg (30.3 lb) Dual Channel



## HP 8110A Service Guide

**Recalibration period** 1 year recommended

**Warranty** 3 years standard

## Acoustic Noise Emission

**Acoustic Noise Emission**  
For ambient temperature up to 30°C,  
under normal operation and at the typical  
operator position:

LpA = 46 dB

Measured in accordance with  
ISO 7779/EN 27779.

**Geräuschemissionswerte**  
Bei einer Umgebungstemperatur bis 30°C

LpA = 46 dB

am Arbeitsplatz, normaler Betrieb.

Angabe ist das Ergebnis einer Typprüfung  
nach ISO 7779/EN 27779.

## Declaration of Conformity

**Manufacturer:** Hewlett-Packard GmbH  
Böblingen Instruments Division  
Herrenberger Str. 130  
71034 Böblingen Germany

### We declare that the product

**HP 8110A 150 MHz Pulse Generator** conforms to the following standards:

**Safety:** IEC 1010- (1990)

**EMC:** EN 55011 (1991)/CISPR 11 Group 1, Class A

EN 50082-1 (1991)

IEC 801-2 ESD: 4kV cd, 8kV ad

IEC 801-3 Radiated Immunity: 3V/m

IEC 801-4 Fast Transients: 0.5kV, 1kV

### Supplementary Information

During the measurement against EN 55011, the I/O ports were terminated with their normal impedance, the HP-IB connector was terminated with the cable HP 10833B. When the product is connected to other devices, the user must ensure that the connecting cables and the other devices are adequately shielded to prevent radiation.

Böblingen 19th April 1993

Robert Hofgärtner  
Quality Assurance Manager

## HP 8110A 150 MHz Pulse Generator Mainframe

### Timing

#### Period

Period can also be entered as frequency.

|                         | Period                                 |
|-------------------------|--|
| <b>Range:</b>           | 6.65 ns to 999 ms                      |
| <b>Resolution:</b>      | 3 digits, 10 ps best case <sup>1</sup> |
| <b>Accuracy:</b>        | $\pm 5\% \pm 100 \text{ ps}^1$         |
| <b>RMS-jitter:</b>      | $0.03\% + 25 \text{ ps}^2$             |
| <b>Frequency range:</b> | 1.00 Hz to 150 MHz                     |

<sup>1</sup> This specification is improved if the HP 81106A PLL/External Clock module is fitted, see "HP 81106A PLL/External Clock for the HP 8110A"

<sup>2</sup> 0.05%+25 ps for 50–100 ns

### Configuration

The HP 8110A mainframe can be configured with the following modules:

| Module    | Description              | Minimum | Maximum |
|-----------|--------------------------|---------|---------|
| HP 81103A | 10 V/2 ns Output Channel | 1       | 2       |
| HP 81106A | PLL/External Clock       | 0       | 1       |
| HP 81107A | Multichannel Deskew      | 0       | 1       |

### Channel Addition

With two output channels fitted, 2-, 3- and 4-level complex signals can be generated by adding channel 2 to channel 1 at the OUTPUT 1 connector. OUTPUT 2 is disabled.

### Output Modes

#### Pulses Mode

The output signal consists of single or double pulses, controlled by the Trigger mode.

#### Burst Mode

The output signal consists of bursts of single or double pulses, controlled by the Trigger mode.

|                     |                         |
|---------------------|-------------------------|
| <b>Burst count:</b> | 2 to 65536              |
| <b>Format:</b>      | single or double pulses |

**Pattern Mode**

The output signal consists of patterns of RZ or NRZ pulses, controlled by the Trigger mode.

|                        |  |
|------------------------|--|
| <b>Pattern length:</b> | 4096 bits/channel including STROBE OUT |
| <b>Format:</b>         | RZ (return-to-zero)                    |
|                        | NRZ (non-return-to-zero)               |
|                        | DNRZ (delayed non-return-to-zero)      |
| <b>Random pattern:</b> | PRBS $2^n - 1$ , $n=7,8,9,10,11,12$    |
|                        | CCITT 0.151 standard                   |

**Trigger Modes**

**Continuous**

Generate continuous pulses, double pulses, bursts or patterns.

**Triggered**

Each active input transition (rising, falling or both) triggers a single or double pulse, a burst or a pattern.

The trigger source can be selected from:

- External Input
- **(MAN)** Manual Trigger key
- PLL, if HP 81106A PLL/External Clock is fitted. The first pulse is undistorted.

**Gated**

The active input level (high or low) enables pulses, double pulses, bursts or patterns. The last pulse, double pulse, burst or pattern is always completed. The gate source can be selected from:

- External Input
- **(MAN)** Manual Trigger key

**External Width**

The period and width of an External Input signal are maintained, levels, delay and transitions can be set.

|                           |         |
|---------------------------|---------|
| <b>Maximum Frequency:</b> | 100 MHz |
|---------------------------|---------|

**External Input**



|                        |                               |
|------------------------|-------------------------------|
| Input impedance:       | 50Ω or 10kΩ selectable        |
| Threshold:             | -10 V to +10 V                |
| Maximum input voltage: | ±15 V                         |
| Input transitions:     | <100 ns                       |
| Input frequency:       | dc to 150 MHz                 |
| Minimum pulse width:   | 3.3 ns                        |
| Input sensitivity:     | ≤300 mV <sub>pp</sub> typical |

**Strobe Output**



|                           |                                |
|---------------------------|--------------------------------|
| Level:                    | TTL or ECL selectable          |
| Output impedance:         | 50 Ohm typical                 |
| Maximum external voltage: | -2 V/+7 V                      |
| Transition times:         | 2 ns typical                   |
| Pattern:                  | 4096 bits NRZ in pattern mode. |

**Typical Delay from EXT INPUT**

| Pulse Mode | Period Source        |                                |
|------------|----------------------|--------------------------------|
|            | Internal Osc         | PLL or CLK IN                  |
| PULSES     | No STROBE OUT signal |                                |
| BURST      | 16.5 ns              | 16.5 ns + (1 < n ≤ 2) × period |
| PATTERN    | 18.5 ns              | 18.5 ns + (1 < n ≤ 2) × period |

**Trigger Output**



|                           |                         |
|---------------------------|-------------------------|
| Level:                    | TTL or ECL selectable   |
| Output impedance:         | 50 Ohm typical          |
| Trigger pulse width:      | typically 50% of period |
| Maximum external voltage: | -2 V/+7 V               |
| Transition times:         | 2 ns typical            |

**Typical Delay from EXT INPUT**

| Pulse Mode | Period Source |                                |
|------------|---------------|--------------------------------|
|            | Internal Osc  | PLL or CLK IN                  |
| PULSES     | 18.5 ns       | 18.5 ns + (1 < n ≤ 2) × period |
| BURST      | 18.5 ns       | 18.5 ns + (1 < n ≤ 2) × period |
| PATTERN    | 18.5 ns       | 18.5 ns + (1 < n ≤ 2) × period |

**Human Interface**

**Overprogramming**

Parameter values can be entered exceeding the specified range.

**Warnings and Errors**

Warning messages indicate potentially conflicting parameters due to accuracy tolerances.

Error messages indicate conflicting parameters.

**HELP key**

Displays a context-sensitive message about the selected parameter. Concept help for getting started is also available. If warnings or errors occur, the **HELP** key displays the warning/error list accordingly.

**Memory**

**Non-volatile memory**

Actual setting is saved on power-down. 9 user and 1 default setting are also stored in instrument.

**Memory-card**

40 settings can be stored per 128 kB (MS-DOS, PCMCIA). Also used for convenient firmware updates.

## HP 8110A Mainframe

**Remote Control** Operates according to IEEE standard 488.2, 1987 and SCPI 1992.0.  
**Function Code:** SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0.

### Programming times

(checks off and display off)

| Command                   | Typical execution time |
|---------------------------|------------------------|
| One parameter or mode     | 5 to 60 ms             |
| Timing                    | 8 to 20 ms             |
| Levels                    | 40 ms                  |
| Trigger modes             | 57 ms                  |
| Other modes               | 4 to 8 ms              |
| Recall Setting            | < 250 ms               |
| 4096 bit pattern update   | < 70 ms                |
| 4096 bit pattern transfer | < 1.7 s                |

## HP 81103A 10 V/2 ns Output Channel for the HP 8110A

One or two output channels can be installed in one HP 8110A mainframe. The second output channel can be retrofitted without recalibration. All specifications apply for 50Ω source impedance with a 50Ω load.

### Timing Parameters

All timing parameters are measured at 50% of amplitude at fastest transitions in continuous mode with 50Ω source and load impedance.

#### Common specifications

|                |                              |
|----------------|------------------------------|
| Repeatability: | 4 times better than accuracy |
| Resolution:    | 3 digits, best case 10 ps    |
| RMS Jitter:    | 0.03% + 25 ps <sup>1</sup>   |

<sup>1</sup> 0.05%+25 ps for 50–100 ns

#### Width

Can be entered as absolute width, duty cycle or trailing-edge delay.

|             |                                |
|-------------|--------------------------------|
| Range:      | 3.30 ns to 999 ms <sup>1</sup> |
| Accuracy:   | ±5% ± 250 ps                   |
| Duty cycle: | 0.01% to 99.9%                 |

<sup>1</sup> Max. value: Period – 3.3 ns

#### Delay

Measured between trigger output and main output. Can be entered as absolute delay, phase<sup>o</sup> or % of period.

|                               |                                |
|-------------------------------|--------------------------------|
| Fixed delay from TRIGGER OUT: | 34.0 ns typical                |
| Additional variable range:    | 0.00 ns to 999 ms <sup>1</sup> |
| Accuracy:                     | ±5% ±1 ns                      |

<sup>1</sup> Maximum value: Period – 6.6 ns

#### Double Pulse Delay

Double Pulse Delay and delay are mutually exclusive. Double Pulse Delay is the delay between the two pulses in Double Pulse mode.

|                           |                                |
|---------------------------|--------------------------------|
| Double Pulse Delay range: | 6.65 ns to 999 ms <sup>1</sup> |
| Accuracy:                 | ±5% ±250 ps                    |
| Min. period:              | 13.3 ns (75 MHz)               |

<sup>1</sup> Max. value: Period – Width – 3.3 ns



## HP 81103A 10V/2 ns Output Channel

### Transition Times

Measured between 10% and 90% of amplitude. Can be entered as leading/trailing edge or % of width.

|                         |   |
|-------------------------|---|
| <b>Range:</b>           | 2.00 ns to 200 ms   |
| <b>Min. transition:</b> | < 2.0 ns for levels within $\pm 5$ V window<br>< 2.5 ns for all levels<br>1.4 ns typical for ECL levels (20% to 80% of amplitude) |
| <b>Accuracy:</b>        | $\pm 10\%$ $\pm 200$ ps   |
| <b>Linearity:</b>       | 3% typical for transitions >100 ns  |

Leading and trailing edges can be programmed independently within the following ranges (Maximum ratio 1:20):

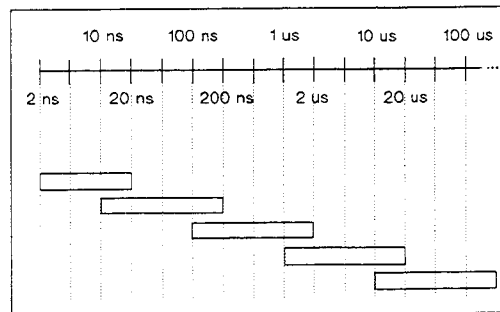


Figure 2-1. Leading/Trailing Edge ranges

### Outputs



|                                  |  |
|----------------------------------|--|
| <b>Source impedance:</b>         | selectable 50 $\Omega$ or 1k $\Omega$ $\pm 1\%$ typical<br>(48 $\Omega$ or 500 $\Omega$ with Added Channels) |
| <b>Maximum external voltage:</b> | $\pm 25$ V   |
| <b>Short circuit current:</b>    | $\pm 400$ mA max.  |
| <b>Normal/complement:</b>        | selectable   |
| <b>ON/OFF:</b>                   | relays connect/disconnect output (HiZ).  |
| <b>Limits:</b>                   | high and low levels can be limited to protect the DUT.   |
| <b>Dynamic Crosstalk</b>         | < 0.1% typical   |

### External Load compensation

For loads  $\neq 50\Omega$ , the actual load impedance can be entered to correct the output values into a static load.

**Level Parameters**

Level parameters can be entered as voltage or current, as high/low-level or offset/amplitude in terms of voltage or current.

|                 | Voltage(50Ω into 50Ω) <sup>1</sup> | Current (1kΩ into short) |
|-----------------|------------------------------------|--------------------------|
| Amplitude:      | 100 mV to 10.0 V                   | 4mA to 400 mA            |
| High-level      | -9.90 V to +10.0 V                 | -396 mA to +400 mA       |
| Low-level       | -10.0 V to +9.90 V                 | -400 mA to +396 mA       |
| Level Accuracy: | ±(1% Amplitude + 50 mV)            | -                        |
| Resolution:     | 10 mV                              | 1 mA                     |

1 Voltages double into open circuit

**Table 2-1. Typical Influence of Source Impedance on Timing and Levels**

|        | Source Impedance        | Seperate Channels    |                     | Channels Added at OUTPUT 1 |             |                    |          |
|--------|-------------------------|----------------------|---------------------|----------------------------|-------------|--------------------|----------|
|        |                         | 50 Ω                 | 1 kΩ                | 48 Ω                       | 500 Ω       | OUTPUT 1           | OUTPUT 2 |
|        | Accuracy                | ±1% typical          | ±1% typical         | ±1% typical                | ±1% typical | OUTPUT 1           | OUTPUT 2 |
| Levels | Voltage<br>(50Ω Load)   | (Doubles into open)  |                     |                            |             |                    |          |
|        | Amplitude               | 100 mV to 10.0 V     | 200 mV to 19.0 V    | 0 V to 19.5 V <sup>1</sup> |             | 0 V to 20.0 V      |          |
|        | High-level              | -9.90 V to +10.0 V   | -18.8 V to +19.0 V  | -19.3 V to +19.5 V         |             | -20.0 V to +20.0 V |          |
|        | Low-level               | -10.0 V to +9.90 V   | -19.0 V to +18.8 V  | -19.5 V to +19.3 V         |             | -20.0 V to +20.0 V |          |
|        | Accuracy                | ±(1% Ampl.+ 50 mV)   | ±(1% Ampl.+ 100 mV) | -                          |             | -                  |          |
|        | Resolution              | 10 mV                | 20 mV               | 10 mV                      |             | 20 mV              |          |
|        | Current<br>(into short) |                      |                     |                            |             |                    |          |
|        | Amplitude               | -                    | +4 mA to +400 mA    | -                          |             | 0 mA to +800 mA    |          |
|        | High-level              | -                    | -396 mA to +400 mA  | -                          |             | -792 mA to +800 mA |          |
|        | Low-level               | -                    | -400 mA to +396 mA  | -                          |             | -800 mA to +792 mA |          |
| Timing | Min.Transitions         | 2.0 ns (within ±5 V) |                     |                            |             |                    |          |
|        |                         | 2.5 ns               | 7.5 ns              | 2.5 ns                     | 7.5 ns      | 30 ns              | 30 ns    |
|        | Min.Period              | 6.65 ns              | 24 ns               | 24 ns                      |             | 90 ns              |          |
|        | Min.Width               | 3.3 ns               | 12 ns               | 3.5 ns                     | 12 ns       | 45 ns              | 45 ns    |
|        | Delay Accuracy          | ±(5% + 1 ns)         | -                   | -                          |             | -                  |          |
|        | Add.Fixed delay         | 0                    | -                   | -                          |             | +0.6 ns            | +0.6 ns  |

1 See Figure 2-2, Highest and lowest level combinations.

**Pulse Performance**

**Overshoot/Preshoot, Ringing:**

|                              |                        |
|------------------------------|------------------------|
| Overshoot/Preshoot, Ringing: | ±5% of amplitude ±20mV |
| Settling time:               | 30 ns typical          |

Channel Addition from 48Ω into 50Ω

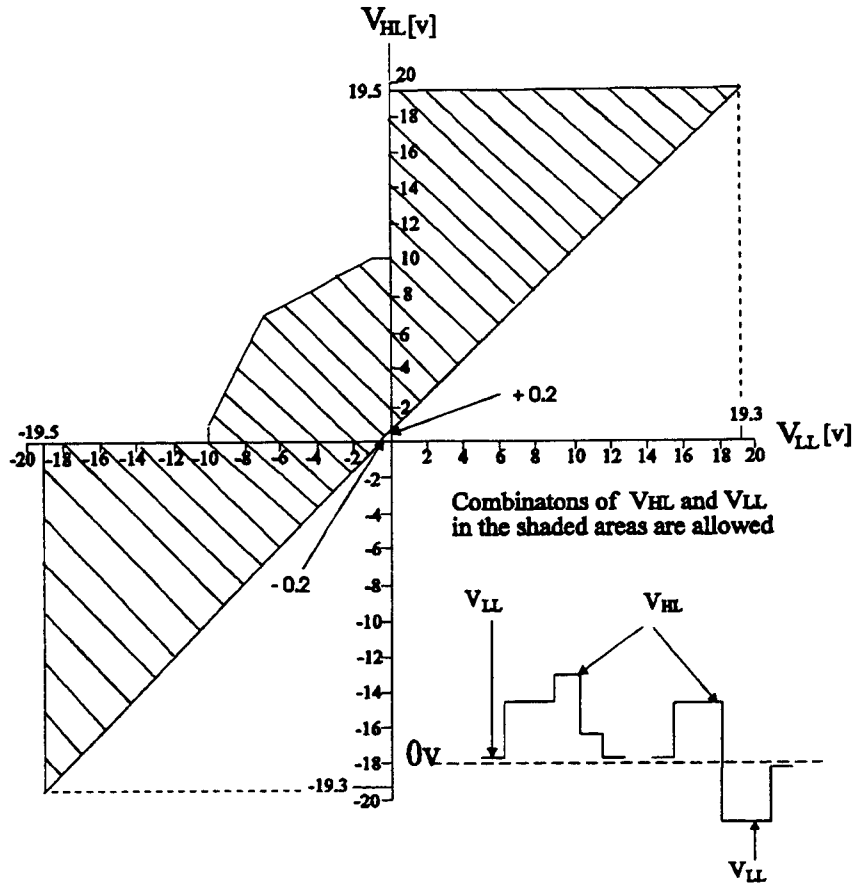


Figure 2-2. Highest and lowest level combinations

$V_{HL}$  = highest level of output signal.

$V_{LL}$  = lowest level of output signal.

$$V_{PP} = V_{HL} - V_{LL}$$

$V_{PP}$  = amplitude of output signal.

Minimum  $V_{PP} = -0.2V$ .

## HP 81106A PLL/External Clock for the HP 8110A

The PLL/External Clock module can be retrofitted without recalibration.

### Clock Input/ PLL Reference Input

|                        |                        |
|------------------------|------------------------|
| Input impedance:       | 50Ω or 10kΩ selectable |
| Threshold:             | -10 V to +10 V         |
| Maximum input voltage: | ±15 V                  |
| Input transitions:     | <100 ns                |
| Input Frequency:       | dc to 150 MHz          |
| Minimum pulse width:   | 3.3 ns                 |
| Input sensitivity:     | <300 mVpp typical      |
| Delay to TRIGGER OUT:  | 22 ns typical          |

Rear panel BNC connector used as:

- External system clock input : pulse frequency = input frequency
- or 5 MHz or 10 MHz frequency reference input for internal PLL.

The input frequency can be measured.

### Phase Locked Loop

- Locks either to an external frequency reference at the Clock/PLL Ref Input (5 MHz or 10 MHz selectable) or to its internal reference.
- High accuracy period (frequency) source. When locked to the internal reference, period accuracy, range, resolution, and jitter are improved:

|                    |                           |
|--------------------|---------------------------|
| Period Accuracy:   | ±0.1%                     |
| Period Range:      | 6.65 ns to 999 s          |
| Period Resolution: | 4 digits, best case 10 ps |
| Period RMS-jitter: | 0.003% +20 ps             |
| Period Stability:  | ±50 ppm/year typical      |

When locked to an external frequency reference, the external frequency affects these accuracies.

- Internal triggering of bursts and patterns: the internal PLL can replace an external trigger source, while the output period is determined by the normal internal oscillator.

## HP 81106A PLL/External Clock Module

- External Clock**
- The output period is determined by signal at clock input. Frequency accuracy can be increased by using a precise external clock.
  - Trigger synchronously to external clock: the output period is synchronous to the signal at clock input. The signal at the External Input is used for arming.

## HP 81107A Multichannel Deskew for the HP 8110A

Supports up to two output channels. The multichannel deskew can be used for two applications:

- Multichannel calibration: When using up to four HP 8110As synchronously (Maximum 8 channels), compensate for the delay between EXT INPUT and main outputs.
- Delay calibration: compensate for measurement system delays e.g. caused by cable delays or pre-trigger delays of oscilloscopes.

|                         |                |
|-------------------------|----------------|
| Variable range:         | 0 ns to 28 ns  |
| Resolution:             | 10 ps          |
| Additional fixed delay: | 6.5 ns typical |



## Testing the HP 8110A

---

### Introduction

Use the tests in this chapter if you want to check that the HP 8110A 150MHz Pulse Generator is working correctly. Before starting any testing allow all test equipment to warm up for at least 30 minutes.

### Conventions Used

When referring to actions that you perform during the tests, the following conventions are used:

**FUNCTION**

This indicates that a labelled button must be pressed

**TRG MODE**

This shows that a soft-key must be pressed. A soft-key is an unlabelled button whose label is shown on the display, and which can vary according to the job that the button is doing

**CONTINUOUS PULSES**

This is an option shown on the display, and is selected by use of the vernier keys. It is shown in upper or lower case to match the case displayed.

### Test Results Tables

Tables for entering the results of the tests are included at the end of this chapter. The tests are numbered and reference numbers for each Test Result (TR) are given in a small table at the end of each test. The reference number shows you where the actual results should be entered in the Test Results Tables.

The Test Results tables at the end of the chapter should be photocopied, and the Test Results entered on the copies. Then, if the tests need to be repeated, the tables can be copied again.

If Channel 2 has been fitted to your instrument, make an extra copy of the Test Results tables for entry of the results of tests on that channel. In this case, however, it is not necessary to repeat the Period tests, as these are common to both channels.



---

## Recommended Test Equipment and Accessories

The following tables list the recommended test equipment you need to perform all the tests in this chapter. You can use alternative instruments if they meet the critical specifications given. The test set-ups and procedures assume you are using the recommended equipment.

**Table 3-1. Recommended Test Equipment List**

| Test Equipment    | Model     | Critical Specifications                                  |
|-------------------|-----------|--|
| Oscilloscope      | HP 54121T | 20 GHz, 10 bit vertical resolution, Histogram capability |
| Counter           | HP 5334B  | Period and Time Interval measurements                    |
| Counter           | HP 5335A  | Frequency measurements > 150 MHz                         |
| Digital Voltmeter | HP 3458A  | DCV up to 20 V   |
| Pulse Generator   | HP 8112A  | 50 MHz   |
| Delay line        | HP 54008A | 22 ns  |

**Table 3-2. Recommended Accessories**

| Accessories                          | Model          | Critical Specifications   |
|--------------------------------------|----------------|---------------------------|
| Digitizing Oscilloscopes Accessories |                |                           |
| Attenuators                          | HP 33340C#020  | 20 dB                     |
|                                      | HP 33340C#006  | 6 dB                      |
| Power Splitter                       | HP 11667B      |                           |
| SMA/SMA (m-m) adaptor                | 1250-1159      |                           |
| SMA/BNC Adaptor                      | 1250-1700      |                           |
| SMA Cable                            | 8120-4948      |                           |
| 50 $\Omega$ Feedthrough Termination  | HP 10100C      | 2 W, 1%                   |
|                                      | See Figure 3-1 | 10 W, 0.1%                |
| Adapter                              | 1251-2277      | BNC to Banana             |
| Cable Assemblies, BNC                | 8120-1839      |                           |
| Torque Wrench                        | 8710-1582      | 5/16 in, 5 lb-in (56 Ncm) |

### Note



When you connect the test equipment for the first time, and whenever you change the setup during the course of these tests, use the 8710 - 1582 torque wrench to tighten and loosen SMA connectors. This will ensure that the connectors are at the correct tightness and give the best signal transfer.

---

## 50 Ohm, 0.1%, 10 W Feedthrough Termination

The following figure provides a schematic and a parts list except for the case. The case must provide shielding and maintain grounding integrity.

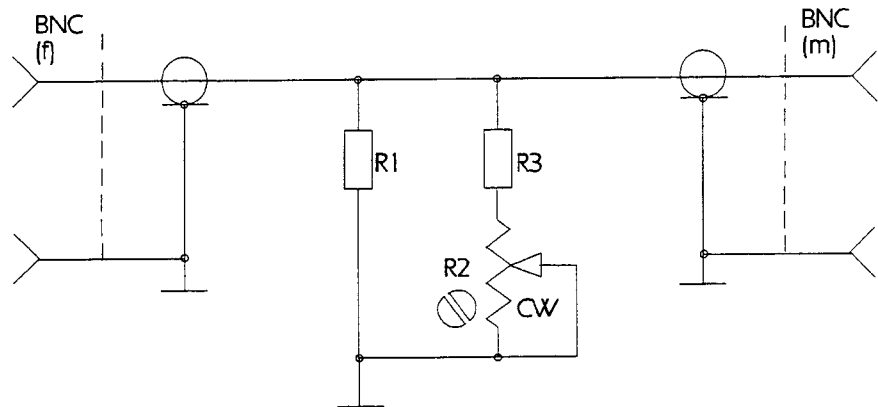


Figure 3-1. 50 Ohm, 0.1%, 10 W Feedthrough Termination

The following parts are required:

1. R1 = 53.6 $\Omega$ , 1%, 10 W; HP Part Number: 0699-0146.
2. R2 = 200  $\Omega$ , 10%, 0.5 W, Variable trimmer; HP Part Number: 2100-3350.
3. R3 = 681  $\Omega$ , 1%, 0.5 W; HP Part Number: 0757-0816.
4. BNC (M): HP Part Number: 1250-0045.
5. BNC (F): HP Part Number: 1250-0083.

---

## Getting Started

The HP 8110A is controlled by selecting options in a series of pages that are displayed on the instrument's screen. These options vary with the boards that are fitted in the instrument. When the HP 8110A is being tested, therefore, different situations can arise, depending on whether you have a standard instrument or one that has had additional boards fitted. The following examples illustrate this

## Typical Examples of Displayed Screens

Figure 3-2 shows the TRG MODE (Trigger Mode) screen of an instrument that has a full complement of PC boards, including a PLL Board and an Output 2 Board.

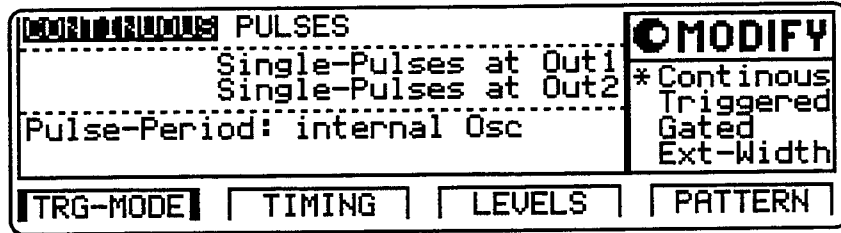


Figure 3-2. The TRG MODE Screen Display in a Fully Fitted HP 8110A

Figure 3-3 shows the TRG MODE screen of a standard instrument.

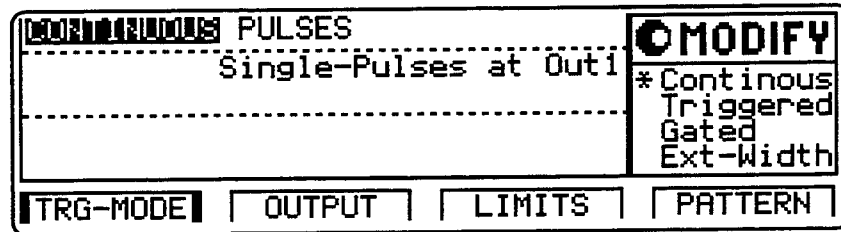


Figure 3-3. The TRG MODE Screen Display in a Standard HP 8110A

Figure 3-4 shows the TRG MODE screen of a fully-fitted instrument where manual triggering has been selected.

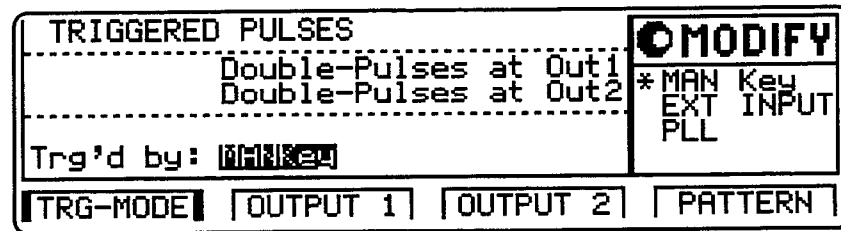
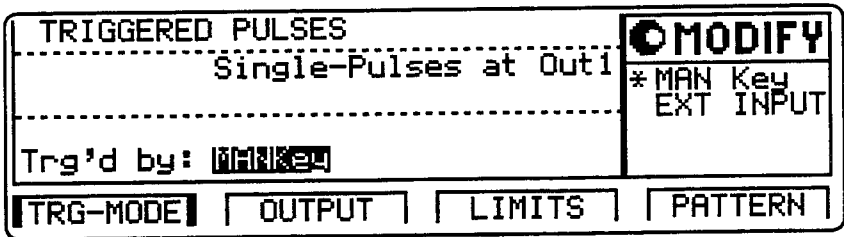


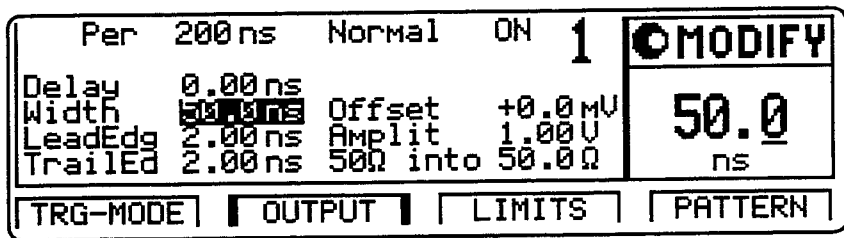
Figure 3-4.  
The TRG MODE Screen With Manual Triggering in a Fully-Fitted  
HP 8110A

Figure 3-5 shows the TRG MODE screen of a standard instrument where manual triggering has been selected.



**Figure 3-5.**  
**The TRG MODE Screen With Manual Triggering in a Standard HP 8110A**

Figure 3-6 shows the OUTPUT screen of a standard instrument.



**Figure 3-6. The Output Screen in a Standard HP 8110A**

## Instrument Serial Numbers

You will need to write the serial numbers of the instrument and its boards at the top of the Test Reports. These can be found as follows:

Press **HELP**, **MORE**, **SERIAL #**

The HP 8110A display lists the instrument's product and serial numbers.

The display on your instrument should look similar to this:

```

Prod.Nr. Serial Nr.
FRAME 8110A 3236G00153
CH1-Bd. 81103A 3233G00135
CH2-Bd. 81103A 3304G00216
PLL-Bd. 81106A 3237G00184
DSK-Bd. 81107A 3308G00173

```

The number given for the FRAME applies to the Mainframe, the Power Supply, the Microprocessor Board, and the Period Board. The serial number is available on the Period Board.

## Initial Setup of the HP 8110A

In the majority of these tests the initial setting up of the instrument is identical. Therefore, it is described once here, and then referred-to where appropriate. In cases where the initial setup differs, an illustration of the settings is shown.

Set up the HP 8110A as follows:

1. Select **TRG-MODE**
  - CONTINUOUS PULSES
  - Single-Pulses at Out 1 (plus Single-Pulses at Out 2, if second channel is installed)

If PLL (HP 81106A) is fitted, set:

- Pulse-Period: internal Osc
2. If a second output channel is installed, select **MORE** **CONFIG** screen and set up as follows:

|  |               |
|--|---------------|
| HP-IB Address: 22                                  | <b>MODIFY</b> |
| Perform Selftest: All                              | Tim/Lev       |
| <b>GROUP PARAMS</b> <b>OUT</b> <b>OUTPUT 1 / 2</b> | *Out 1/2      |
| PLL-Ref : Internal                                 |               |
| Deskew 1: 0.00 ns 2: 0.00 ns                       |               |
| LIMITS   | TRG-LEV       |
| MEMCARD  | CONFIG        |

Figure 3-7. **CONFIG** Screen, Parameters grouped by **OUTPUT**

### Note



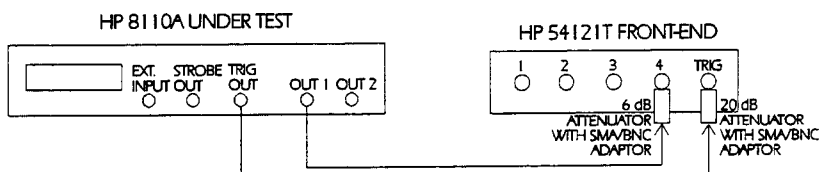
Set-ups are given in all the tests for **OUTPUT 1** and **OUTPUT 2**. If you are testing a single channel instrument set up the **OUTPUT** screen with the settings given for **OUTPUT 1**.

## Test 1: Period

|                            |            |  |
|----------------------------|------------|--|
| <b>Test Specifications</b> | Range      | 6.65 ns to 999 ms  |
|                            | Resolution | 3 digits, best case 10 ps                                  |
|                            | Accuracy   | $\pm 5\% \pm 100$ ps                                       |
|                            | RMS-Jitter | 0.03% + 25 ps (0.05% + 25 ps in the range 50 ns to 100 ns) |

|                         |  |
|-------------------------|--|
| <b>Equipment Needed</b> | Digitizing Oscilloscope with Accessories |
|                         | Counter                                  |
|                         | Cable, 50 $\Omega$ , coaxial, BNC        |

- Procedure** 1. Connect the HP 8110A to the digitizing oscilloscope as shown:



### Connecting the HP 8110A to the Scope

2. Set up the HP 8110A as described in "Initial Setup of the HP 8110A"

- On the HP 8110A press **MORE** and set up **OUTPUT 1** and **OUTPUT 2** pages as shown in the following illustrations:

|          |        |          |        |          |               |         |  |
|----------|--------|----------|--------|----------|---------------|---------|--|
| Per      | 6.65ns | Normal   | ON     | 1        | <b>MODIFY</b> |         |  |
| Delay    | 0.00ns |          |        |          | 6.65<br>ns    |         |  |
| DutyCyc  | 50.0%  | Offset   | +0.0mV |          |               |         |  |
| LeadEdg  | 2.00ns | Amplit   | 1.00V  |          |               |         |  |
| Trailed  | 2.00ns | 50Ω into | 50.0Ω  |          |               |         |  |
| TRG-MODE |        | OUTPUT 1 |        | OUTPUT 2 |               | PATTERN |  |

Configuring Output 1

|          |        |          |        |          |               |         |  |
|----------|--------|----------|--------|----------|---------------|---------|--|
| Per      | 6.65ns | Normal   | OFF    | 2        | <b>MODIFY</b> |         |  |
| Delay    | 0.00ns | Separate | Out2   |          | 6.65<br>ns    |         |  |
| DutyCyc  | 50.0%  | Offset   | +0.0mV |          |               |         |  |
| LeadEdg  | 2.00ns | Amplit   | 1.00V  |          |               |         |  |
| Trailed  | 2.00ns | 50Ω into | 50.0Ω  |          |               |         |  |
| TRG-MODE |        | OUTPUT 1 |        | OUTPUT 2 |               | PATTERN |  |

Configuring Output 2

**Note**



When you are testing instruments with 2 output channels it is necessary to:

- Configure *both* channels.
- Switch OFF the channel that is not being tested

If you then test the other channel:

- Switch ON the channel you are testing, and switch OFF the other channel.

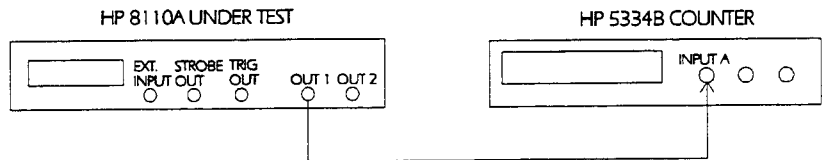
- Set the Digitizing Oscilloscope HP 54121T:
  - Press **AUTOSCALE**
  - Select the Display menu and set the Number of Averages to 32
  - Press **MORE** key
  - Press **MEASURE** key
  - Press **PERIOD** key

5. Check the HP 8110A pulse period at the following settings:

**Table 3-3. Period Settings and TR Reference**

| Oscilloscope Timebase | Period  | Acceptable Range        | TR entry |
|-----------------------|---------|-------------------------|----------|
| 1 ns/div              | 6.65 ns | 6.2175 ns to 7.0825 ns  | 1 - 1    |
| 2 ns/div              | 9.99 ns | 9.390 ns to 10.589 ns   | 1 - 2    |
| 2 ns/div              | 10.0 ns | 9.4 ns to 10.6 ns       | 1 - 3    |
| 10 ns/div             | 50.0 ns | 47.4 ns to 52.6 ns      | 1 - 4    |
| 20 ns/div             | 99.9 ns | 94.805 ns to 104.995 ns | 1 - 5    |

6. Connect the HP 8110A to the Counter as follows:



**Connecting HP 8110A to the Counter**

7. Set the Counter to:

FUNCTION    Period A  
 INPUT A    50 Ω  
 SENSE      On

8. Check the HP 8110A period at the following settings:

**Table 3-4. Period Settings and TR Reference**

| Period | Acceptable Range      | TR entry |
|--------|-----------------------|----------|
| 100 ns | 94.9 ns to 105.1 ns   | 1 - 6    |
| 500 ns | 474.9 ns to 525.1 ns  | 1 - 7    |
| 1 μs   | 949.9 ns to 1050.1 ns | 1 - 8    |
| 5 μs   | 4.75 μs to 5.25 μs    | 1 - 9    |
| 50 μs  | 47.5 μs to 52.5 μs    | 1 - 10   |
| 500 μs | 475 μs to 525 μs      | 1 - 11   |
| 5 ms   | 4.75 ms to 5.35 ms    | 1 - 12   |
| 50 ms  | 47.5 ms to 52.5 ms    | 1 - 13   |
| 500 ms | 475 ms to 525 ms      | 1 - 14   |



---

## Test 2: PLL Period

---

### Note



This test is only performed if HP 81106A is installed.

---

### Test Specifications

Range 6.65 ns to 999 second  
Resolution 4 digits, best case 10 ps  
Accuracy  $\pm 0.1\%$   
RMS-Jitter 0.003% + 20 ps

### Equipment Needed

Counter HP 5335A  
Cable, 50  $\Omega$ , coaxial, BNC

---

### Note

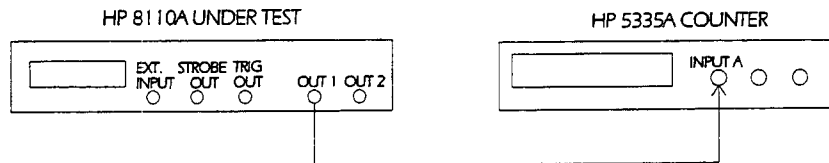


The HP 5335A counter is used in frequency mode to meet the MIL CAL A uncertainty requirements for TAR (Test Accuracy Ratio) > 4:1.

---

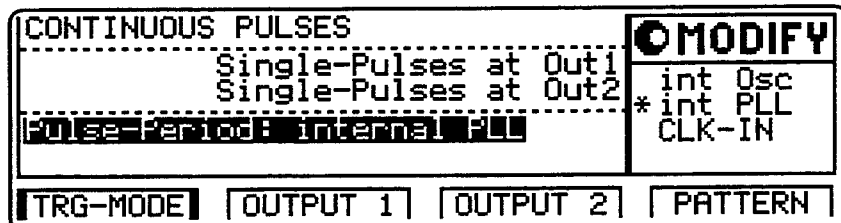
### Procedure

1. Connect the HP 8110A to the counter as follows:



#### Connecting HP 8110A to the Counter

2. Set up the HP 8110A as described in "Initial Setup of the HP 8110A"
3. Select the **TRG-MODE** screen on the HP 8110A and set up as follows:



#### The TRG MODE Screen Setup

4. On the HP 8110A set up **OUTPUT 1** and **OUTPUT 2** pages as shown in the following illustrations:

|  |                 |          |         |          |                    |          |                 |          |         |
|--|-----------------|----------|---------|----------|--------------------|----------|-----------------|----------|---------|
| Per  | <b>6.650 ns</b> | Normal   | ON      | <b>1</b> | <b>MODIFY</b>      |          |                 |          |         |
| Delay  | 0.00 ns         |          |         |          | <b>6.650</b><br>ns |          |                 |          |         |
| DutyCyc  | 50.0%           | Offset   | +0.0 mV |          |                    |          |                 |          |         |
| LeadEdg  | 2.00 ns         | Amplit   | 1.00 V  |          |                    |          |                 |          |         |
| TrailEd  | 2.00 ns         | 50Ω into | 50.0 Ω  |          |                    |          |                 |          |         |
| <table border="1"> <tr> <td>TRG-MODE</td> <td><b>OUTPUT 1</b></td> <td>OUTPUT 2</td> <td>PATTERN</td> </tr> </table> |                 |          |         |          |                    | TRG-MODE | <b>OUTPUT 1</b> | OUTPUT 2 | PATTERN |
| TRG-MODE   | <b>OUTPUT 1</b> | OUTPUT 2 | PATTERN |          |                    |          |                 |          |         |

Configuring Output Screen 1

|  |                 |                 |         |          |                    |          |          |                 |         |
|--|-----------------|-----------------|---------|----------|--------------------|----------|----------|-----------------|---------|
| Per  | <b>6.650 ns</b> | Normal          | OFF     | <b>2</b> | <b>MODIFY</b>      |          |          |                 |         |
| Delay  | 0.00 ns         | Separate        | Out2    |          | <b>6.650</b><br>ns |          |          |                 |         |
| DutyCyc  | 50.0%           | Offset          | +0.0 mV |          |                    |          |          |                 |         |
| LeadEdg  | 2.00 ns         | Amplit          | 1.00 V  |          |                    |          |          |                 |         |
| TrailEd  | 2.00 ns         | 50Ω into        | 50.0 Ω  |          |                    |          |          |                 |         |
| <table border="1"> <tr> <td>TRG-MODE</td> <td>OUTPUT 1</td> <td><b>OUTPUT 2</b></td> <td>PATTERN</td> </tr> </table> |                 |                 |         |          |                    | TRG-MODE | OUTPUT 1 | <b>OUTPUT 2</b> | PATTERN |
| TRG-MODE   | OUTPUT 1        | <b>OUTPUT 2</b> | PATTERN |          |                    |          |          |                 |         |

Configuring Output Screen 2

**Note**



When you are testing instruments with 2 output channels it is necessary to:

- a. Configure *both* channels.
- b. Switch OFF the channel that is not being tested

If you then test the other channel:

- c. Switch ON the channel you want to test, and switch OFF the other channel.

5. Set the Counter to:

|          |             |
|----------|-------------|
| FUNCTION | Frequency A |
| INPUT A  | 50 Ω        |
| SENSE    | On          |

6. Check the HP 8110A PLL pulse period at the following settings:

**Table 3-5. PLL Period Settings and TR Reference**

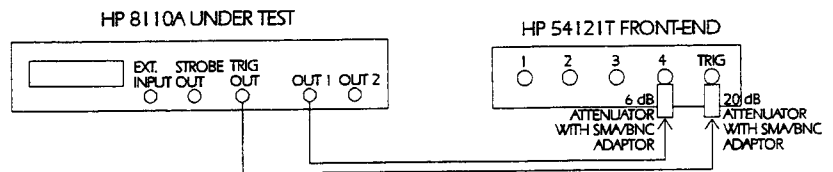
| Period      | Frequency    | Acceptable Range             | TR Entry |
|-------------|--------------|------------------------------|----------|
| 6.650 ns    | 150.3759 MHz | 150.2257 MHz to 150.5264 MHz | 2 - 1    |
| 9.999 ns    | 100.0100 MHz | 99.910 MHz to 100.110 MHz    | 2 - 2    |
| 10.00 ns    | 100 MHz      | 99.900 MHz to 100.100 MHz    | 2 - 3    |
| 50.00 ns    | 20 MHz       | 19.980 MHz to 20.020 MHz     | 2 - 4    |
| 99.99 ns    | 10.0010 MHz  | 9.991 MHz to 10.001 MHz      | 2 - 5    |
| 100 ns      | 10 MHz       | 9.990 MHz to 10.010 MHz      | 2 - 6    |
| 500 ns      | 2 MHz        | 1.998 MHz to 2.002 MHz       | 2 - 7    |
| 1 $\mu$ s   | 1 MHz        | 999 kHz to 1.001 MHz         | 2 - 8    |
| 5 $\mu$ s   | 200 kHz      | 199.800 kHz to 200.200 kHz   | 2 - 9    |
| 50 $\mu$ s  | 20 kHz       | 19.980 kHz to 20.020 kHz     | 2 - 10   |
| 500 $\mu$ s | 2 kHz        | 1.998 kHz to 2.002 kHz       | 2 - 11   |
| 5 ms        | 200 Hz       | 199.800 Hz to 200.200 Hz     | 2 - 12   |
| 50 ms       | 20 Hz        | 19.980 Hz to 20.020 Hz       | 2 - 13   |
| 500 ms      | 2 Hz         | 1.998 Hz to 2.002 Hz         | 2 - 14   |
| 5 s         | 0.2 Hz       | 0.1998 Hz to 0.2002 Hz       | 2 - 15   |

## Test 3: Width

|                            |            |  |
|----------------------------|------------|--|
| <b>Test Specifications</b> | Range      | 3.30 ns to 999 ms  |
|                            | Resolution | 3 digits, best case 10 ps                                  |
|                            | Accuracy   | $\pm 5\% \pm 250$ ps                                       |
|                            | RMS-Jitter | 0.03% + 25 ps (0.05% + 25 ps in the range 50 ns to 100 ns) |

|                         |  |
|-------------------------|--|
| <b>Equipment Needed</b> | Digitizing Oscilloscope with Accessories |
|                         | Counter                                  |
|                         | Cable, 50 $\Omega$ , coaxial, BNC        |

- Procedure** 1. Connect HP 8110A to the Scope as shown:



### Connecting HP 8110A to the Scope

2. Set up the HP 8110A as described in "Initial Setup of the HP 8110A"

3. On the HP 8110A press **MORE** and set up **OUTPUT 1** and **OUTPUT 2** pages as shown in the following illustrations:

|   |          |          |         |   |               |          |          |          |         |
|---|----------|----------|---------|---|---------------|----------|----------|----------|---------|
| Per   | 200 ns   | Normal   | ON      | 1 | <b>MODIFY</b> |          |          |          |         |
| Delay   | 0.00 ns  |          |         |   | 50.0<br>ns    |          |          |          |         |
| Width   | 50.0 ns  | Offset   | +0.0 mV |   |               |          |          |          |         |
| LeadEdg   | 2.00 ns  | Amplit   | 1.00 U  |   |               |          |          |          |         |
| TrailEd   | 2.00 ns  | 50Ω into | 50.0 Ω  |   |               |          |          |          |         |
| <table border="1"> <tr> <td>TRG-MODE</td> <td>OUTPUT 1</td> <td>OUTPUT 2</td> <td>PATTERN</td> </tr> </table> |          |          |         |   |               | TRG-MODE | OUTPUT 1 | OUTPUT 2 | PATTERN |
| TRG-MODE  | OUTPUT 1 | OUTPUT 2 | PATTERN |   |               |          |          |          |         |

Configuring Output Screen 1

|   |          |          |         |   |               |          |          |          |         |
|---|----------|----------|---------|---|---------------|----------|----------|----------|---------|
| Per   | 200 ns   | Normal   | OFF     | 2 | <b>MODIFY</b> |          |          |          |         |
| Delay   | 0.00 ns  | Separate | Out2    |   | 50.0<br>ns    |          |          |          |         |
| Width   | 50.0 ns  | Offset   | +0.0 mV |   |               |          |          |          |         |
| LeadEdg   | 2.00 ns  | Amplit   | 1.00 U  |   |               |          |          |          |         |
| TrailEd   | 2.00 ns  | 50Ω into | 50.0 Ω  |   |               |          |          |          |         |
| <table border="1"> <tr> <td>TRG-MODE</td> <td>OUTPUT 1</td> <td>OUTPUT 2</td> <td>PATTERN</td> </tr> </table> |          |          |         |   |               | TRG-MODE | OUTPUT 1 | OUTPUT 2 | PATTERN |
| TRG-MODE  | OUTPUT 1 | OUTPUT 2 | PATTERN |   |               |          |          |          |         |

Configuring Output Screen 2

**Note**



When you are testing instruments with 2 output channels it is necessary to:

- a. Configure *both* channels.
- b. Switch OFF the channel that is not being tested

If you then test the other channel:

- c. Switch ON the channel you are testing, and switch OFF the other channel.

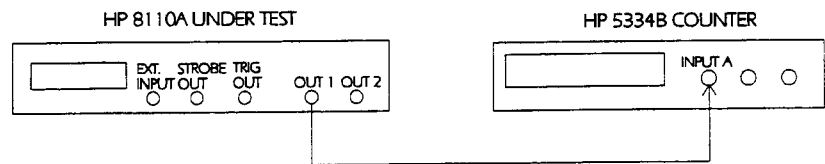
4. Set the Digitizing Oscilloscope HP 54121T:
  - Press **AUTOSCALE**
  - Select the Display menu and set the Number of Averages to 32
  - Select the delta V menu and turn the voltage markers On
  - Set the preset levels to 50% -50% and press **AUTO LEVEL SET**
  - Select the delta t menu and turn the time markers ON
  - Set START ON EDGE = POS 1 and STOP ON EDGE = NEG1
5. Change the oscilloscope timebase to 1 ns/div
6. Change the HP 8110A width to 3.3 ns
7. Center the pulse in the Scope display
8. Press the **PRECISE EDGE FIND** key for each new Width setting

9. Check the HP 8110A pulse width at the following settings:

**Table 3-6. Width Settings and TR Reference**

| Oscilloscope Timebase | Period    | Width   | Acceptable Range        | TR Entry |
|-----------------------|-----------|---------|-------------------------|----------|
| 1 ns/div              | 200 ns    | 3.30 ns | 2.885 ns to 3.715 ns    | 3 - 1    |
| 1 ns/div              | 200 ns    | 6.60 ns | 6.020 ns to 7.180 ns    | 3 - 2    |
| 2 ns/div              | 200 ns    | 9.99 ns | 9.240 ns to 10.739 ns   | 3 - 3    |
| 2 ns/div              | 200 ns    | 10.0 ns | 9.250 ns to 10.750 ns   | 3 - 4    |
| 10 ns/div             | 200 ns    | 50.0 ns | 47.25 ns to 52.75 ns    | 3 - 5    |
| 20 ns/div             | 200 ns    | 99.9 ns | 94.655 ns to 105.145 ns | 3 - 6    |
| 20 ns/div             | 1 $\mu$ s | 100 ns  | 94.75 ns to 105.25 ns   | 3 - 7    |
| 100 ns/div            | 1 $\mu$ s | 500 ns  | 474.75 ns to 525.25 ns  | 3 - 8    |

10. Connect the HP 8110A to the Counter as shown:



**Connecting HP 8110A to the Counter**

11. Set the Counter to:

|          |                              |
|----------|------------------------------|
| FUNCTION | TI A $\rightarrow$ B         |
| SENSE    | On                           |
| INPUT A  | 50 $\Omega$                  |
| COM A    | On                           |
| INPUT B  | 50 $\Omega$ , negative slope |

12. Check the HP 8110A width at the following settings:

**Table 3-7. Width Settings and TR Reference**

| Period      | Width       | Acceptable Range             | TR Entry |
|-------------|-------------|------------------------------|----------|
| 100 $\mu$ s | 1 $\mu$ s   | 949.75 ns to 1050.25 $\mu$ s | 3 - 9    |
| 100 $\mu$ s | 5 $\mu$ s   | 4.75 $\mu$ s to 5.25 $\mu$ s | 3 - 10   |
| 100 $\mu$ s | 50 $\mu$ s  | 47.5 $\mu$ s to 52.5 $\mu$ s | 3 - 11   |
| 10 ms       | 500 $\mu$ s | 475 $\mu$ s to 525 $\mu$ s   | 3 - 12   |
| 10 ms       | 5 ms        | 4.75 ms to 5.25 ms           | 3 - 13   |
| 999 ms      | 50 ms       | 47.5 ms to 52.5 ms           | 3 - 14   |
| 999 ms      | 500ms       | 475 ms to 525 ms             | 3 - 15   |

**Note**



Repeat the entire test for the second channel, if it is installed

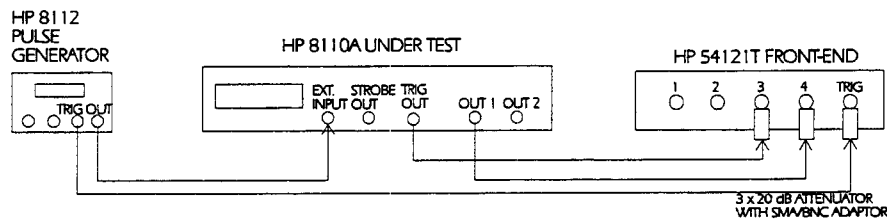
## Test 4: Delay

|                            |            |  |
|----------------------------|------------|--|
| <b>Test Specifications</b> | Range      | Fixed: typical 34.0 ns<br>Variable: 0.00 ns to 999 ns      |
|                            | Resolution | 3 digits, best case 10 ps                                  |
|                            | Accuracy   | $\pm 5\% \pm 1$ ns   |
|                            | RMS-Jitter | 0.03% + 25 ps (0.05% + 25 ps in the range 50 ns to 100 ns) |

**Equipment Needed**

- Digitizing Oscilloscope with Accessories
- Pulse Generator
- Counter
- Cable, 50  $\Omega$ , coaxial, BNC

**Procedure** 1. Connect HP 8110A to the Scope as shown:



**Connecting HP 8110A to the Scope**

2. Set up the HP 8110A as described in "Initial Setup of the HP 8110A"

3. Set the Pulse Generator to:

Period            1  $\mu$ s  
 Width            100 ns  
 Amplitude       1 V  
 Offset            0 V  
 Output            Enable

4. Select the **TRG-MODE** screen on the HP 8110A and set up as follows:

|  |          |  |
|--|----------|--|
| PULSES   |          | <b>MODIFY</b>                                  |
| Single-Pulses at Out1<br>Single-Pulses at Out2 |          | Continous<br>* Triggered<br>Gated<br>Ext-Width |
| Trg'd by: EXT-IN f                             |          |  |
| TRG-MODE                                       | OUTPUT 1 | OUTPUT 2                                       |
| PATTERN  |          |  |

The TRG MODE Screen Setup

5. On the HP 8110A set up **OUTPUT 1** and **OUTPUT 2** pages as shown in the following illustrations:

|  |               |          |         |
|--|---------------|----------|---------|
| Per ----- Normal ON 1                          | <b>MODIFY</b> |          |         |
| Delay <b>0.00 ns</b>                           | 0.00<br>ns    |          |         |
| Width 100 ns Offset +0.0 mV                    |               |          |         |
| LeadEdg 2.00 ns Amplit 1.00 V                  |               |          |         |
| Trailed 2.00 ns 50 $\Omega$ into 50.0 $\Omega$ |               |          |         |
| TRG-MODE                                       | OUTPUT 1      | OUTPUT 2 | PATTERN |

Configuring Output Screen 1

|  |               |          |         |
|--|---------------|----------|---------|
| Per ----- Normal OFF 2                         | <b>MODIFY</b> |          |         |
| Delay <b>0.00 ns</b> Separate Out2             | 0.00<br>ns    |          |         |
| Width 100 ns Offset +0.0 mV                    |               |          |         |
| LeadEdg 2.00 ns Amplit 1.00 V                  |               |          |         |
| Trailed 2.00 ns 50 $\Omega$ into 50.0 $\Omega$ |               |          |         |
| TRG-MODE                                       | OUTPUT 1      | OUTPUT 2 | PATTERN |

Configuring Output Screen 2



**Note**


---

When you are testing instruments with 2 output channels it is necessary to:

- a. Configure *both* channels.
- b. Switch OFF the channel that is not being tested

If you then test the other channel:

- c. Switch ON the channel you are testing, and switch OFF the other channel.
- 

6. Set the Digitizing Oscilloscope HP 54121T:

- Press **AUTOSCALE**
- Set timebase to TIME/DIV = 10 ns/div
- Center the positive-going edges of the two signals
- Select the Display menu and set the screen function to single; set the number of averages to 32
- Select the Delta V menu and turn the voltage markers ON and assign marker 1 to channel 3 and marker 2 to channel 4
- Set Preset levels to 50% - 50% and press **AUTO LEVEL SET**
- Select the Delta t menu and turn the time markers ON
- Set START ON EDGE= POS1 and STOP ON EDGE= POS 1
- Press the **PRECISE EDGE FIND** key

7. Check the HP 8110A delay at the following settings:

---

**Note**

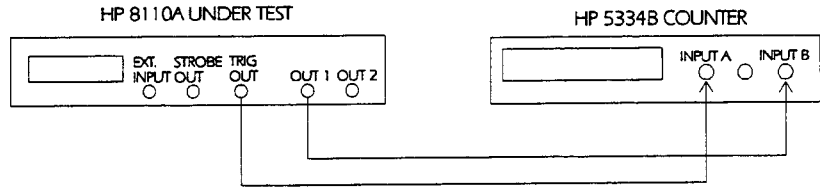
Record the value of the fixed delay and subtract it from the other readings.

---

**Table 3-8. Delay Settings and TR Reference**

| Oscilloscope Timebase | Delay   | Acceptable Range        | TR Entry |
|-----------------------|---------|-------------------------|----------|
| 10 ns/div             | 0.00 ns | fixed Delay             | 4 - 1    |
| 10 ns/div             | 5.00 ns | 3.75 ns to 6.25 ns      | 4 - 2    |
| 20 ns/div             | 9.99 ns | 8.49 ns to 11.49 ns     | 4 - 3    |
| 20 ns/div             | 50.0 ns | 46.5 ns to 53.5 ns      | 4 - 4    |
| 50 ns/div             | 99.9 ns | 93.905 ns to 105.895 ns | 4 - 5    |
| 50 ns/div             | 100 ns  | 94 ns to 106 ns         | 4 - 6    |
| 200 ns/div            | 500 ns  | 474 ns to 526 ns        | 4 - 7    |

8. Connect the HP 8110A to the Counter as follows:



### Connecting HP 8110A to the Counter

9. Set HP 8110A to Continuous-Pulses on the TRG MODE screen

10. Set the Counter to:

```

FUNCTION  TI A → B
SENSE     On
INPUT A   50 Ω
INPUT B   50 Ω
    
```

11. Check the HP 8110A delay at the following settings:

**Note**



Subtract the fixed delay from the other readings

**Table 3-9. Delay Settings and TR Reference**

| Period | Delay  | Acceptable Range     | TR Entry |
|--------|--------|----------------------|----------|
| 100 μs | 1 μs   | 949 ns to 1051 ns    | 4 - 8    |
| 100 μs | 5 μs   | 4.749 μs to 5.251 μs | 4 - 9    |
| 100 μs | 50 μs  | 47.5 μs to 52.5 μs   | 4 - 10   |
| 10 ms  | 500 μs | 475 μs to 525 μs     | 4 - 11   |
| 10 ms  | 5 ms   | 4.75 ms to 5.25 ms   | 4 - 12   |
| 999 ms | 50 ms  | 47.5 ms to 52.5 ms   | 4 - 13   |
| 999 ms | 500ms  | 475 ms to 525 ms     | 4 - 14   |

**Note**



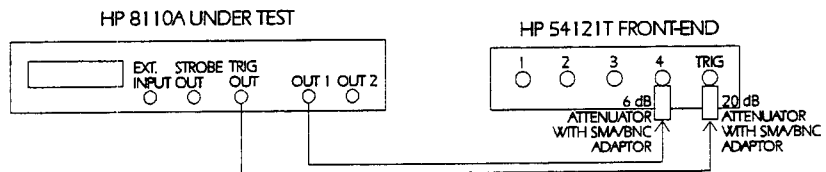
Repeat the entire test for the second channel, if it is installed.

## Test 5: Double Pulse Delay

|                            |            |                           |
|----------------------------|------------|---------------------------|
| <b>Test Specifications</b> | Range      | 6.65 ns to 999 ms         |
|                            | Resolution | 3 digits, best case 10 ps |
|                            | Accuracy   | $\pm 5\% \pm 250$ ps      |

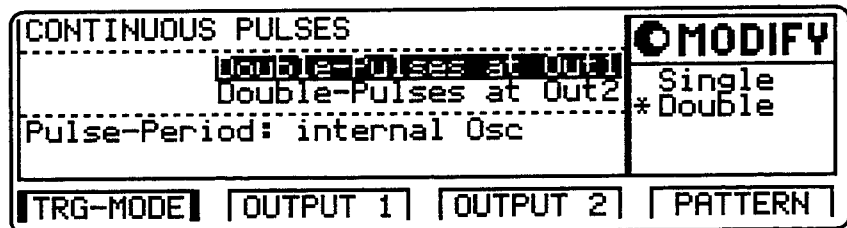
|                         |  |
|-------------------------|--|
| <b>Equipment Needed</b> | Digitizing Oscilloscope with Accessories |
|                         | Counter                                  |
|                         | Cable, 50 $\Omega$ , coaxial, BNC        |

- Procedure** 1. Connect HP 8110A to the Scope as shown:



### Connecting HP 8110A to the Scope

- Set up the HP 8110A as described in "Initial Setup of the HP 8110A"
- Select the **TRG-MODE** screen on the HP 8110A and set up as follows:



The TRG MODE Screen Setup

4. On the HP 8110A set up **OUTPUT 1** and **OUTPUT 2** pages as shown in the following illustrations:

|   |                    |          |         |   |               |          |          |          |         |
|---|--------------------|----------|---------|---|---------------|----------|----------|----------|---------|
| Per   | 200 ns             | Normal   | ON      | 1 | <b>MODIFY</b> |          |          |          |         |
| Db1Del  | <del>6.65 ns</del> |          |         |   | 6.65<br>ns    |          |          |          |         |
| Width   | 3.30 ns            | Offset   | +0.0 mV |   |               |          |          |          |         |
| LeadEdg   | 2.00 ns            | Amplit   | 1.00 V  |   |               |          |          |          |         |
| Trailed   | 2.00 ns            | 50Ω into | 50.0 Ω  |   |               |          |          |          |         |
| <table border="1"> <tr> <td>TRG-MODE</td> <td>OUTPUT 1</td> <td>OUTPUT 2</td> <td>PATTERN</td> </tr> </table> |                    |          |         |   |               | TRG-MODE | OUTPUT 1 | OUTPUT 2 | PATTERN |
| TRG-MODE  | OUTPUT 1           | OUTPUT 2 | PATTERN |   |               |          |          |          |         |

Configuring Output Screen 1

|   |                    |          |         |   |               |          |          |          |         |
|---|--------------------|----------|---------|---|---------------|----------|----------|----------|---------|
| Per   | 200 ns             | Normal   | OFF     | 2 | <b>MODIFY</b> |          |          |          |         |
| Db1Del  | <del>6.65 ns</del> | Separate | Out2    |   | 6.65<br>ns    |          |          |          |         |
| Width   | 3.30 ns            | Offset   | +0.0 mV |   |               |          |          |          |         |
| LeadEdg   | 2.00 ns            | Amplit   | 1.00 V  |   |               |          |          |          |         |
| Trailed   | 2.00 ns            | 50Ω into | 50.0 Ω  |   |               |          |          |          |         |
| <table border="1"> <tr> <td>TRG-MODE</td> <td>OUTPUT 1</td> <td>OUTPUT 2</td> <td>PATTERN</td> </tr> </table> |                    |          |         |   |               | TRG-MODE | OUTPUT 1 | OUTPUT 2 | PATTERN |
| TRG-MODE  | OUTPUT 1           | OUTPUT 2 | PATTERN |   |               |          |          |          |         |

Configuring Output Screen 2

**Note**



When you are testing instruments with 2 output channels it is necessary to:

- Configure *both* channels.
- Switch OFF the channel that is not being tested

If you then test the other channel:

- Switch ON the channel you are testing, and switch OFF the other channel.

5. Set the Digitizing Oscilloscope HP 54121T:

- Press **AUTOSCALE**
- Center the double pulse signal
- Select the Display menu and set the Number of Averages to 32
- Select the Delta V menu and turn the Voltage markers On
- Set Preset Levels = 50% -50% and press **AUTO LEVEL SET**
- Select the Delta t menu and turn the Time markers On
- Set START ON EDGE = POS1 and STOP ON EDGE = POS2

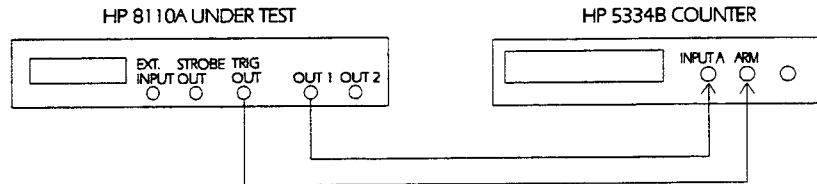
6. Press the **PRECISE EDGE FIND** key for each new Double Delay setting

7. Check the HP 8110A double delay at the following settings:

**Table 3-10. Double Delay Settings and TR Reference**

| Oscilloscope Timebase | Double Delay | Acceptable Range        | TR Entry |
|-----------------------|--------------|-------------------------|----------|
| 2 ns/div              | 6.65 ns      | 6.0675 ns to 7.2325 ns  | 5 - 1    |
| 2 ns/div              | 9.99 ns      | 9.241 ns to 10.74 ns    | 5 - 2    |
| 10 ns/div             | 50.0 ns      | 47.25 ns to 52.75 ns    | 5 - 3    |
| 20 ns/div             | 99.9 ns      | 94.655 ns to 105.145 ns | 5 - 4    |

8. Connect the HP 8110A to the Counter as shown:

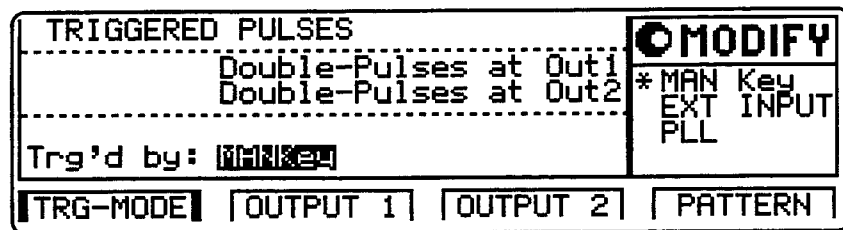


**Connecting HP 8110A to the Counter**

9. Set the Counter to:

FUNCTION    Period A  
 INPUT A    50 Ω  
 SENSE       On  
 EXT ARM SELECT  
     a. Start (ST): leading edge  
     b. Stop (SP): trailing edge

10. Set up the HP 8110A as described in “Initial Setup of the HP 8110A”
11. Select the **TRG-MODE** screen on the HP 8110A and set up as follows:



**The TRG MODE Screen Setup**

12. On the HP 8110A set up **OUTPUT 1** and **OUTPUT 2** pages as shown in the following illustrations:

```

Per ----- Normal ON 1 MODIFY
Db1Del 100 ns
Width 20.0 ns Offset +0.0 mV
LeadEdg 2.00 ns Amplit 1.00 V
Trailed 2.00 ns 50Ω into 50.0 Ω
100
ns
| TRG-MODE | OUTPUT 1 | OUTPUT 2 | PATTERN |
  
```

Configuring Output Screen 1

```

Per ----- Normal OFF 2 MODIFY
Db1Del 100 ns Separate Out2
Width 20.0 ns Offset +0.0 mV
LeadEdg 2.00 ns Amplit 1.00 V
Trailed 2.00 ns 50Ω into 50.0 Ω
100
ns
| TRG-MODE | OUTPUT 1 | OUTPUT 2 | PATTERN |
  
```

Configuring Output Screen 2

**Note**



When you are testing instruments with 2 output channels it is necessary to:

- a. Configure *both* channels.
- b. Switch OFF the channel that is not being tested

If you then test the other channel:

- c. Switch ON the channel you are testing, and switch OFF the other channel.

13. Check the HP 8110A double pulse delay at the following settings:

**Table 3-11. Double Delay Settings and TR Reference**

| Double Delay | Acceptable Range        | TR Entry |
|--------------|-------------------------|----------|
| 100 ns       | 94.75 ns to 105.25 ns   | 5 - 5    |
| 500 ns       | 474.75 ns to 525.25 ns  | 5 - 6    |
| 1 μs         | 949.75 ns to 1050.25 μs | 5 - 7    |
| 5 μs         | 4.759 μs to 5.25 μs     | 5 - 8    |
| 50 μs        | 47.5 μs to 52.5 μs      | 5 - 9    |
| 500 μs       | 475 μs to 525 μs        | 5 - 10   |
| 5 ms         | 4.75 ms to 5.25 ms      | 5 - 11   |
| 50 ms        | 47.5 ms to 52.5 ms      | 5 - 12   |
| 500 ms       | 475 ms to 525 ms        | 5 - 13   |

**Note**



Repeat the entire test for the second channel, if it is installed.

## Test 6: Jitter

The following tests are required:

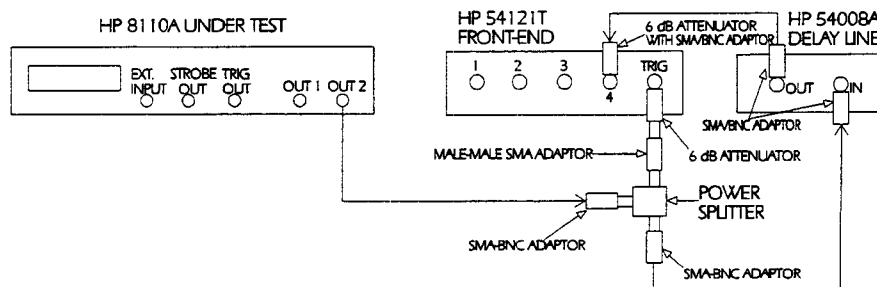
1. Period Jitter
  - a. Internal Oscillator
  - b. Internal PLL (if HP 81106A is installed)
2. Width Jitter
3. Delay Jitter

### Test 6.1a: Period Jitter, Internal Oscillator

**Test Specifications**    RMS-Jitter     $0.03\% + 25 \text{ ps}$  ( $0.05\% + 25 \text{ ps}$  in the range 50 ns to 100 ns)

**Equipment Needed**    Digitizing Oscilloscope with Accessories  
Delay Line (22 ns)  
Power Splitter  
Cable, 50  $\Omega$ , coaxial, BNC

- Procedure**    1. Connect HP 8110A to the Scope as shown:



**Equipment Set-up for Jitter Test**

2. Set up the HP 8110A as described in "Initial Setup of the HP 8110A"

3. On the HP 8110A set up **OUTPUT 1** and **OUTPUT 2** pages as shown in the following illustrations:

|  |         |          |         |   |            |
|--|---------|----------|---------|---|------------|
| Per                                      | 50.0 ns | Normal   | ON      | 1 | MODIFY     |
| Delay                                    | 0.00 ns |          |         |   | 50.0<br>ns |
| Width                                    | 25.0 ns | Offset   | +500 mV |   |            |
| LeadEdg                                  | 2.00 ns | Amplit   | 1.00 U  |   |            |
| Trailed                                  | 2.00 ns | 50Ω into | 50.0 Ω  |   |            |
| TRG-MODE   OUTPUT 1   OUTPUT 2   PATTERN |         |          |         |   |            |

Configuring Output Screen 1

|  |         |          |         |   |            |
|--|---------|----------|---------|---|------------|
| Per                                      | 50.0 ns | Normal   | OFF     | 2 | MODIFY     |
| Delay                                    | 0.00 ns | Separate | Out2    |   | 50.0<br>ns |
| Width                                    | 25.0 ns | Offset   | +500 mV |   |            |
| LeadEdg                                  | 2.00 ns | Amplit   | 1.00 U  |   |            |
| Trailed                                  | 2.00 ns | 50Ω into | 50.0 Ω  |   |            |
| TRG-MODE   OUTPUT 1   OUTPUT 2   PATTERN |         |          |         |   |            |

Configuring Output Screen 2

**Note**



When you are testing instruments with 2 output channels it is necessary to:

- a. Configure *both* channels.
- b. Switch OFF the channel that is not being tested

If you then test the other channel:

- c. Switch ON the channel you are testing, and switch OFF the other channel.

4. Set the Digitizing Oscilloscope HP 54121T:

- Press **AUTOSCALE**
- Select the Display menu and set the Number of Averages to 64
- Select the Channel menu and set the Attenuation factor of channel 4 to 2
- Set the VOLTS/DIV of channel 4 to 10 mV/div
- Set OFFSET to 250 mV
- Select the Timebase menu and set the TIME/DIV to 100 ps/div
- Center the first positive-going edge of the signal (approximate Delay = 32.4 ns)
- Select the Delta V menu and turn the V markers On
- Set the Marker 1 Position to 245 mV and the Marker 2 Position to 250 mV
- Select the Delta t menu and turn the T Markers On
- Set START ON EDGE = POS1 and STOP ON EDGE = POS1



- Press the **PRECISE EDGE FIND** key
5. RECORD the delta t reading. This is the rise time of the reference signal within a 1% amplitude window of the signal connected to Input 4. This value is needed later to calculate the correct jitter. (delta.t.up)
  6. Select the Timebase menu and center the second positive-going edge of the signal (approximate Delay = 82.35 ns)
  7. Press **MORE** and **HISTOGRAM**
    - Select the Window submenu and set:
      - Source is channel 4
      - Choose the Time Histogram
      - Press **WINDOW MARKER 1** and set it to 245 mV
      - Press **WINDOW MARKER 2** and set it to 250 mV
  8. Select the Acquire submenu, set the Number of Samples to 1000 and press **START ACQUIRING**
  9. After the data for the time histogram has been acquired (# Samples = 100%), select the Result submenu.
  10. Press **MEAN** and **SIGMA**. RECORD the values of sigma
  11. The RMS-jitter is calculated as follows:

$$RMS - jitter = \frac{6sigma - delta.t.up}{6}$$

12. The RMS-jitter for period of 50 ns is 50 ps. Enter the result in the Test Report as TR entry 6.1a - 1
13. Set the HP 8110A period to 500 ns
14. Repeat steps 6 to 11

**Note**




---

TIME/DIV = 200 ps/div; approximate Delay = 532 ns

---

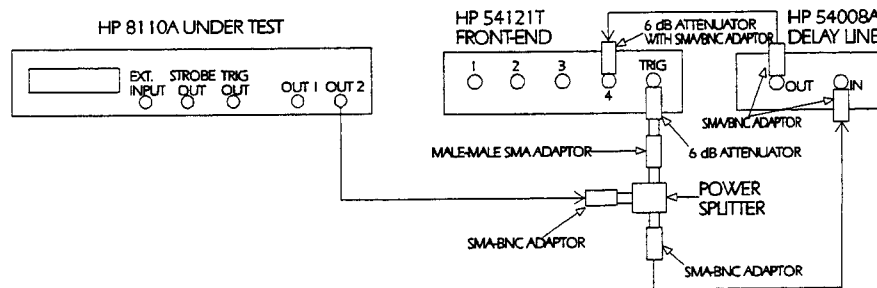
15. The RMS-jitter for period of 500 ns is 175 ps. Enter the result in the Test Report as TR entry 6.1a - 2

## Test 6.1b: Period Jitter, Internal PLL (If HP 81106A is installed)

**Test Specifications**      RMS-Jitter      0.003% + 20 ps

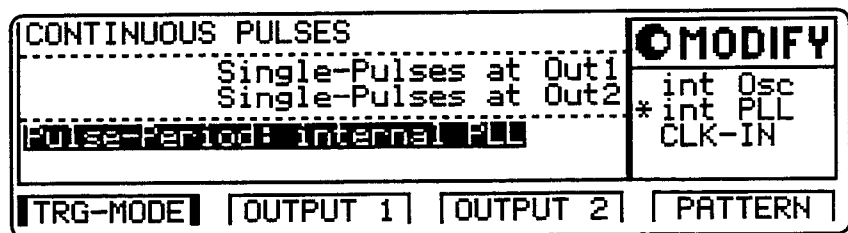
**Equipment Needed**      Digitizing Oscilloscope with Accessories  
    Delay Line (22 ns)  
    Power Splitter  
    Cable, 50 Ω, coaxial, BNC

**Procedure**      1. Connect HP 8110A to the Scope as shown:



### Equipment Set-up for Jitter Test

2. Set up the HP 8110A as described in “Initial Setup of the HP 8110A”
3. Select the **TRG-MODE** screen on the HP 8110A and set up as follows:



The TRG MODE Screen Setup

4. On the HP 8110A set up **OUTPUT 1** and **OUTPUT 2** pages as shown in the following illustrations:

|  |                 |          |         |   |               |          |                 |          |         |
|--|-----------------|----------|---------|---|---------------|----------|-----------------|----------|---------|
| Per  | 32.4 ns         | Normal   | ON      | 1 | <b>MODIFY</b> |          |                 |          |         |
| Delay  | 0.00 ns         |          |         |   | 20.0<br>ns    |          |                 |          |         |
| Width  | 10.0 ns         | Offset   | +500 mV |   |               |          |                 |          |         |
| LeadEdg  | 2.00 ns         | Amplit   | 1.00 U  |   |               |          |                 |          |         |
| Traille  | =LeadE          | 50Ω into | 50.0 Ω  |   |               |          |                 |          |         |
| <table border="1"> <tr> <td>TRG-MODE</td> <td><b>OUTPUT 1</b></td> <td>OUTPUT 2</td> <td>PATTERN</td> </tr> </table> |                 |          |         |   |               | TRG-MODE | <b>OUTPUT 1</b> | OUTPUT 2 | PATTERN |
| TRG-MODE   | <b>OUTPUT 1</b> | OUTPUT 2 | PATTERN |   |               |          |                 |          |         |

Configuring Output Screen 1

|  |          |                 |         |   |               |          |          |                 |         |
|--|----------|-----------------|---------|---|---------------|----------|----------|-----------------|---------|
| Per  | 32.4 ns  | Normal          | ON      | 2 | <b>MODIFY</b> |          |          |                 |         |
| Delay  | 0.00 ns  | Separate        | Out2    |   | 20.0<br>ns    |          |          |                 |         |
| Width  | 10.0 ns  | Offset          | +500 mV |   |               |          |          |                 |         |
| LeadEdg  | 2.00 ns  | Amplit          | 1.00 U  |   |               |          |          |                 |         |
| Traille  | =LeadE   | 50Ω into        | 50.0 Ω  |   |               |          |          |                 |         |
| <table border="1"> <tr> <td>TRG-MODE</td> <td>OUTPUT 1</td> <td><b>OUTPUT 2</b></td> <td>PATTERN</td> </tr> </table> |          |                 |         |   |               | TRG-MODE | OUTPUT 1 | <b>OUTPUT 2</b> | PATTERN |
| TRG-MODE   | OUTPUT 1 | <b>OUTPUT 2</b> | PATTERN |   |               |          |          |                 |         |

Configuring Output Screen 2

**Note**



When you are testing instruments with 2 output channels it is necessary to:

- Configure *both* channels.
- Switch OFF the channel that is not being tested

If you then test the other channel:

- Switch ON the channel you are testing, and switch OFF the other channel.

5. Set the Digitizing Oscilloscope HP 54121T:

- Press **AUTOSCALE**
- Select the Display menu and set the Number of Averages to 64
- Select the Channel menu and set the Attenuation factor of channel 4 to 2
- Set the VOLTS/DIV of channel 4 to 10 mV/div
- Set OFFSET to 250 mV
- Select the Timebase menu and set the TIME/DIV to 100 ps/div
- Center the first positive-going edge of the signal (approximate Delay = 32.4 ns)
- Select the Delta V menu and turn the V markers On
- Set the Marker 1 Position to 245 mV and the Marker 2 Position to 250mV
- Select the Delta t menu and turn the T Markers On
- Set START ON EDGE = POS1 and STOP ON EDGE = POS1
- Press the **PRECISE EDGE FIND** key

6. RECORD the delta t reading. This is the rise time of the reference signal within a 1% amplitude window of the signal connected to Input 4. This value is needed later to calculate the correct jitter. (delta.t.up)
7. Select the Timebase menu and center the second positive-going edge of the signal (approximate Delay = 52 ns)
8. Press **MORE** and **HISTOGRAM**
  - Select the Window submenu and set:
    - Source is channel 4
    - Choose the Time Histogram
    - Press **WINDOW MARKER 1** and set it to 245 mV
    - Press **WINDOW MARKER 2** and set it to 250 mV
9. Select the Acquire submenu, set the Number of Samples to 1000 and press **START ACQUIRING**
10. After the data for the time histogram has been acquired (# Samples = 100%), select the Result submenu.
11. Press **MEAN** and **SIGMA**. RECORD the values of sigma
12. The RMS-jitter is calculated as follows:
 
$$RMS - jitter = \frac{6sigma - delta.t.up}{6}$$
13. The RMS-jitter for period of 20 ns is 20.6 ps. Enter the result in the Test Report as TR entry 6.1b - 1

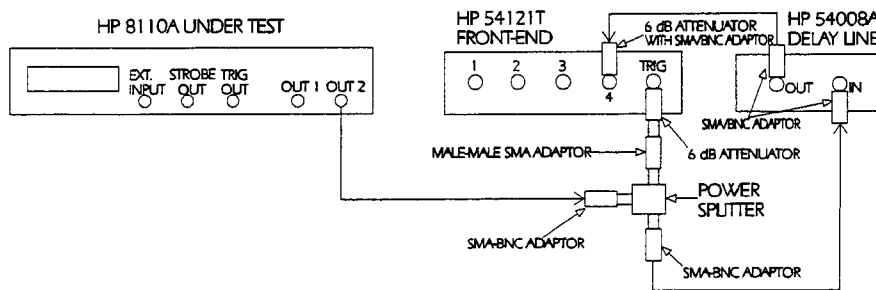
## Test 6.2: Width Jitter

**Test Specifications**    RMS-Jitter    0.03% + 25 ps (0.05% + 25 ps in the range 50 ns to 100 ns)

**Equipment Needed**

- Digitizing Oscilloscope with Accessories
- Delay Line (22 ns)
- Power Splitter
- Cable, 50  $\Omega$ , coaxial, BNC

**Procedure**    1. Connect HP 8110A to the Scope as shown:



### Equipment Set-up for Jitter Test

2. Set up the HP 8110A as described in "Initial Setup of the HP 8110A"

3. On the HP 8110A set up **OUTPUT 1** and **OUTPUT 2** pages as shown in the following illustrations:

|                  |                    |                  |               |         |               |
|------------------|--------------------|------------------|---------------|---------|---------------|
| Per 1.00 $\mu$ s |                    | Normal           | ON            | 1       | <b>MODIFY</b> |
| Delay            | 0.00 ns            |                  |               |         | 3.30<br>ns    |
| Width            | <del>3.30 ns</del> | Offset           | +500 mV       |         |               |
| LeadEdg          | 2.00 ns            | Amplit           | 1.00 U        |         |               |
| Trailed          | 2.00 ns            | 50 $\Omega$ into | 50.0 $\Omega$ |         |               |
| TRG-MODE         |                    | OUTPUT 1         | OUTPUT 2      | PATTERN |               |

Configuring Output Screen 1

|                  |                    |                  |               |         |               |
|------------------|--------------------|------------------|---------------|---------|---------------|
| Per 1.00 $\mu$ s |                    | Normal           | OFF           | 2       | <b>MODIFY</b> |
| Delay            | 0.00 ns            | Separate         | Out2          |         | 3.30<br>ns    |
| Width            | <del>3.30 ns</del> | Offset           | +500 mV       |         |               |
| LeadEdg          | 2.00 ns            | Amplit           | 1.00 U        |         |               |
| Trailed          | 2.00 ns            | 50 $\Omega$ into | 50.0 $\Omega$ |         |               |
| TRG-MODE         |                    | OUTPUT 1         | OUTPUT 2      | PATTERN |               |

Configuring Output Screen 2

**Note**



When you are testing instruments with 2 output channels it is necessary to:

- a. Configure *both* channels.
- b. Switch OFF the channel that is not being tested

If you then test the other channel:

- c. Switch ON the channel you are testing, and switch OFF the other channel.

4. Set the Digitizing Oscilloscope HP 54121T:

- Press **AUTOSCALE**
- Select the Display menu and set the Number of Averages to 128
- Select the Channel menu and set the Attenuation factor of channel 4 to 2
- Set the VOLTS/DIV of channel 4 to 10 mV/div
- Set OFFSET to 250 mV
- Select the Timebase menu and set the TIME/DIV to 10 ps/div
- Center the first negative-going edge of the signal (approximate Delay = 35.5 ns)
- Select the Delta V menu and turn the V markers On
- Set the Marker 1 Position to 255 mV and the Marker 2 Position to 250 mV
- Select the Delta t menu and turn the T Markers On
- Set START ON EDGE = NEG1 and STOP ON EDGE = NEG1

- Press the **PRECISE EDGE FIND** key
5. RECORD the delta t reading. This is the fall time of the reference signal within a 1% amplitude window of the signal connected to Input 4. This value is needed later to calculate the correct jitter. (delta.t.dn)
  6. Set the HP 8110A Pulse Width to 50 ns
  7. Select the Timebase menu and center the first negative-going edge of the signal (approximate Delay = 82.5 ns)
  8. Press **MORE** and **HISTOGRAM**
  9. Select the Window submenu and set:
    - Source is channel 4
    - Choose the Time Histogram
    - Press **WINDOW MARKER 1** and set it to 255 mV
    - Press **WINDOW MARKER 2** and set it to 250 mV
  10. Select the Acquire submenu, set the Number of Samples to 1000 and press **START ACQUIRING**
  11. After the data for the time histogram has been acquired (# Samples = 100%), select the Result submenu.
  12. Press **MEAN** and **SIGMA**. RECORD the value of sigma
  13. The RMS-jitter is calculated as follows:
 
$$RMS - jitter = \frac{6sigma - delta.t.dn}{6}$$
  14. The RMS-jitter for pulse width of 50 ns is 50 ps. Enter the result in the Test Report as TR entry 6.2 - 1
  15. Set the HP 8110A for pulse width of 500ns
  16. Repeat steps 7 to 13

**Note**




---

TIME/DIV = 200ps/div. Approximate delay = 533 ns

---

17. The RMS-jitter for pulse width of 500 ns is 175 ps. Enter the result in the Test Report as TR entry 6.2 - 2

### Test 6.3: Delay Jitter

#### Test Specifications

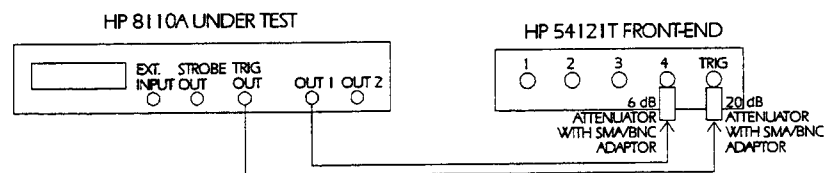
RMS-Jitter 0.03% + 25 ps (0.05% + 25 ps in the range 50 ns to 100 ns)

#### Equipment Needed

Digitizing Oscilloscope with Accessories

#### Procedure

1. Connect HP 8110A to the Scope as shown:



#### Equipment Set-up for Delay Jitter Test

2. For calculating the RMS-jitter, the rise time of the reference signal within a 1% amplitude window is required. If this value is not already measured in the Period Jitter test, then perform the first 6 steps of the Period Jitter test.
3. Set up the HP 8110A as described in "Initial Setup of the HP 8110A"



4. On the HP 8110A press **MORE** and set up **OUTPUT 1** and **OUTPUT 2** pages as shown in the following illustrations:

|                  |         |                  |               |          |               |
|------------------|---------|------------------|---------------|----------|---------------|
| Per 1.00 $\mu$ s |         | Normal           | ON            | 1        | <b>MODIFY</b> |
| Delay            | 50.0 ns |                  |               |          | 50.0<br>ns    |
| Width            | 50.0 ns | Offset           | +500 mV       |          |               |
| LeadEdg          | 2.00 ns | Amplit           | 1.00 V        |          |               |
| Trailed          | 2.00 ns | 50 $\Omega$ into | 50.0 $\Omega$ |          |               |
| TRG-MODE         |         | OUTPUT 1         |               | OUTPUT 2 | PATTERN       |

Configuring Output Screen 1

|                  |         |                  |               |   |               |
|------------------|---------|------------------|---------------|---|---------------|
| Per 1.00 $\mu$ s |         | Normal           | OFF           | 2 | <b>MODIFY</b> |
| Delay            | 50.0 ns | Separate         | Out2          |   | 50.0<br>ns    |
| Width            | 50.0 ns | Offset           | +500 mV       |   |               |
| LeadEdg          | 2.00 ns | Amplit           | 1.00 V        |   |               |
| Trailed          | 2.00 ns | 50 $\Omega$ into | 50.0 $\Omega$ |   |               |
| TRG-MODE         |         | OUTPUT 1         | OUTPUT 2      |   | PATTERN       |

Configuring Output Screen 2

**Note**



When you are testing instruments with 2 output channels it is necessary to:

- a. Configure *both* channels.
- b. Switch OFF the channel that is not being tested

If you then test the other channel:

- c. Switch ON the channel you are testing, and switch OFF the other channel.

5. Set the Digitizing Oscilloscope HP 54121T:
  - Press **AUTOSCALE**
  - Select the Display menu and set the Number of Averages to 64
  - Set the VOLTS/DIV = 10 mV/div
  - Set OFFSET to 500 mV
  - Select the Timebase menu and set the TIME/DIV to 100 ps/div
  - Center the first positive-going edge of the signal (approximate Delay = 78.3 ns)
6. Press **MORE** and **HISTOGRAM**
7. Select the Window submenu and press **WINDOW MARKER 1** and set it to 490 mV
8. Press **WINDOW MARKER 2** and set it to 500 mV
9. Select the Acquire submenu, set the Number of Samples to 1000 and press **START ACQUIRING**

10. After the delta for the time histogram has been acquired (# Samples = 100%), select the Result submenu.
11. Press **MEAN** and **SIGMA**. RECORD the values of sigma!
12. The RMS-jitter is calculated as follows:  

$$RMS - jitter = \frac{6sigma - delta.t.up}{6}$$
13. The RMS-jitter for delay of 50 ns is 50 ps. Enter the result in the Test Report as TR entry 6.3 - 1
14. Set HP 8110A for delay of 500 ns
15. Repeat steps 9 to 12

**Note**




---

TIME/DIV = 200 ps/div. Approximate delay = 528.7 ns

---

16. The RMS jitter for delay of 500 ns is 175 ps. Enter the result in the Test Report as TR entry 6.3 - 2

---

## Test 7: High and Low Levels

The following tests are required:

1. High level from 50Ω into 50Ω
2. Low level from 50Ω into 50Ω
3. High level from 1KΩ into 50Ω
4. Low level from 1KΩ into 50Ω

### Test Specifications

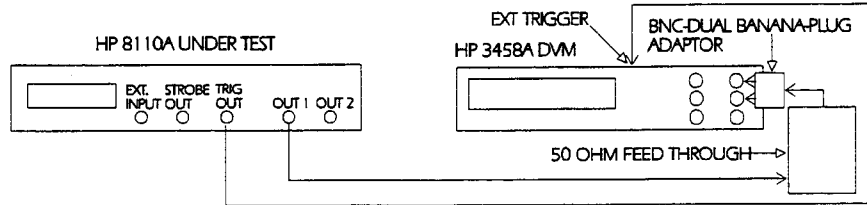
**Table 3-12. High and Low Test Specifications**

|                  | Load Impedance: 50 Ω |                     |
|------------------|----------------------|---------------------|
| Source Impedance | 50 Ω                 | 1 K Ω               |
| High Level       | -9.90 V to +10.0 V   | -18.8 V to +19.0 V  |
| Low Level        | -10.0 V to +9.9 V    | -19.0 V to +18.8 V  |
| Amplitude        | 0.10 V to 10.0 V     | 0.20 V to 20.0 V    |
| Level Resolution | 10 mV                | 10 mV               |
| Level Accuracy   | ±1% of ampl ±50 mV   | ±1% of ampl ±100 mV |

### Equipment Needed

1. Digitizing Voltmeter (DVM)
2. 50 Ω Feedthrough Termination, 0.1%, 10 W Adapter.
3. BNC to dual banana plug (HP 1251-2277)

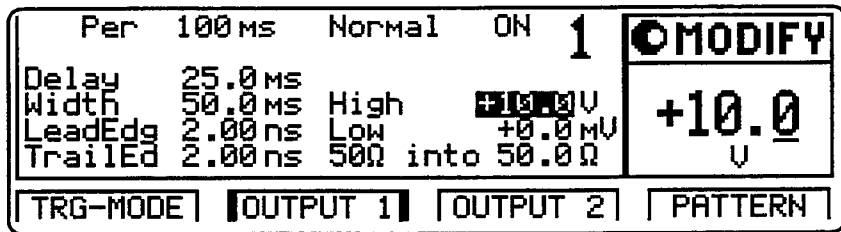
**Procedure** Connect HP 8110A to the DVM as shown:



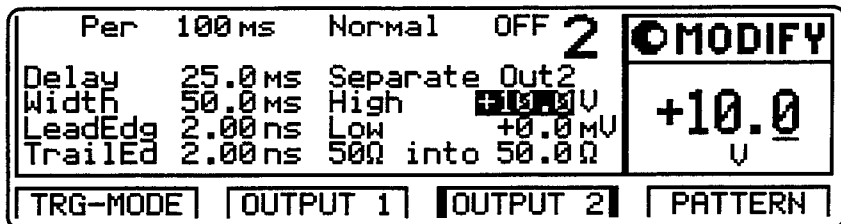
### Connecting the DVM for High and Low Levels Tests

#### Test 7.1: High Level, 50 Ohms into 50 Ohms

1. Set up the HP 8110A as described in “Initial Setup of the HP 8110A”
2. On the HP 8110A press **MORE** and set up **OUTPUT 1** and **OUTPUT 2** pages as shown in the following illustrations:



Configuring Output Screen 1



Configuring Output Screen 2

**Note**


---

When you are testing instruments with 2 output channels it is necessary to:

- a. Configure *both* channels.
- b. Switch OFF the channel that is not being tested

If you then test the other channel:

- c. Switch ON the channel you are testing, and switch OFF the other channel.
- 

3. Set the DVM HP 3458A to:

Function: DCV

Trigger: TRIG EXT

AD-Converter integration time NPLC: 0.1

(Number of Power Line Cycles)

4. Check the HP 8110A high level at the following high level settings with the low level set to 0.0 V.

**Table 3-13.**  
**High Level Settings (50 ohms - 50 ohms) and TR Reference**

| High Level | Acceptable Range  | TR Entry |
|------------|-------------------|----------|
| 10.0 V     | 9.85 V to 10.15 V | 7.1 - 1  |
| 5.0 V      | 4.90 V to 5.10 V  | 7.1 - 2  |
| 3.0 V      | 2.92 V to 3.08 V  | 7.1 - 3  |
| 1.0 V      | 0.94 V to 1.06 V  | 7.1 - 4  |
| 0.5 V      | 445 mV to 555 mV  | 7.1 - 5  |
| 0.1 V      | 49 mV to 151 mV   | 7.1 - 6  |

The low level may vary within  $\pm 1\%$  of amplitude  $\pm 50$  mV

## Test 7.2: Low Level, 50 Ohms into 50 Ohms

1. Set up the HP 8110A as described in "Initial Setup of the HP 8110A"
2. On the HP 8110A press **MORE** and set up **OUTPUT 1** and **OUTPUT 2** pages as shown in the following illustrations:

|   |         |        |                    |   |               |
|---|---------|--------|--------------------|---|---------------|
| Per   | 100 ms  | Normal | ON                 | 1 | <b>MODIFY</b> |
| Delay   | 75.0 ms |        |                    |   |               |
| Width   | 50.0 ms | High   | +0.0 mV            |   | <b>-100</b>   |
| LeadEdg   | 2.00 ns | Low    | <del>-100</del> mV |   | mV            |
| Trailed   | 2.00 ns | 50Ω    | into 50.0Ω         |   |               |
| TRG-MODE   <b>OUTPUT 1</b>   OUTPUT 2   PATTERN |         |        |                    |   |               |

Configuring Output Screen 1

|   |         |          |                    |   |               |
|---|---------|----------|--------------------|---|---------------|
| Per   | 100 ms  | Normal   | OFF                | 2 | <b>MODIFY</b> |
| Delay   | 75.0 ms | Separate | Out2               |   |               |
| Width   | 50.0 ms | High     | +0.0 mV            |   | <b>-100</b>   |
| LeadEdg   | 2.00 ns | Low      | <del>-100</del> mV |   | mV            |
| Trailed   | 2.00 ns | 50Ω      | into 50.0Ω         |   |               |
| TRG-MODE   OUTPUT 1   <b>OUTPUT 2</b>   PATTERN |         |          |                    |   |               |

Configuring Output Screen 2

### Note



When you are testing instruments with 2 output channels it is necessary to:

- a. Configure *both* channels.
- b. Switch OFF the channel that is not being tested

If you then test the other channel:

- c. Switch ON the channel you are testing, and switch OFF the other channel.

3. Check the HP 8110A low level at the following low level settings with the high level set to 0.0 V

**Table 3-14.**  
**Low Level Settings (50 ohms - 50 ohms) and TR Reference**

| Low Level | Acceptable Range   | TR Entry |
|-----------|--------------------|----------|
| -0.1 V    | -49 mV to -151 mV  | 7.2 - 1  |
| -0.5 V    | -445 mV to -555 mV | 7.2 - 2  |
| -1.0 V    | -0.94 V to -1.06 V | 7.2 - 3  |
| -3.0 V    | -2.92 V to 3.08 V  | 7.2 - 4  |
| -5.0 V    | -4.90 V to -5.10 V | 7.2 - 5  |
| -10.0 V   | -9.85 V to 10.15 V | 7.2 - 6  |

The high level 0.0 V may vary  $\pm 1\%$  of amplitude  $\pm 50$  mV.

### Test 7.3: High Level, 1K Ohms into 50 Ohms

1. Set up the HP 8110A as described in "Initial Setup of the HP 8110A"
2. On the HP 8110A press **MORE** and set up **OUTPUT 1** and **OUTPUT 2** pages as shown in the following illustrations:

|   |          |             |                    |   |                   |          |          |          |         |
|---|----------|-------------|--------------------|---|-------------------|----------|----------|----------|---------|
| Per   | 100ms    | Normal      | ON                 | 1 | <b>MODIFY</b>     |          |          |          |         |
| Delay   | 25.0ms   |             |                    |   | <b>+19.0</b><br>V |          |          |          |         |
| Width   | 50.0ms   | High        | 5.00V              |   |                   |          |          |          |         |
| LeadEdg   | 2.00ns   | Low         | +0.0mV             |   |                   |          |          |          |         |
| TrailEd   | 2.00ns   | 1k $\Omega$ | into 50.0 $\Omega$ |   |                   |          |          |          |         |
| <table border="1"> <tr> <td>TRG-MODE</td> <td>OUTPUT 1</td> <td>OUTPUT 2</td> <td>PATTERN</td> </tr> </table> |          |             |                    |   |                   | TRG-MODE | OUTPUT 1 | OUTPUT 2 | PATTERN |
| TRG-MODE  | OUTPUT 1 | OUTPUT 2    | PATTERN            |   |                   |          |          |          |         |

Configuring Output Screen 1

|   |          |             |                    |   |                   |          |          |          |         |
|---|----------|-------------|--------------------|---|-------------------|----------|----------|----------|---------|
| Per   | 100ms    | Normal      | OFF                | 2 | <b>MODIFY</b>     |          |          |          |         |
| Delay   | 25.0ms   | Separate    | Out2               |   | <b>+19.0</b><br>V |          |          |          |         |
| Width   | 50.0ms   | High        | 5.00V              |   |                   |          |          |          |         |
| LeadEdg   | 2.00ns   | Low         | +0.0mV             |   |                   |          |          |          |         |
| TrailEd   | 2.00ns   | 1k $\Omega$ | into 50.0 $\Omega$ |   |                   |          |          |          |         |
| <table border="1"> <tr> <td>TRG-MODE</td> <td>OUTPUT 1</td> <td>OUTPUT 2</td> <td>PATTERN</td> </tr> </table> |          |             |                    |   |                   | TRG-MODE | OUTPUT 1 | OUTPUT 2 | PATTERN |
| TRG-MODE  | OUTPUT 1 | OUTPUT 2    | PATTERN            |   |                   |          |          |          |         |

Configuring Output Screen 2

**Note**

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When you are testing instruments with 2 output channels it is necessary to:

- a. Configure *both* channels.
- b. Switch OFF the channel that is not being tested

If you then test the other channel:

- c. Switch ON the channel you are testing, and switch OFF the other channel.
- 

3. Check the HP 8110A high level at the following high level settings with the low level set to 0.0 V.

**Table 3-15.**  
**High Level Settings (1 Kohms - 50 ohms) and TR Reference**

| High Level | Acceptable Range   | TR Entry |
|------------|--------------------|----------|
| 19.0 V     | 18.71 V to 19.29 V | 7.3 - 1  |
| 10.0 V     | 9.80 V to 10.20 V  | 7.3 - 2  |
| 5.0 V      | 4.85 V to 5.15 V   | 7.3 - 3  |
| 1.0 V      | 0.89 V to 1.11 V   | 7.3 - 4  |
| 0.2 V      | 98 mV to 302 mV    | 7.3 - 5  |

The low level 0.0 V may vary  $\pm 1\%$  of amplitude  $\pm 100$  mV.

## Test 7.4: Low Level, 1K Ohms into 50 Ohms

1. Set up the HP 8110A as described in “Initial Setup of the HP 8110A”
2. On the HP 8110A press **MORE** and set up **OUTPUT 1** and **OUTPUT 2** pages as shown in the following illustrations:

|          |         |          |      |                    |                   |         |  |
|----------|---------|----------|------|--------------------|-------------------|---------|--|
| Per      | 100 ms  | Normal   | ON   | 1                  | <b>MODIFY</b>     |         |  |
| Delay    | 75.0 ms |          |      |                    | <b>-200</b><br>MV |         |  |
| Width    | 50.0 ms | High     |      | +0.0 MV            |                   |         |  |
| LeadEdg  | 2.00 ns | Low      |      | <del>-200</del> MV |                   |         |  |
| Trailed  | 2.00 ns | 1kΩ      | into | 50.0 Ω             |                   |         |  |
| TRG-MODE |         | OUTPUT 1 |      | OUTPUT 2           |                   | PATTERN |  |

Configuring Output Screen 1

|          |         |          |      |                    |                   |         |  |
|----------|---------|----------|------|--------------------|-------------------|---------|--|
| Per      | 100 ms  | Normal   | OFF  | 2                  | <b>MODIFY</b>     |         |  |
| Delay    | 75.0 ms | Separate | Out2 |                    | <b>-200</b><br>MV |         |  |
| Width    | 50.0 ms | High     |      | +0.0 MV            |                   |         |  |
| LeadEdg  | 2.00 ns | Low      |      | <del>-200</del> MV |                   |         |  |
| Trailed  | 2.00 ns | 1kΩ      | into | 50.0 Ω             |                   |         |  |
| TRG-MODE |         | OUTPUT 1 |      | OUTPUT 2           |                   | PATTERN |  |

Configuring Output Screen 2

### Note



When you are testing instruments with 2 output channels it is necessary to:

- a. Configure *both* channels.
- b. Switch OFF the channel that is not being tested

If you then test the other channel:

- c. Switch ON the channel you are testing, and switch OFF the other channel.



3. Check the HP 8110A low level at the following low level settings with the high level set to 0.0 V.

**Table 3-16.**  
**Low Level Settings (1 Kohms - 50 ohms) and TR Reference**

| Low Level | Acceptable Range     | TR Entry |
|-----------|----------------------|----------|
| -0.2 V    | -98 mV to -302 mV    | 7.4 - 1  |
| -1.0 V    | -0.89 mV to -1.11 V  | 7.4 - 2  |
| -5.0 V    | -4.85 V to -5.15 V   | 7.4 - 3  |
| -10.0 V   | -9.80 V to 10.20 V   | 7.4 - 4  |
| -19.0 V   | -18.71 V to -19.29 V | 7.4 - 5  |

The high level 0.0 V may vary  $\pm 1\%$  of amplitude  $\pm 100$  mV

**Note**



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Repeat the High and Low Level tests for the second channel, if it is installed.

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## Test 8: Transition Time

The following tests are required:

1.  $\leq \pm 5V$  window:
  - a. Minimum Leading Edge and Leading Edge range
  - b. Minimum Trailing Edge and Trailing Edge range
2.  $> \pm 5V$  window:
  - a. Minimum Leading Edge
  - b. Minimum Trailing Edge

|                            |                     |   |
|----------------------------|---------------------|---|
| <b>Test Specifications</b> | Range               | 2.0 ns to 200 ms<br>(measured between 10% and 90% of amplitude)   |
|                            | Minimum Transitions | $\leq 2.0$ ns<br>for levels within $\pm 5$ V window,<br><2.5 ns for all levels,<br>(typical 1.4 ns for levels within $\pm 5$ V window<br>measured between 20% and 80% of amplitude) |
|                            | Resolution          | 3 digits, best case 10 ps   |
|                            | Accuracy            | $\pm 10\% \pm 200$ ps   |
|                            | Linearity           | typical 3% for transitions $> 100$ ns   |

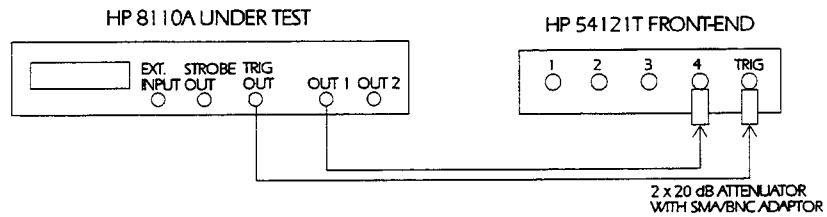
**Equipment Needed**      Digitizing Oscilloscope with Accessories

**Procedure** Perform the tests as shown in the following sections:

### Test 8.1a: Leading Edge Test

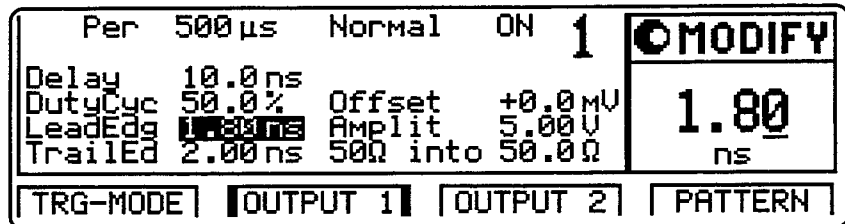
Minimum Leading Edge and Leading Edge ranges within  $\leq \pm 5V$  window.

1. Connect HP 8110A to the Scope as shown:

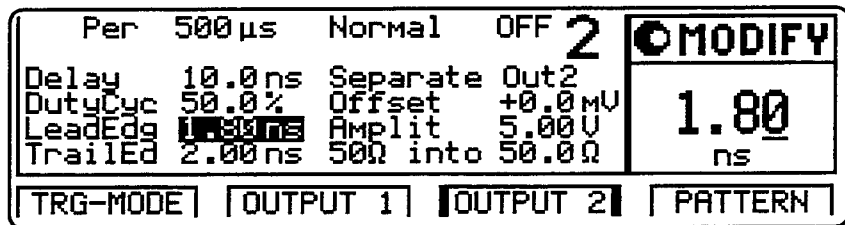


#### Connecting HP 8110A to the Scope

2. Set up the HP 8110A as described in “Initial Setup of the HP 8110A”
3. On the HP 8110A press **MORE** and set up **OUTPUT 1** and **OUTPUT 2** pages as shown in the following illustrations:



Configuring Output Screen 1



Configuring Output Screen 2

**Note**

When you are testing instruments with 2 output channels it is necessary to:

- a. Configure *both* channels.
- b. Switch OFF the channel that is not being tested

If you then test the other channel:

- c. Switch ON the channel you are testing, and switch OFF the other channel.

4. Set the Digitizing Oscilloscope HP 54121T:

- Press **AUTOSCALE**
- Center one pulse on screen, e.g.: TIME/DIV = 50  $\mu$ s/div, DELAY = 365  $\mu$ s,
- Select the Display menu and set the Number of Averages to 32
- Select the Channel menu and set the Attenuation factor to 10
- Select the Delta V menu and turn the voltage markers On
- Set the Preset Levels = 10-90% and press **AUTO LEVEL SET**
- Select the Timebase menu and set TIME/DIV = 2 ns/div, DELAY = 29 ns
- Select the Delta t menu and turn the markers On
- Set START ON EDGE = POS1 and STOP ON EDGE = POS1

5. Set period of HP 8110A to: Period = 1  $\mu$ s

6. After the averaging, while the oscilloscope is in the Delta t menu, Press the **PRECISE EDGE FIND** key

7. Check the HP 8110A rise times at the following leading edge settings:

**Table 3-17. Leading Edge Settings and TR Reference**

| Oscilloscope<br>TIME/DIV | Period      | Leading<br>Edge | Trailing<br>Edge | Acceptable<br>Range              | TR<br>Entry |
|--------------------------|-------------|-----------------|------------------|----------------------------------|-------------|
| 2 ns/div                 | 1 $\mu$ s   | 1.8 ns *        | 2 ns             | $\leq 2$ ns                      | 8.1a - 1    |
| 5 ns/div                 | 1 $\mu$ s   | 10 ns           | 5 ns             | 8.8 ns to 11.2 ns                | 8.1a - 2    |
| 10 ns/div                | 1 $\mu$ s   | 50 ns           | 50 ns            | 44.8 ns to 55.2ns                | 8.1a - 3    |
| 100 ns/div               | 5 $\mu$ s   | 500 ns          | 500 ns           | 449.8 ns to 550.2 ns             | 8.1a - 4    |
| 1 $\mu$ s/div            | 50 $\mu$ s  | 5 $\mu$ s       | 5 $\mu$ s        | 4.4998 $\mu$ s to 5.5002 $\mu$ s | 8.1a - 5    |
| 10 $\mu$ s/div           | 500 $\mu$ s | 50 $\mu$ s      | 50 $\mu$ s       | 45 $\mu$ s to 55 $\mu$ s         | 8.1a - 6    |
| 100 $\mu$ s/div          | 5 ms        | 500 $\mu$ s     | 200 $\mu$ s      | 450 $\mu$ s to 550 $\mu$         | 8.1a - 7    |
| 10 ms/div                | 500 ms      | 50 ms           | 50 ms            | 45 ms to 55 ms                   | 8.1a - 8    |

\* Programming down to 1.8 ns is allowed, to meet this specification.

## Test 8.1b: Trailing Edge Test

Minimum Trailing Edge and Trailing Edge range within  $\leq \pm 5V$  window.

1. Set up the HP 8110A as described in “Initial Setup of the HP 8110A”
2. On the HP 8110A press **MORE** and set up **OUTPUT 1** and **OUTPUT 2** pages as shown in the following illustrations:

|                  |          |                  |               |               |
|------------------|----------|------------------|---------------|---------------|
| Per 1.00 $\mu$ s | Normal   | ON               | 1             | <b>MODIFY</b> |
| Delay            | 10.0 ns  |                  |               | 1.80<br>ns    |
| DutyCyc          | 50.0%    | Offset           | +0.0 mV       |               |
| LeadEdg          | 2.00 ns  | Amplit           | 5.00 V        |               |
| Trailed          | 1.80 ns  | 50 $\Omega$ into | 50.0 $\Omega$ |               |
| TRG-MODE         | OUTPUT 1 | OUTPUT 2         | PATTERN       |               |

Configuring Output Screen 1

|                  |          |                  |               |               |
|------------------|----------|------------------|---------------|---------------|
| Per 1.00 $\mu$ s | Normal   | OFF              | 2             | <b>MODIFY</b> |
| Delay            | 10.0 ns  | Separate         | Out2          | 1.80<br>ns    |
| DutyCyc          | 50.0%    | Offset           | +0.0 mV       |               |
| LeadEdg          | 2.00 ns  | Amplit           | 5.00 V        |               |
| Trailed          | 1.80 ns  | 50 $\Omega$ into | 50.0 $\Omega$ |               |
| TRG-MODE         | OUTPUT 1 | OUTPUT 2         | PATTERN       |               |

Configuring Output Screen 2

### Note



When you are testing instruments with 2 output channels it is necessary to:

- a. Configure *both* channels.
- b. Switch OFF the channel that is not being tested

If you then test the other channel:

- c. Switch ON the channel you are testing, and switch OFF the other channel.

3. Set the digitizing oscilloscope HP 54121T:
  - Select the oscilloscopes Timebase menu and set TIME/DIV to 2 ns/div and DELAY to approximately 529 ns
  - Select the oscilloscopes Delta t menu and set START ON EDGE = NEG1 and STOP ON EDGE = NEG1
4. While the oscilloscope is in the Delta t menu, press the **PRECISE EDGE FIND** key

5. Check the HP 8110A output signal falls at the following trailing edge settings:

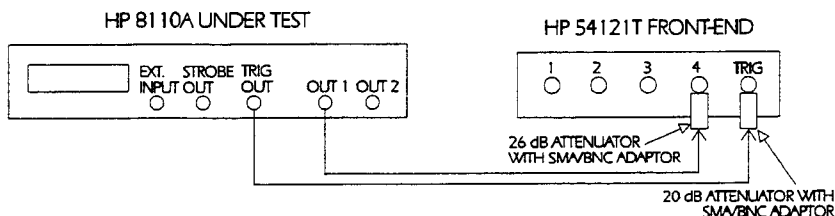
**Table 3-18. Trailing Edge Settings and TR Reference**

| Oscilloscope TIME/DIV | Delay       | Period      | Trailing Edge | Leading Edge | Acceptable Range                 | TR Entry |
|-----------------------|-------------|-------------|---------------|--------------|----------------------------------|----------|
| 2 ns/div              | 529 ns      | 1 $\mu$ s   | 1.8 ns *      | 2 ns         | $\leq$ 2 ns                      | 8.1b - 1 |
| 5 ns/div              | 529 ns      | 1 $\mu$ s   | 10 ns         | 5 ns         | 8.8 ns to 11.2 ns                | 8.1b - 2 |
| 10 ns/div             | 529 ns      | 1 $\mu$ s   | 50 ns         | 50 ns        | 44.8 ns to 55.2 ns               | 8.1b - 3 |
| 100 ns/div            | 25 $\mu$ s  | 5 $\mu$ s   | 500 ns        | 50 ns        | 449.8 ns to 550.2 ns             | 8.1b - 4 |
| 1 $\mu$ s/div         | 25 $\mu$ s  | 50 $\mu$ s  | 5 $\mu$ s     | 5 $\mu$ s    | 4.4998 $\mu$ s to 5.5002 $\mu$ s | 8.1b - 5 |
| 10 $\mu$ s/div        | 250 $\mu$ s | 500 $\mu$ s | 50 $\mu$ s    | 50 $\mu$ s   | 45 $\mu$ s to 55 $\mu$ s         | 8.1b - 6 |
| 100 $\mu$ s/div       | 2.5 ms      | 5 ms        | 500 $\mu$ s   | 200 $\mu$ s  | 450 $\mu$ s to 550 $\mu$ s       | 8.1b - 7 |
| 10 ms/div             | 250 ms      | 500 ms      | 50 ms         | 50 ms        | 45 ms to 55 ms                   | 8.1b - 8 |

\* Programming down to 1.8 ns is allowed, to meet this specification.

## Test 8.2a: Min. Leading edge for Level Window $> \pm 5V$

1. Connect HP 8110A to the Scope as shown:



### Connecting HP 8110A to the Scope

2. Set up the HP 8110A as described in “Initial Setup of the HP 8110A”
3. On the HP 8110A press **MORE** and set up **OUTPUT 1** and **OUTPUT 2** pages as shown in the following illustrations:

|  |                    |                  |               |               |
|--|--------------------|------------------|---------------|---------------|
| Per 1.00 $\mu$ s                         | Normal             | ON               | 1             | <b>MODIFY</b> |
| Delay                                    | 10.0 ns            |                  |               | 2.00<br>ns    |
| DutyCyc                                  | 50.0%              | Offset           | +5.00V        |               |
| LeadEdg                                  | <del>2.00 ns</del> | Amplit           | 10.0V         |               |
| TrailEd                                  | 2.00 ns            | 50 $\Omega$ into | 50.0 $\Omega$ |               |
| TRG-MODE   OUTPUT 1   OUTPUT 2   PATTERN |                    |                  |               |               |

### Configuring Output Screen 1

|  |                    |                  |               |               |
|--|--------------------|------------------|---------------|---------------|
| Per 1.00 $\mu$ s                         | Normal             | OFF              | 2             | <b>MODIFY</b> |
| Delay                                    | 10.0 ns            | Separate         | Out2          | 2.00<br>ns    |
| DutyCyc                                  | 50.0%              | Offset           | +5.00V        |               |
| LeadEdg                                  | <del>2.00 ns</del> | Amplit           | 10.0V         |               |
| TrailEd                                  | 2.00 ns            | 50 $\Omega$ into | 50.0 $\Omega$ |               |
| TRG-MODE   OUTPUT 1   OUTPUT 2   PATTERN |                    |                  |               |               |

### Configuring Output Screen 2

**Note**

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When you are testing instruments with 2 output channels it is necessary to:

- a. Configure *both* channels.
- b. Switch OFF the channel that is not being tested

If you then test the other channel:

- c. Switch ON the channel you are testing, and switch OFF the other channel.
- 

4. Set the Digitizing Oscilloscope HP 54121T:

- Press **AUTOSCALE**
- Select the Display menu and set the Number of Averages to 32
- Select the Channel menu and set the Attenuation factor to 20
- Select the Timebase menu and set TIME/DIV = 50  $\mu$ s/div, DELAY = 365  $\mu$ s
- Select the Delta V menu and turn the voltage markers On
- Set the Preset Levels = 10-90% and press **AUTO LEVEL SET**
- Select the Timebase menu and set TIME/DIV = 2 ns/div, DELAY = 29 ns
- Select the Delta t menu and turn the markers On
- Set START ON EDGE = POS1 and STOP ON EDGE = POS1

5. Set HP 8110A Period = 1  $\mu$ s

6. On the Scope press **PRECISE EDGE FIND** in the Delta t menu

7. Check that the HP 8110A rise time is < 2.5 ns

8. Enter the result in the Test Report as TR entry 8.2a - 1

**Test 8.2b: Min.Trailing edge for Level Window  $>\pm 5v$** 

1. Set the Scope timebase to:

- TIME/DIV = 2 ns/div
- DELAY = 529 ns
- Select the Delta t menu and turn the markers ON
- Set START ON EDGE = NEG1 and STOP ON EDGE = NEG1
- Press **Precise Edge Find**

2. Check that the HP 8110A fall time is < 2.5 ns

3. Enter the result in the Test Report as TR entry 8.2b - 1

**Note**

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Repeat the entire test for the second channel, if it is installed

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## Test 9: Pulse Aberration Test

The following tests are required:

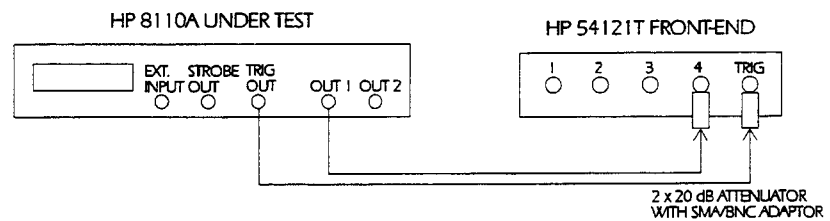
Overshoot and Ringing

Preshoot

**Test Specifications**      Overshoot/Preshoot/Ringing  
    $\pm 5\%$  of amplitude  $\pm 20$  mV

**Equipment Needed**      Digitizing Oscilloscope with Accessories

**Procedure**                1. Connect HP 8110A to the Scope as shown:



### Connecting HP 8110A to the Scope

2. Set up the HP 8110A as described in "Initial Setup of the HP 8110A"

3. On the HP 8110A press **MORE** and set up **OUTPUT 1** and **OUTPUT 2** pages as shown in the following illustrations:

|  |                              |             |                    |          |                       |          |                 |          |         |
|--|------------------------------|-------------|--------------------|----------|-----------------------|----------|-----------------|----------|---------|
| Per  | <b>500 <math>\mu</math>s</b> | Normal      | ON                 | <b>1</b> | <b>MODIFY</b>         |          |                 |          |         |
| Delay  | 0.00 ns                      |             |                    |          | <b>500</b><br>$\mu$ s |          |                 |          |         |
| DutyCyc  | 50.0%                        | High        | +5.00 V            |          |                       |          |                 |          |         |
| LeadEdg  | 2.00 ns                      | Low         | +0.0 mV            |          |                       |          |                 |          |         |
| Trailed  | 2.00 ns                      | 50 $\Omega$ | into 50.0 $\Omega$ |          |                       |          |                 |          |         |
| <table border="1"> <tr> <td>TRG-MODE</td> <td><b>OUTPUT 1</b></td> <td>OUTPUT 2</td> <td>PATTERN</td> </tr> </table> |                              |             |                    |          |                       | TRG-MODE | <b>OUTPUT 1</b> | OUTPUT 2 | PATTERN |
| TRG-MODE   | <b>OUTPUT 1</b>              | OUTPUT 2    | PATTERN            |          |                       |          |                 |          |         |

Configuring Output Screen 1

|  |                              |                 |                    |          |                       |          |          |                 |         |
|--|------------------------------|-----------------|--------------------|----------|-----------------------|----------|----------|-----------------|---------|
| Per  | <b>500 <math>\mu</math>s</b> | Normal          | OFF                | <b>2</b> | <b>MODIFY</b>         |          |          |                 |         |
| Delay  | 0.00 ns                      | Separate        | Out2               |          | <b>500</b><br>$\mu$ s |          |          |                 |         |
| DutyCyc  | 50.0%                        | High            | +5.00 V            |          |                       |          |          |                 |         |
| LeadEdg  | 2.00 ns                      | Low             | +0.0 mV            |          |                       |          |          |                 |         |
| Trailed  | 2.00 ns                      | 50 $\Omega$     | into 50.0 $\Omega$ |          |                       |          |          |                 |         |
| <table border="1"> <tr> <td>TRG-MODE</td> <td>OUTPUT 1</td> <td><b>OUTPUT 2</b></td> <td>PATTERN</td> </tr> </table> |                              |                 |                    |          |                       | TRG-MODE | OUTPUT 1 | <b>OUTPUT 2</b> | PATTERN |
| TRG-MODE   | OUTPUT 1                     | <b>OUTPUT 2</b> | PATTERN            |          |                       |          |          |                 |         |

Configuring Output Screen 2

**Note**



When you are testing instruments with 2 output channels it is necessary to:

- a. Configure *both* channels.
- b. Switch OFF the channel that is not being tested

If you then test the other channel:

- c. Switch ON the channel you are testing, and switch OFF the other channel.

**Overshoot and Ringing**

4. Set the digitizing oscilloscope HP 54121T:
  - Press **AUTOSCALE**
  - Select the Display menu and set the Number of Averages to 32
  - Select the Channel menu and set the Attenuation factor to 10
  - Center one pulse horizontally and vertically on screen (e.g. TIME/DIV = 50 $\mu$ s/div, DELAY = 365  $\mu$ s)
  - Select the delta V menu and turn the voltage markers On
  - Set the VARIABLE LEVELS = 95% - 105% and press **AUTO LEVEL SET**
  - Select the channel menu and center vertically the top pulse (offset = 5 V)
  - Set the VOLTS/DIV = 200 mV/div
  - Select the Timebase menu and set TIME/DIV = 5 ns/div, DELAY = 16 ns
5. Set the HP 8110A to period = 500 ns

6. Check that Overshoot and Ringing are within the  $\pm 5\%$  of amplitude  $\pm 20$  mV window
7. Enter the result in the Test Report as TR entry 9 - 1

## Note



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Take the oscilloscope's trace flatness error (GaAs input circuit) into account.

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8. Set HP 8110A to: high level = 500 mV
9. Repeat the Overshoot and Ringing test, but this time set the VARIABLE LEVELS = 91% - 109% and press **AUTO LEVEL SET**
10. Enter the result in the Test Report as TR entry 9 - 2

## Preshoot

11. Set HP 8110A to:
  - Period = 500  $\mu$ s
  - High Level = 5 V
  - Low Level = 0 V
  - Delay = 10 ns
12. Set the digitizing oscilloscope, HP 54121T:
  - Press **AUTOSCALE**
  - Select the Display menu and set the Number of Averages to 32
  - Select the Channel menu and set the Attenuation factor to 10
  - Center one pulse horizontally and vertically on screen (e.g. TIME/DIV = 50  $\mu$ s/div, DELAY = 365  $\mu$ s)
  - Select the delta V menu and turn the voltage markers On
  - Set the VARIABLE LEVELS = -5% to +5% and press **AUTO LEVEL SET**
  - Select the channel menu and center vertically the bottom of the pulse (offset = 0 V)
  - Set the VOLTS/DIV = 200 mV/div
  - Select the Timebase menu and set TIME/DIV = 5 ns/div, DELAY = 16 ns
13. Set HP 8110A to period = 500 ns
14. Check that Preshoot is within the  $\pm 5\%$  of amplitude  $\pm 20$  mV window.
15. Enter the result in the Test Report as TR entry 9 - 3

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# HP 8110A Performance Test Records

Test Facility:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Report No. \_\_\_\_\_

Date \_\_\_\_\_

Customer \_\_\_\_\_

Tested By \_\_\_\_\_

Model            HP 8110A 150 MHz Pulse Generator

Serial No.        \_\_\_\_\_

Ambient temperature \_\_\_\_\_ °C

Options            \_\_\_\_\_

Relative humidity    \_\_\_\_\_ %

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Firmware Rev.    \_\_\_\_\_

Line frequency        \_\_\_\_\_ Hz

Special Notes:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

### Test Equipment Used

| Description          | Model No. | Trace No. | Cal. Due Date |
|----------------------|-----------|-----------|---------------|
| 1. Oscilloscope      | HP 54121T | _____     | _____         |
| 2. Counter           | HP 5334B  | _____     | _____         |
| 4. Digital Voltmeter | HP 3458A  | _____     | _____         |
| 3. Pulse Generator   | HP 8112A  | _____     | _____         |
| 5. Delay Line        | HP 54008A | _____     | _____         |
| 6. _____             | _____     | _____     | _____         |
| 7. _____             | _____     | _____     | _____         |
| 8. _____             | _____     | _____     | _____         |
| 9. _____             | _____     | _____     | _____         |
| 10. _____            | _____     | _____     | _____         |
| 11. _____            | _____     | _____     | _____         |
| 12. _____            | _____     | _____     | _____         |
| 13. _____            | _____     | _____     | _____         |
| 14. _____            | _____     | _____     | _____         |
| 15. _____            | _____     | _____     | _____         |
| 16. _____            | _____     | _____     | _____         |
| 17. _____            | _____     | _____     | _____         |
| 18. _____            | _____     | _____     | _____         |

**Test Results for HP 8110A Mainframe**

Serial No. \_\_\_\_\_ Ambient temperature \_\_\_\_\_ °C  
 Customer \_\_\_\_\_ Relative humidity \_\_\_\_\_ %  
 CSO# \_\_\_\_\_ Line frequency \_\_\_\_\_ Hz  
 Tested by \_\_\_\_\_ Date \_\_\_\_\_

Comments:

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**Internal Oscillator Period**

Scope Uncertainty factor \_\_\_\_\_

| TR Entry | Test    | Limit<br>Minimum | Actual<br>Result | Limit<br>Maximum | Pass | Fail |
|----------|---------|------------------|------------------|------------------|------|------|
| 1 - 1    | 6.65 ns | 6.2175 ns        | _____            | 7.0825 ns        | ___  | ___  |
| 1 - 2    | 9.99 ns | 9.390 ns         | _____            | 10.589 ns        | ___  | ___  |
| 1 - 3    | 10.0 ns | 9.4 ns           | _____            | 10.6 ns          | ___  | ___  |
| 1 - 4    | 50.0 ns | 47.4 ns          | _____            | 52.6 ns          | ___  | ___  |
| 1 - 5    | 99.9 ns | 94.805 ns        | _____            | 104.995 ns       | ___  | ___  |

Counter Uncertainty factor \_\_\_\_\_

| TR Entry | Test      | Limit<br>Minimum | Actual<br>Result | Limit<br>Maximum | Pass | Fail |
|----------|-----------|------------------|------------------|------------------|------|------|
| 1 - 6    | 100 ns    | 94.9 ns          | _____            | 105.1 ns         | ___  | ___  |
| 1 - 7    | 500 ns    | 474.9 ns         | _____            | 525.1 ns         | ___  | ___  |
| 1 - 8    | 1 $\mu$ s | 949.9 ns         | _____            | 1050.1 ns        | ___  | ___  |

**Internal Oscillator Period (continued)**

| TR Entry | Test        | Limit<br>Minimum | Actual<br>Result | Limit<br>Maximum | Pass | Fail |
|----------|-------------|------------------|------------------|------------------|------|------|
| 1 - 9    | 5 $\mu$ s   | 4.75 $\mu$ s     | _____            | 5.25 $\mu$ s     | ___  | ___  |
| 1 - 10   | 50 $\mu$ s  | 47.5 $\mu$ s     | _____            | 52.5 $\mu$ s     | ___  | ___  |
| 1 - 11   | 500 $\mu$ s | 475 $\mu$ s      | _____            | 525 $\mu$ s      | ___  | ___  |
| 1 - 12   | 5 ms        | 4.75ms           | _____            | 5.35 ms          | ___  | ___  |
| 1 - 13   | 50 ms       | 47.5 ms          | _____            | 52.5 ms          | ___  | ___  |
| 1 - 14   | 500 ms      | 475 ms           | _____            | 525 ms           | ___  | ___  |

**Internal Period Jitter**

Scope Uncertainty factor \_\_\_\_\_

| TR Entry | Test   | Limit<br>Minimum | Actual<br>Result | Limit<br>Maximum | Pass | Fail |
|----------|--------|------------------|------------------|------------------|------|------|
| 6.2 - 1  | 50 ns  |                  | _____            | 50 ps            | ___  | ___  |
| 6.2 - 2  | 500 ns |                  | _____            | 175 ps           | ___  | ___  |

### Test Results for HP 81103A 2ns/10V Output Board

Serial No. \_\_\_\_\_ Ambient temperature \_\_\_\_\_ °C  
 Customer \_\_\_\_\_ Relative humidity \_\_\_\_\_ %  
 CSO# \_\_\_\_\_ Line frequency \_\_\_\_\_ Hz  
 Tested by \_\_\_\_\_ Date \_\_\_\_\_

Comments:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

#### Width

Scope Uncertainty factor \_\_\_\_\_

| TR Entry | Test    | Limit<br>Minimum | Actual<br>Result | Limit<br>Maximum | Pass | Fail |
|----------|---------|------------------|------------------|------------------|------|------|
| 3 - 1    | 3.30 ns | 2.885 ns         | _____            | 3.715 ns         | ___  | ___  |
| 3 - 2    | 6.60 ns | 6.020 ns         | _____            | 7.180 ns         | ___  | ___  |
| 3 - 3    | 9.99 ns | 9.240 ns         | _____            | 10.739 ns        | ___  | ___  |
| 3 - 4    | 10.0 ns | 9.250 ns         | _____            | 10.750 ns        | ___  | ___  |
| 3 - 5    | 50.0 ns | 47.25 ns         | _____            | 52.75 ns         | ___  | ___  |
| 3 - 6    | 99.9 ns | 94.655 ns        | _____            | 105.145 ns       | ___  | ___  |
| 3 - 7    | 100 ns  | 94.75 ns         | _____            | 105.25 ns        | ___  | ___  |
| 3 - 8    | 500 ns  | 474.75 ns        | _____            | 525.25 ns        | ___  | ___  |



**Width (continued)**

Counter Uncertainty factor \_\_\_\_\_

| TR Entry | Test        | Limit<br>Minimum | Actual<br>Result | Limit<br>Maximum | Pass | Fail |
|----------|-------------|------------------|------------------|------------------|------|------|
| 3 - 9    | 1 $\mu$ s   | 949.75 ns        | _____            | 1050.25 $\mu$ s  | ___  | ___  |
| 3 - 10   | 5 $\mu$ s   | 4.75 $\mu$ s     | _____            | 5.25 $\mu$ s     | ___  | ___  |
| 3 - 11   | 50 $\mu$ s  | 47.5 $\mu$ s     | _____            | 52.5 $\mu$ s     | ___  | ___  |
| 3 - 12   | 500 $\mu$ s | 475 $\mu$ s      | _____            | 525 $\mu$ s      | ___  | ___  |
| 3 - 13   | 5 ms        | 4.75 ms          | _____            | 5.25 ms          | ___  | ___  |
| 3 - 14   | 50 ms       | 47.5 ms          | _____            | 52.5 ms          | ___  | ___  |
| 3 - 15   | 500ms       | 475 ms           | _____            | 525 ms           | ___  | ___  |

**Width Jitter**

Scope Uncertainty factor \_\_\_\_\_

| TR Entry | Test   | Limit<br>Minimum | Actual<br>Result | Limit<br>Maximum | Pass | Fail |
|----------|--------|------------------|------------------|------------------|------|------|
| 6.2 - 1  | 50 ns  |                  | _____            | 50 ps            | ___  | ___  |
| 6.2 - 2  | 500 ns |                  | _____            | 175 ps           | ___  | ___  |

### Delay

Scope Uncertainty factor \_\_\_\_\_

| TR Entry | Test    | Limit Minimum | Actual Result | Limit Maximum | Pass | Fail |
|----------|---------|---------------|---------------|---------------|------|------|
| 4 - 1    | 0.00 ns |               | _____         | Fixed Delay   | ___  | ___  |
| 4 - 2    | 5.00 ns | 3.75 ns       | _____         | 6.25 ns       | ___  | ___  |
| 4 - 3    | 9.99 ns | 8.49 ns       | _____         | 11.49 ns      | ___  | ___  |
| 4 - 4    | 50.0 ns | 46.5 ns       | _____         | 53.5 ns       | ___  | ___  |
| 4 - 5    | 99.9 ns | 93.905 ns     | _____         | 105.895 ns    | ___  | ___  |
| 4 - 6    | 100 ns  | 94 ns         | _____         | 106 ns        | ___  | ___  |
| 4 - 7    | 500 ns  | 474 ns        | _____         | 526 ns        | ___  | ___  |

### Delay (continued)

Counter Uncertainty factor \_\_\_\_\_

| TR Entry | Test        | Limit Minimum | Actual Result | Limit Maximum | Pass | Fail |
|----------|-------------|---------------|---------------|---------------|------|------|
| 4 - 8    | 1 $\mu$ s   | 949 ns        | _____         | 1051 ns       | ___  | ___  |
| 4 - 9    | 5 $\mu$ s   | 4.749 $\mu$ s | _____         | 5.251 $\mu$ s | ___  | ___  |
| 4 - 10   | 50 $\mu$ s  | 47.5 $\mu$ s  | _____         | 52.5 $\mu$ s  | ___  | ___  |
| 4 - 11   | 500 $\mu$ s | 475 $\mu$ s   | _____         | 525 $\mu$ s   | ___  | ___  |
| 4 - 12   | 5 ms        | 4.75 ms       | _____         | 5.25 ms       | ___  | ___  |
| 4 - 13   | 50 ms       | 47.5 ms       | _____         | 52.5 ms       | ___  | ___  |
| 4 - 14   | 500ms       | 475 ms        | _____         | 525 ms        | ___  | ___  |

### Delay Jitter

Scope Uncertainty factor \_\_\_\_\_

| TR Entry | Test | Limit<br>Minimum | Actual<br>Result | Limit<br>Maximum | Pass | Fail |
|----------|------|------------------|------------------|------------------|------|------|
| 6.3 - 1  |      |                  | _____            | 50 ps            | ___  | ___  |
| 6.3 - 2  |      |                  | _____            | 175 ps           | ___  | ___  |

### Double Pulse Delay

Scope Uncertainty factor \_\_\_\_\_

| TR Entry | Test    | Limit<br>Minimum | Actual<br>Result | Limit<br>Maximum | Pass | Fail |
|----------|---------|------------------|------------------|------------------|------|------|
| 5 - 1    | 6.65 ns | 6.0675 ns        | _____            | 7.2325 ns        | ___  | ___  |
| 5 - 2    | 9.99 ns | 9.241 ns         | _____            | 10.74 ns         | ___  | ___  |
| 5 - 3    | 50.0 ns | 47.25 ns         | _____            | 52.75 ns         | ___  | ___  |
| 5 - 4    | 99.9 ns | 94.655 ns        | _____            | 105.145 ns       | ___  | ___  |

Counter Uncertainty factor \_\_\_\_\_

| TR Entry | Test        | Limit<br>Minimum | Actual<br>Result | Limit<br>Maximum | Pass | Fail |
|----------|-------------|------------------|------------------|------------------|------|------|
| 5 - 5    | 100 ns      | 94.75 ns         | _____            | 105.25 ns        | ___  | ___  |
| 5 - 6    | 500 ns      | 474.75 ns        | _____            | 525.25 ns        | ___  | ___  |
| 5 - 7    | 1 $\mu$ s   | 949.75 ns        | _____            | 1050.25 $\mu$ s  | ___  | ___  |
| 5 - 8    | 5 $\mu$ s   | 4.759 $\mu$ s    | _____            | 5.25 $\mu$ s     | ___  | ___  |
| 5 - 9    | 50 $\mu$ s  | 47.5 $\mu$ s     | _____            | 52.5 $\mu$ s     | ___  | ___  |
| 5 - 10   | 500 $\mu$ s | 475 $\mu$ s      | _____            | 525 $\mu$ s      | ___  | ___  |
| 5 - 11   | 5 ms        | 4.75 ms          | _____            | 5.25 ms          | ___  | ___  |
| 5 - 12   | 50 ms       | 47.5 ms          | _____            | 52.5 ms          | ___  | ___  |
| 5 - 13   | 500 ms      | 475 ms           | _____            | 525 ms           | ___  | ___  |

**High Level 50Ω-50Ω**

| TR Entry | Test   | Limit<br>Minimum | Actual<br>Result | Limit<br>Maximum | Pass | Fail |
|----------|--------|------------------|------------------|------------------|------|------|
| 7.1 - 1  | 10.0 V | 9.85 V           | _____            | 10.15 V          | ___  | ___  |
| 7.1 - 2  | 5.0 V  | 4.90 V           | _____            | 5.10 V           | ___  | ___  |
| 7.1 - 3  | 3.0 V  | 2.92 V           | _____            | 3.08 V           | ___  | ___  |
| 7.1 - 4  | 1.0 V  | 0.94 V           | _____            | 1.06 V           | ___  | ___  |
| 7.1 - 5  | 0.5 V  | 445 mV           | _____            | 555 mV           | ___  | ___  |
| 7.1 - 6  | 0.1 V  | 49 mV            | _____            | 151 mV           | ___  | ___  |

**High Level 1KΩ-50Ω**

| TR Entry | Test   | Limit<br>Minimum | Actual<br>Result | Limit<br>Maximum | Pass | Fail |
|----------|--------|------------------|------------------|------------------|------|------|
| 7.3 - 1  | 19.0 V | 18.71 V          | _____            | 19.29 V          | ___  | ___  |
| 7.3 - 2  | 10.0 V | 9.80 V           | _____            | 10.20 V          | ___  | ___  |
| 7.3 - 3  | 5.0 V  | 4.85 V           | _____            | 5.15 V           | ___  | ___  |
| 7.3 - 4  | 1.0 V  | 0.89 V           | _____            | 1.11 V           | ___  | ___  |
| 7.3 - 5  | 0.2 V  | 98 mV            | _____            | 302 mV           | ___  | ___  |

**Low Level 50Ω-50Ω**

| TR Entry | Test    | Limit<br>Minimum | Actual<br>Result | Limit<br>Maximum | Pass | Fail |
|----------|---------|------------------|------------------|------------------|------|------|
| 7.2 - 1  | -0.1 V  | -49 mV           | _____            | -151 mV          | ___  | ___  |
| 7.2 - 2  | -0.5 V  | -445 mV          | _____            | -555 mV          | ___  | ___  |
| 7.2 - 3  | -1.0 V  | -0.94 V          | _____            | -1.06 V          | ___  | ___  |
| 7.2 - 4  | -3.0 V  | -2.92 V          | _____            | 3.08 V           | ___  | ___  |
| 7.2 - 5  | -5.0 V  | -4.90 V          | _____            | -5.10 V          | ___  | ___  |
| 7.2 - 6  | -10.0 V | -9.85 V          | _____            | 10.15 V          | ___  | ___  |

**Low Level 1KΩ-50Ω**

| TR Entry | Test    | Limit<br>Minimum | Actual<br>Result | Limit<br>Maximum | Pass | Fail |
|----------|---------|------------------|------------------|------------------|------|------|
| 7.4 - 1  | -0.2 V  | -98 mV           | _____            | -302 mV          | ___  | ___  |
| 7.4 - 2  | -1.0 V  | -0.89 mV         | _____            | -1.11 V          | ___  | ___  |
| 7.4 - 3  | -5.0 V  | -4.85 V          | _____            | -5.15 V          | ___  | ___  |
| 7.4 - 4  | -10.0 V | -9.80 V          | _____            | 10.20 V          | ___  | ___  |
| 7.4 - 5  | -19.0 V | -18.71 V         | _____            | -19.29 V         | ___  | ___  |

Leading Edge for  $\leq \pm 5V$  Level Window

Scope Uncertainty factor \_\_\_\_\_

| TR Entry | Test        | Limit Minimum  | Actual Result | Limit Maximum  | Pass  | Fail  |
|----------|-------------|----------------|---------------|----------------|-------|-------|
| 8.1a - 1 | 1.8 ns      |                | _____         | $\leq 2$ ns    | _____ | _____ |
| 8.1a - 2 | 10 ns       | 8.8 ns         | _____         | 11.2 ns        | _____ | _____ |
| 8.1a - 3 | 50 ns       | 44.8 ns        | _____         | 55.2ns         | _____ | _____ |
| 8.1a - 4 | 500 ns      | 449.8 ns       | _____         | 550.2 ns       | _____ | _____ |
| 8.1a - 5 | 5 $\mu s$   | 4.4998 $\mu s$ | _____         | 5.5002 $\mu s$ | _____ | _____ |
| 8.1a - 6 | 50 $\mu s$  | 45 $\mu s$     | _____         | 55 $\mu s$     | _____ | _____ |
| 8.1a - 7 | 500 $\mu s$ | 450 $\mu s$    | _____         | 550 $\mu$      | _____ | _____ |
| 8.1a - 8 | 50 ms       | 45 ms          | _____         | 55 ms          | _____ | _____ |

Trailing Edge for  $\leq \pm 5V$  Level Window

| TR Entry | Test        | Limit Minimum  | Actual Result | Limit Maximum  | Pass  | Fail  |
|----------|-------------|----------------|---------------|----------------|-------|-------|
| 8.1b - 1 | 1.8 ns      |                | _____         | $\leq 2$ ns    | _____ | _____ |
| 8.1b - 2 | 10 ns       | 8.8 ns         | _____         | 11.2 ns        | _____ | _____ |
| 8.1b - 3 | 50 ns       | 44.8 ns        | _____         | 55.2ns         | _____ | _____ |
| 8.1b - 4 | 500 ns      | 449.8 ns       | _____         | 550.2 ns       | _____ | _____ |
| 8.1b - 5 | 5 $\mu s$   | 4.4998 $\mu s$ | _____         | 5.5002 $\mu s$ | _____ | _____ |
| 8.1b - 6 | 50 $\mu s$  | 45 $\mu s$     | _____         | 55 $\mu s$     | _____ | _____ |
| 8.1b - 7 | 500 $\mu s$ | 450 $\mu s$    | _____         | 550 $\mu$      | _____ | _____ |
| 8.1b - 8 | 50 ms       | 45 ms          | _____         | 55 ms          | _____ | _____ |

Leading Edge for  $> \pm 5V$  Level Window

| TR Entry | Test      | Limit<br>Minimum | Actual<br>Result | Limit<br>Maximum | Pass | Fail |
|----------|-----------|------------------|------------------|------------------|------|------|
| 8.2a - 1 | $2 \mu s$ |                  | _____            | $< 2.5 \mu s$    | ___  | ___  |

Trailing Edge for  $> \pm 5V$  Level Window

| TR Entry | Test      | Limit<br>Minimum | Actual<br>Result | Limit<br>Maximum | Pass | Fail |
|----------|-----------|------------------|------------------|------------------|------|------|
| 8.2b - 1 | $2 \mu s$ |                  | _____            | $< 2.5 \mu s$    | ___  | ___  |

Overshoot and Ringing

Scope Uncertainty factor \_\_\_\_\_

| TR Entry | Test  | Limit<br>Minimum | Actual<br>Result | Limit<br>Maximum                 | Pass | Fail |
|----------|-------|------------------|------------------|----------------------------------|------|------|
| 9 - 1    | 5V    |                  | _____            | $\pm 5\%$ of ampl.<br>$\pm 20mV$ | ___  | ___  |
| 9 - 2    | 500mV |                  | _____            | $\pm 5\%$ of ampl.<br>$\pm 20mV$ | ___  | ___  |

Preshoot

| TR Entry | Test | Limit<br>Minimum | Actual<br>Result | Limit<br>Maximum                 | Pass | Fail |
|----------|------|------------------|------------------|----------------------------------|------|------|
| 9 - 3    | 0 V  |                  | _____            | $\pm 5\%$ of ampl.<br>$\pm 20mV$ | ___  | ___  |

**Test Results for HP 81106A PLL/External Clock Board**

Serial No. \_\_\_\_\_ Ambient temperature \_\_\_\_\_ °C

Customer \_\_\_\_\_ Relative humidity \_\_\_\_\_ %

CSO# \_\_\_\_\_ Line frequency \_\_\_\_\_ Hz

Tested by \_\_\_\_\_ Date \_\_\_\_\_

Comments:

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**HP 8110A Service Guide**

**PLL Period**  
(Results measured as frequency by counter)

Counter Uncertainty factor \_\_\_\_\_

| TR Entry | Test        | Limit Minimum | Actual Result | Limit Maximum | Pass | Fail |
|----------|-------------|---------------|---------------|---------------|------|------|
| 2 - 1    | 6.650 ns    | 150.3759 MHz  | _____         | 150.5264 MHz  | ___  | ___  |
| 2 - 2    | 9.999 ns    | 99.910 MHz    | _____         | 100.110 MHz   | ___  | ___  |
| 2 - 3    | 10.00 ns    | 99.900 MHz    | _____         | 100.100 MHz   | ___  | ___  |
| 2 - 4    | 50.00 ns    | 19.980 MHz    | _____         | 20.020 MHz    | ___  | ___  |
| 2 - 5    | 99.99 ns    | 9.991 MHz     | _____         | 10.011 MHz    | ___  | ___  |
| 2 - 6    | 100 ns      | 9.990 MHz     | _____         | 10.010 Mhz    | ___  | ___  |
| 2 - 7    | 500 ns      | 1.998 MHz     | _____         | 2.002 MHz     | ___  | ___  |
| 2 - 8    | 1 $\mu$ s   | 999 kHz       | _____         | 1.001 MHz     | ___  | ___  |
| 2 - 9    | 5 $\mu$ s   | 199.800 kHz   | _____         | 200.200 kHz   | ___  | ___  |
| 2 - 10   | 50 $\mu$ s  | 19.980 kHz    | _____         | 20.020 kHz    | ___  | ___  |
| 2 - 11   | 500 $\mu$ s | 1.998 kHz     | _____         | 2.002 kHz     | ___  | ___  |
| 2 - 12   | 5 ms        | 199.800 Hz    | _____         | 200.200 Hz    | ___  | ___  |
| 2 - 13   | 50 ms       | 19.980 Hz     | _____         | 20.020 Hz     | ___  | ___  |
| 2 - 14   | 500 ms      | 1.998 Hz      | _____         | 2.002 Hz      | ___  | ___  |
| 2 - 15   | 5 s         | 0.1998 Hz     | _____         | 0.2002 Hz     | ___  | ___  |

**PLL Period Jitter**

Scope Uncertainty factor \_\_\_\_\_

| TR Entry | Test  | Limit Minimum | Actual Result | Limit Maximum | Pass | Fail |
|----------|-------|---------------|---------------|---------------|------|------|
| 6.1b - 1 | 20 ns |               | _____         | 20.6 ps       | ___  | ___  |

## Troubleshooting

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Some of the components on the PC Boards fitted in the HP 8110A use SMT (Surface-Mounted Technology). These components are difficult to replace in the field. Other boards use part SMT and part Through-Hole Plated. Through-hole mounted components are not as difficult to change as SMT. The Power Supply Board uses Through-Hole, and can be repaired down to component level.

The following table lists HP 8110A boards, stating whether they are standard or optional, and the component mounting method:

**Table 4-1. Field Repair Level of HP 8110A Boards**

| Board Name                   | Standard or Optional | Through-hole board | SMT board |
|------------------------------|----------------------|--------------------|-----------|
| Microprocessor               | Standard             | No                 | Yes       |
| Power Supply                 | Standard             | Yes                | No        |
| Period Board                 | Standard             | Yes                | No        |
| Output 1 Board               | Standard             | Part               | Part      |
| Output 2 Board               | Optional             | Part               | Part      |
| Memory Card \Connector Board | Standard             | Yes                | No        |
| Memory Card                  | Standard             | N/a                | N/a       |
| PLL Board                    | Optional             | Yes                | No        |
| Deskew Board                 | Optional             | No                 | Yes       |

This chapter begins with Selftest procedures. If the instrument is completely dead, begin working from “Initial Tests”

## Selftest

### Power-Up Selftest

The HP 8110A Selftest checks only the Microprocessor Board at power-up. If this test fails you can press **HELP** to see a list of the specific error messages resulting from the test. If the list is longer than a single screen, use the cursor keys to scroll the list.

Note that a long error list can result from a single initial error. Therefore, begin to solve problems starting with the first message in the list and after the problem is cleared run Selftest again.

These messages are stored in the Flash EEPROMs or on the Memory Card.

### Extended Selftest

The extended Selftest tests all installed boards.

Start the extended selftest on the **CONFIG** screen:

1. Use the Knob to select **Signal**
2. Press **ENTER**.

If the Selftest fails, a flashing **E** is displayed. Press **HELP** to see the list of error messages.

### Confidence Level

It is not possible to give a Confidence Level figure for the Selftests.

After completion of Performance tests a confidence level of 96% can be assumed. This is because all possible settings and functions are not checked by the Performance Tests.

## Microprocessor Selftest Failure Messages

The following is a list of the Microprocessor Board error messages and their meanings. The first part of the list shows the messages as they are displayed on the instrument. The HP-IB messages are identical, but with the message: **-330 Self-test failed** added in front.

Selftest error: Microproc. board failed

Hardware failure on the Microprocessor Board

ROM test failed Flash EPROMs have failed test.

RAM test failed RAMs have failed test

Crystal Reference for uP lost

Loss of crystal reference. The VCO is running at approximately half normal operating speed, determined by an internal voltage reference for the VCO, instead of the external crystal frequency

VCO for uP has not locked

VCO is enabled but has not yet locked. Normally the VCO locks-on to the required frequency

Unexpected Reset of uP

Reset was caused by one of the following:

- Powerup Reset circuit
- System protection submodule halt monitor
- loss of frequency reference to clock submodule
- loss of frequency reference to test submodule

Normally a reset would be caused by an external signal or by the CPU executing a reset instruction

Internal Serial Device Bus failed

Internal Serial Device bus traffic over the feedback bus has failed

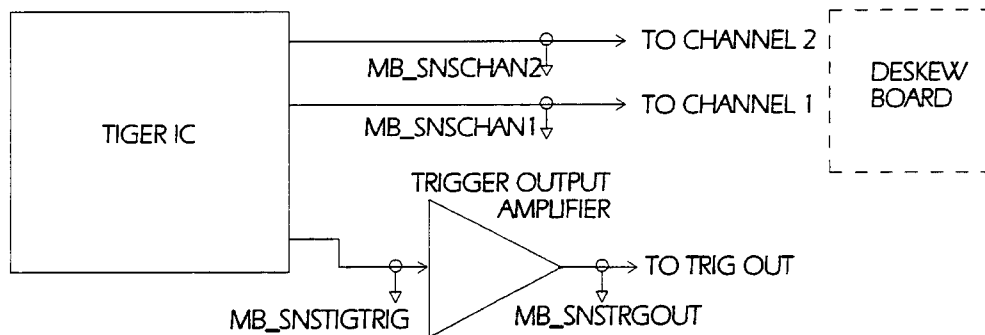
**Signal Boards Selftest**

This section in the Selftest facility tests the Output Board and then the Period Board. It is not automatically run at power-up. You can start this part of the Selftest routine as follows:

1. Switch the instrument ON
2. Wait for the Microprocessor Selftest to finish
3. Press **MORE** and **CONFIG**
4. Using the cursor keys move the highlight down to **Perform Selftest**
5. Using the knob, select **Signal**
6. Press **ENTER**

**Period Board Selftest**

Figure 4-1 shows the Selftest points on the Period Board. This is followed by a list of the possible failure messages.



**Figure 4-1. Testpoints used in Period Board Selftest**

### Period Board Selftest Failure Messages

the HP-IB messages are identical, but with the message: **-330 Self-test failed** added in front.

Ch 1: No output signal PERIOD TIGER  
 Selftest cannot find an output signal on the Period Board

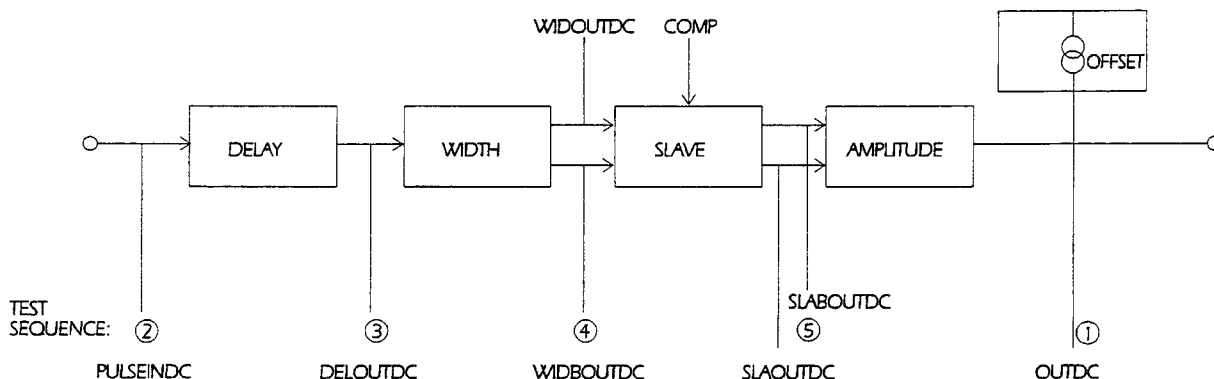
Ch 2: No output signal PERIOD TIGER  
 Selftest cannot find an output signal on the Period Board

No output signal PERIOD TIGER  
 Selftest cannot find a signal on the input to the trigger Output amplifier

Failure in TRIGGER OUTPUT circuitry  
 Selftest cannot find a signal after the Trigger Output amplifier

### Output Board Selftest

Figure 4-2 shows the Selftest points on the Output Board. This is followed by a list of the possible failure messages.



**Figure 4-2. Testpoints used in Output Board Selftest**

### Output Board Selftest Failure Messages

Except for the single exception given in the following list, the HP-IB messages are identical, but with the message: **-330 Self-test failed** added in front.

No input signal at channel board  
 There is no input signal to a channel board

Ch: 1 (or 2) Failure in DELAY circuitry  
 The TIGER IC on the Output Board may be faulty

- Ch: 1 (or 2) Failure in WIDTH circuitry  
The TIGER IC on the Output Board may be faulty
- Ch: 1 (or 2) Failure in SLOPE circuitry  
The SLOPE (SLAVE) circuitry on the Output Board may be faulty
- Ch: 1 (or 2) Failure in AMP/OFFS circuitry  
The Amplifier or the Offset circuitry on the Output Board may be faulty. The HP-IB message is: Ch: 1 (or 2) Failure in AMPLIFIER or OFFSET circuitry

## Initial Tests

There could be a number of reasons why HP 8110A shows no signs of operating. If the instrument appears to be dead, proceed as indicated in Figure 4-3. The figure is divided into two parts: the checks that you should perform if the instrument appears to be “dead” are above the dotted line. If these tests do not solve the problem, continue with the tests below the dotted-line. If these tests do not lead to a section containing information that does solve the problem, look in the text in this chapter for a heading that might apply to the fault.

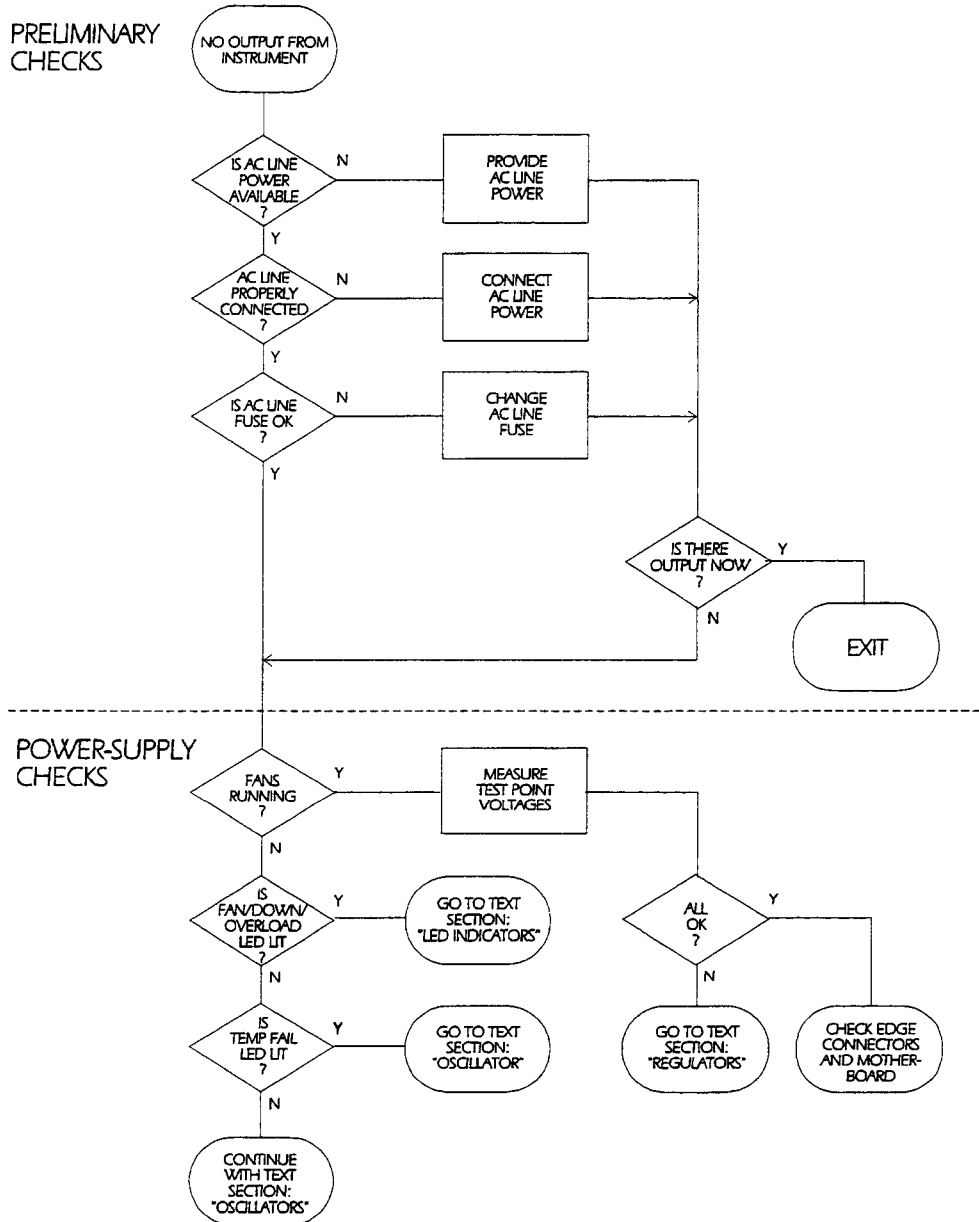


Figure 4-3. getting Started with Troubleshooting the HP 8110A

Troubleshooting information for the individual boards is given on the following pages:

## Power Supply Board

Figure 4-4 gives a general view of the Power Supply Board, showing voltage test points at the lower left corner.

In the diagram the double dashed line across the board divides the Primary and Secondary Sections of the Power Supply.

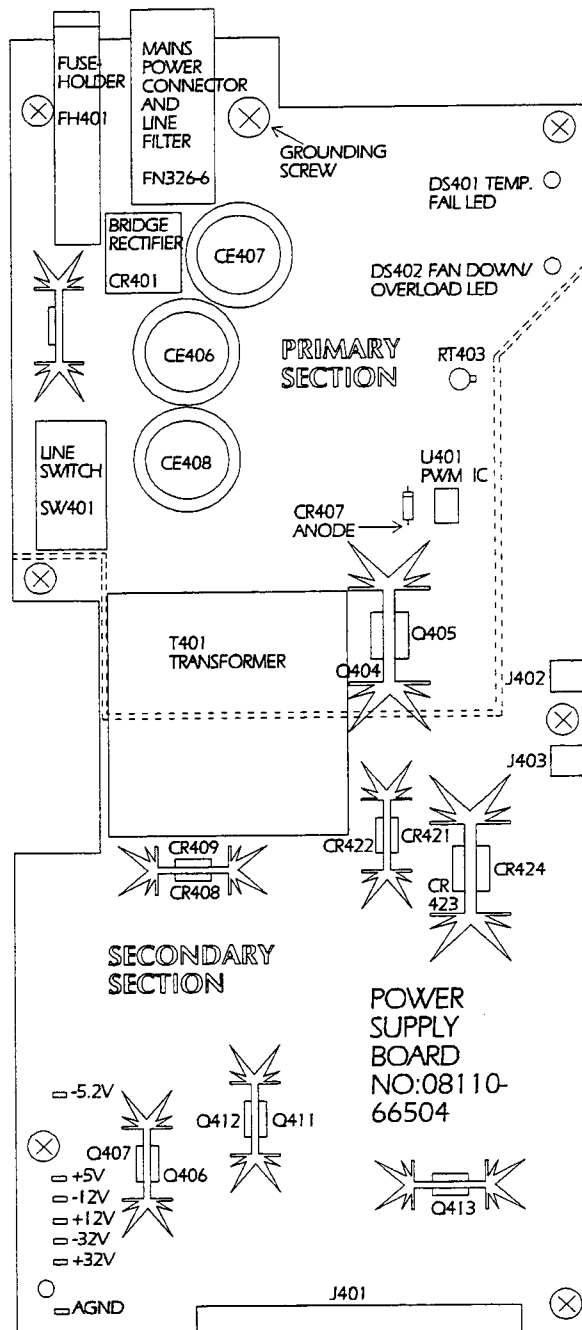


Figure 4-4. The Power Supply Board



**Caution**



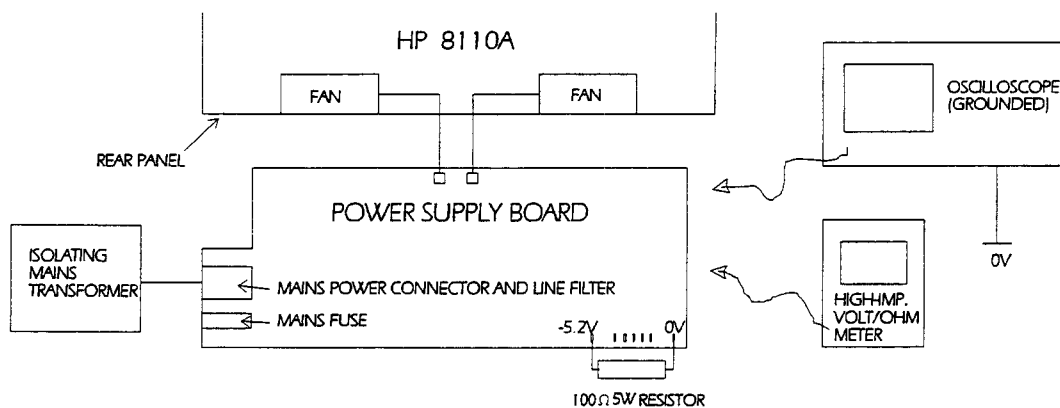
Some voltages on the Primary Section of the Power Supply are dangerous and can kill. For your own safety do not touch these parts. Using an isolating transformer may prevent these voltages from being fatal, but electrical shocks from the unit can cause serious discomfort, especially on capacitors C406, C407 and C408 (see Figure 4-4 for their position).

**Getting Started**

Before you start troubleshooting on the Power Supply Board some setting-up is needed. Figure 4-5 shows what the setup looks like when you are ready to start. You need the following equipment:

1. The main chassis of the HP 8110A
2. An isolating mains transformer
3. An Oscilloscope with grounding to the mains earth
4. A High-impedance Voltmeter
5. A 100Ω resistor, 5W.

First remove the instrument cover and the Power Supply Board, as shown in Figure 4-5. Place the PC Board in front of you on the bench, with the instrument chassis behind it, as shown in Figure 4-5



**Figure 4-5. Test Setup for the Power Supply Board**

On the Power Supply Board:

1. Connect the cable from the isolating mains transformer to the mains power connector
2. Connect the 2 fans to J402 and J403. This is essential as the Power Supply will not run with the fans disconnected
3. Connect the 100Ω resistor between the -5.2 V test point and the AGND (0V) test point
4. Apply power to the isolating transformer and observe the fans.

If the fans are not running:

1. Check that neither of the two LEDs are illuminated (DS401 and DS402 in Figure 4-4). This situation is covered by the flowchart in Figure 4-3
2. disconnect mains power and check that the fans are physically OK - free from damage or obstruction
3. Using an Ohmmeter check for  $<1 \Omega$  continuity: the main fuse, FH401, inductor LP401, switch S401, filter FL401 and the mains cable, including any fuse fitted in the power plug.

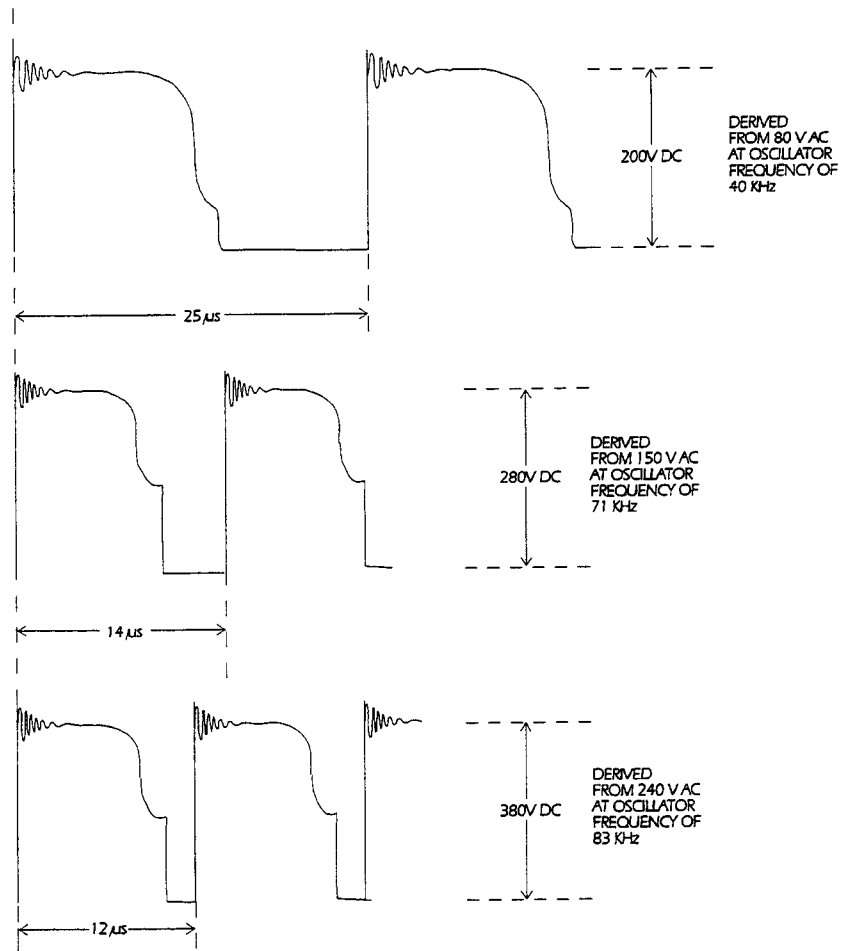
Triac D401 suppresses low impedance voltage peaks on the supply line. If this triac fails, it may not be immediately noticeable, but test-bench fuses may fail if high line voltage peaks occur during high current operation of the HP 8110A.

After these preliminary checks continue by checking whether the oscillator is operating.

### Oscillator

A PWM (Pulse Width Modulation) oscillator provides drive for T401A, the transformer. Assuming that the regulators are not functioning correctly, the first check is that the oscillator is functioning. Proceed as follows:

1. Set the Scope to 500 V DC
2. Connect the Scope to CR407 anode (see Figure 4-4 for connexion point).
3. Check that the observed waveforms are similar to those shown in Figure 4-6



**Figure 4-6. Waveforms at CR407 anode**

If there are no waveforms, and LEDs DS401 and DS402 (Figure 4-4) are not illuminated, check at CR401+ for 100 V - 360 V DC, depending on mains input voltage. If this voltage is present, switch the power OFF and perform continuity checks on FETs Q404 and Q405, plus forward and reverse resistance of diode CR407. If the FETs read short-circuit they are faulty.

If waveforms are still not there, or are showing unusual behaviour, switch OFF and check all diodes (including LEDs) in the Primary Section. In most cases it is sufficient to check the diodes while soldered in position, using an impedance measurement.

Components most likely to be faulty in this area are:

- Q402 - base/emitter short
- CR405 - short-circuit
- Z401 - open circuit, short-circuit, out of specification
- U401 - output stage faulty

FETs Q404 and Q405 are pressed into contact with the heatsink using a spring clamp. Remove this to replace either device. However,

as the FETs Q404 are mounted close to T401, they may prove difficult to remove. In this case, remove the complete subassembly of Q404, Q405 and the heatsink by unsoldering it from the PC Board.

**Caution**


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When changing devices mounted on heatsinks, take care not to damage the insulator between the device and the heatsink.

When replacing devices mounted on heatsinks, do not forget to check the insulator for damage, then replace the spring clamp.

---

**LED Indicators**

When the LED indicators are illuminated the oscillator is not operating.

**DS401, Temperature Fail**

The operation of this circuit is governed by thermistor RT403 (MOXIE). Measure the voltage on the cathode of CR405. This should be in the region of +12 V. If the voltage is considerably higher than this (about +20 V) then Z401 can be considered faulty (open-circuit). A voltage below about +9 V indicates that RT403 is operating, and LED DS401 would be illuminated.

If this voltage is below 8.5 V suspect a fault in the surrounding circuitry. You can apply a quick test by touching RT403 briefly with a source of heat (the barrel of a soldering iron, for example, but **MAKE SURE** that the soldering iron is powered by an isolating transformer).

The voltage on the cathode of CR405 should fall if the RT403 is operating. In cases of overheating, you can get the oscillator going again quickly, by spraying a temperature-reducing aerosol on the thermistor.

**DS402, Fan Down/Overload**

When this LED operates, it remains on for 1 minute due to Q408 holding current. The holding current will only fall below its lower limit when the Power Supply is switched OFF and switched on again after waiting about 1 minute. The oscillator cannot be re-started until this time is over.

As a quick test, if you want to restart the oscillator, without waiting the full minute, short U401, pin 6, to pin 4, briefly. While this connection is made the oscillator will not run, but will start again immediately on release of the short (as long as nothing else is faulty!).

DS402 is driven from thyristor Q408 and optocoupler CP401. If one or both fans is disconnected, Q409 base goes high and Q409 switches Q410 ON, operating opto-coupler CP401, which switches thyristor Q408 ON, thus switching the oscillator OFF through LED DS402.

If either fan draws in excess of about 150% of normal requirement then Q410 is switched ON through the gating of U403. This indicates that one or both of the fans may be blocked or faulty.

If a regulator output is short-circuited the signal SHORT switches Q10 ON.

If you suspect a possible fault in the Fan Control/Overload circuit, and want to isolate it from the rest of the circuitry, proceed as follows:

1. Make a short-circuit across pins 1 and 2 of opto-coupler CP401. (you may also need to short pin6 to pin 4 on U401 to start the oscillator)
2. Ensure that the only load is the 100 $\Omega$  resistor on the -5.2 V regulator.
3. Set the Scope to 500 V DC
4. Connect the Scope to CR407 anode (see Figure 4-4 for connexion point).
5. Check that the observed waveforms are similar to those shown in Figure 4-6
6. Switch off mains power and remove the short across the optocoupler.

If the oscillator is willing operate with the opto-coupler pins shorted, then there is a fault in the fan control and short-circuit detection circuitry.

If the waveforms are present and correct and it is known that regulator outputs are unloaded (except for the -5.2 V regulator), then suspect the Fan Control/Overload circuit.

## Regulators

Two of the regulators are of greatest importance in the Power Supply: -5.2 V and +32 V. The -5.2 V regulator must be working, as failure of the control signals CONTROL+ and CONTROL- causes U401 (the PWM oscillator) to shut down. The +32 V regulator is important because it provides the gate supply voltage for the other regulators.

### -5.2 V Regulator

1. Using the Scope, measure that there is a waveform across T401D
2. Using a Voltmeter, measure voltage between L417 and L418. This should be approximately 6 V DC
3. If this DC voltage is OK, check L418, L422, L417, L421 and associated components
4. If this DC voltage is not OK, check C475, C476 and C477

- +32 V Regulator**
1. Using the Scope, measure that there is a waveform across T401D
  2. Check CR431 (rough DC - Scope or Meter)
  3. Using a Voltmeter, measure voltage between L403 and L404. This should be in the region of +55 to +60 V DC (no load connected)
  4. Using a Voltmeter, measure voltage across Z404. This should be +15 V DC, with or without load
  5. Check Q406, Z405, Z410 and associated components
  6. If there is a DC voltage at Z405 anode, check L407 and L408

To find out which other regulators are not working, measure regulator input waveform and output voltages in the following order:

1. -32 V regulator
2. +5.1 V regulator
3. +12 V regulator
4. -12 V regulator

- 32 V Regulator** Proceed as follows:
1. Using a Voltmeter measure voltage between L405 and L406. This should be greater than 32 V
  2. Check Zener diodes Z406 and Z411
  3. Check inductors L405, L406, L409 and L410 for open-circuit
  4. Check electrolytic capacitors CE435, CE436 and CE440 for short-circuit

- +5.1 V Regulator** Proceed as follows:
1. Using a Voltmeter measure voltage between L415 and L416. This should be greater than 5.1 V
  2. Check Zener diode Z409
  3. Check inductors L415, L416, and L420 for open-circuit
  4. Check electrolytic capacitors CE468, CE469, C470, C473 and CE474 for short-circuit
  5. Check Suppressor XS405

- +12 V Regulator** Proceed as follows:
1. Using a Voltmeter measure voltage between L411 and L412. This should be greater than 12 V
  2. Check Zener diode Z407
  3. Check inductors L411, L412, L423 and L424 for open-circuit
  4. Check electrolytic capacitors CE460, CE461 and CE463 for short-circuit

5. Check Suppressor XS403

**-12 V Regulator**

Proceed as follows:

1. Using a Voltmeter measure voltage between L413 and L414. This should be greater than 12 V
2. Check Zener diode Z408
3. Check inductors L413, L414, L425 and L428 for open-circuit
4. Check electrolytic capacitors CE464, CE465 and CE467 for short-circuit
5. Check Suppressor XS404

## Microprocessor Board

The following checks can be performed on the Microprocessor Board:

| Check  | Procedure   |
|--------|---|
| Visual | Inspect the board carefully for dry joints, unsoldered joints, or broken components   |
| Clock  | Using an Oscilloscope, check that there is a clock signal at the CLKOUT pin (66) on the Microprocessor. The frequency should be 16.78 MHz (8.38 during reset). If a clock signal is not found check crystal Y1 and its associated components. Also check C44, C49 and C66, capacitors used in the VCO circuit |

### DIP Switches

Check that the switches on SW1 are set, according to the following table:

**Table 4-2. Settings for DIP Switch S1**

| Switch Settings |   |   |   |   |   |   |   |   |
|-----------------|---|---|---|---|---|---|---|---|
| Pos:            | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| BIN:            | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 |

Note that Section 1 in the DIP Switch disconnects the Microprocessor clock line, and incorrect setting, or a faulty switch section disables the Microprocessor

|          |  |
|----------|--|
| HP-IB    | If faults are suspected in connection with the HP-IB Interface, check the ribbon cable that joins the HP-IB socket to the Microprocessor Board. Using a resistance meter, check for continuity along each of the ribbon cable conductors   |
| Dividers | Dividers U28A and U28B divide the system clock to produce a clock for the HP-IB Interface. Use an oscilloscope to check operation. Pin 3 on U28 is clock input (16.78 MHz). Pin 5 gives the first divide-by-2 output (8.39 MHz) and pin 9 provides the final clock to U10, the HP-IB IC, just over 4 MHz.      |
| Battery  | BT1 is a 3 V Lithium battery, type: Panasonic +3 V CR2477. Its HP part number is 1420-0394. It is capable of in excess of 5 years' operation. Using a high impedance voltmeter measure across the battery terminals. If you suspect that the battery is faulty, change it by unsoldering it from the PC Board. |



**Caution**



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**RISK OF EXPLOSION!**

**DO NOT** allow Lithium batteries to become short-circuited

**DO NOT** use excessive heat when unsoldering/soldering Lithium batteries.

**DO** dispose of batteries in an approved manner.

---

**RPG Unit** This unit sends an interrupt to the Microprocessor, and a directional signal. These signals are buffered by U43C and U43D. Check that when the knob is rotated signals are present at the input, pin 9 and at the output, pin 8 of U43C and at the input, pin 12 and at the output, pin 11 of U43D

**Reset** At switch-on U13 pin 16 goes high. It then goes low after approximately 100 ms, and remains low until a subsequent reset.

If the Microprocessor Board passes all the above checks and still does not function, its repair is outside the scope of this Troubleshooting guide, and it is recommended that the PC Board be returned to a Hewlett-Packard Service Center.

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**Period Board**

This board consists mainly of data-controlled devices and troubleshooting is reduced to replacing suspect devices. However, basic checks can be performed on some parts of the circuitry:

**Trigger Input**

With an external Trigger applied to J301:

1. Check that the applied signal is  $\pm 10$  V. If not, adjust to  $\pm 10$  V
2. Check that the signal at the junction of R304 and R305 is approximately  $\pm 2.5$  V. If not, suspect CR301, CR302, and associated components
3. Select various Offset settings on the instrument and check that voltages are available from U304A pin 1, U304D pin 14, and U301 pin 8

check the relay K301 as follows:

1. On the instrument select  $50 \Omega$  External Trigger input loading
2. Connect the Scope to R301 at the end that connects to K301
3. The relay should be closed; you will see the trigger waveform
4. Briefly short Q301 Base to Emitter. The relay should open and the scope waveform disappear while the short is applied

**Period Generator**

Check voltage regulators:

1. U405 pin 1 for +12 V and pin 3 for +5 V
2. U406 pin 1 for -12 V and pin 3 for -5.2 V

**TIGER Current Source**

1. Check voltage regulator U506 pin 3 for +12 V
2. Check U506 pin 2 for +9.2 V
3. Select various Period settings on the instrument and check that voltages are available from U504B pin 7.
4. Check that U504D pin 14 and U504C pin 8 mirror changes in U504B pin 7 voltage. Check Q502 and Q503

**Trigger Output**

1. Check that there is an input signal at the junction of R601 and R602
2. Check that the input signal is available (inverted) at Q601 collector
3. Check that the input signal is available (non inverted) at Q602 collector
4. Check that an output signal is available at Q604 collector

**Strobe Output**

1. Check that there is an input signal at the junction of R701 and R702
2. Check that the input signal is available (inverted) at Q701 collector
3. Check that the input signal is available (non inverted) at Q702 collector
4. Check that an output signal is available at Q704 collector

## PLL Board

This board consists mainly of data-controlled devices and troubleshooting is reduced to replacing suspect devices. However, basic checks can be performed on some parts of the circuitry:

### On-Board Regulators

1. Check U205 pin 3 for -12 V and pin 1 for -5.2 V
2. Check U207 pin 3 for +12 V and pin 1 for +5 V
3. Check U208 pin 3 for +32 V and pin 2 for +23.47 V
4. Check U209 pin 2 for -12 V and pin 3 for -5 V

### Clock Input

With an external Clock applied to J401:

1. Check that the applied signal is  $\pm 10$  V. If not, adjust to  $\pm 10$  V
2. Check that the signal at the junction of R406 and R407 is approximately  $\pm 2.5$  V. If not, suspect CR402, CR403, and associated components
3. Select various Threshold settings on the instrument and check that voltages are available from U403B pin 7, U403A pin 1, and U404B pin 9

check the relay K401 as follows:

1. On the instrument select 50  $\Omega$  External Clock input loading
2. Connect the Scope to R405 at the end that connects to K401
3. The relay should be closed; you will see the trigger waveform
4. Briefly short Q401 Base to Emitter. The relay should open and the scope waveform disappear while the short is applied

Check on Y251 pin 8 for 5 MHz signal, if the internal reference clock is being used.

Using the Scope check at U203 pin 5 for a clock signal. If U203 is working, this signal should be present, regardless of whether the internal or external reference clock is being used.

Check at U204B pin 7 for a control voltage for the varicap diodes controlling the frequency of U201, the PLL. This should be in the range -2.2 V to +7.0 V, representing a PLL frequency range of 80 MHz to 160 MHz. Using the Scope, check for the PLL output signal at U202 pin 2.

## **Deskew Board**

This is an SMT board and there are no recommended troubleshooting procedures. Its repair is outside the scope of this Troubleshooting guide, and it is recommended that the PC Board be returned to a Hewlett-Packard Service Center.

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## Output Board

Some parts of this board consist of data-controlled devices and troubleshooting is reduced to replacing suspect devices. Other parts of the board use SMT. However, basic checks can be performed on some parts of the circuitry:

### Onboard Regulators

1. Check U1 pin 1 for +32 V and pin 3 for +15 V
2. Check U2 pin 2 for +12 V and pin 6 for +5 V
3. Check U100A pin 2 for +5 V and pin 1 for -5 V (inverter)
4. Check U3 pin 2 for -32 V and pin 3 for -15 V
5. Check U104 pin 3 for +15 V and pin 2 for +12 V
6. Check U106 pin 1 for +12 V and pin 3 for +5 V
7. Check U107 pin 1 for -12 V and pin 3 for -5.2 V
8. Check U156 pin 1 for +12 V and pin 3 for +5 V
9. Check U157 pin 2 for -12 V and pin 3 for -5.2 V

### Delay Generator

1. Check that the input signal is present at the junction of CR100 and CR101
2. Select various Delay settings on the instrument and check that voltages are available from U102 pin 1 (high impedance) and U100B pin 7.
3. Check that U101B pin 7 and U101A pin 1 mirror changes in U100B pin 7 voltage. Check Q101 and Q103
4. Check that the output signal is available at pin 1H on U103, the TIGER IC

### Width Generator

1. Check that the input signal is present at pin 11H on U153, the Width TIGER IC
2. Select various Width settings on the instrument and check that voltages are available from U152 pin 1 (high impedance) and U100D pin 14
3. Check that U151B pin 7 and U151A pin 1 mirror changes in U100D pin 14 voltage. Check Q151 and Q153
4. Check that differential output signals are available at pins 1I and 1H on U103, the Width TIGER IC pin

## SLAVE IC Slope Switching

Check that differential input signals are available at pins 4H and 5H on U200, the SLAVE IC.

If there are problems with the slope range settings, select faulty ranges and check that the appropriate transistors are switched on. You can also check the capacitors. However, ranges 1 and 2 cannot be checked in this way.

The ranges are switched as follows:

- Range 1 Internal capacitor switched inside U200
- Range 2 Internal capacitor + parasitic capacitance switched inside U200

As the ranges are increased, the external capacitors are switched by the transistors, adding to the previous capacity:

- Range 3 Q200 adds C212 and C213
- Range 4 Q201 adds C214
- Range 5 Q202A addsc215
- Range 6 Q202B addsc215
- Range 7 Q202C addsc215
- Range 8 Relay K220 adds the capacitance multiplier circuit, U220

When a transistor is switched OFF the slope appears at its collector. When the relay is open the slope appears at K220 pin 1. Use the Scope to check, as these are high impedance points.

When a transistor is switched on, 0 V appears at the collector and for the relay, at K220 pin 1.

## Slope Control

This consists of two sections:

### Current Source

1. Select various Slope settings on the instrument and check that voltages are available from U250 pin 1 (high impedance) and U252A pin 1
2. Check that U254D pin 14, U253D pin 14 and U253C pin 8 mirror changes in U252A pin 1 voltage. Check Q250, Q251 and Q252

### Current Sink

1. Select various Slope settings on the instrument and check that voltages are available from U251 pin 1 (high impedance) and U252D pin 14
2. Check that U254A pin 1, U253A pin 1 and U253B pin 7 mirror changes in U252D pin 14 voltage. Check Q253, Q254 and Q255

- Vernier Currents** \*Select various Amplitude settings on the instrument and check that voltages are available from U300 pin 1 (high impedance) and U302D pin 14 \*Check that U302c pin 8, U302A pin 1 and U302B pin 7 mirror changes in U302D pin 14 voltage. Check Q302, Q303 and Q304
- Amplifier** The amplifier is fitted to the Output Board in “piggy-back” manner. It is an SMT board and there are no recommended troubleshooting procedures, except to check the signal at the input and output.  
Signal input points are at J701(1) and J701(2).  
Signal output points are at J702 (6, 8, 10) and J703 (6, 8, 10).  
The repair of the Amplifier is outside the scope of this Troubleshooting guide as any changes to components would affect calibration. and it is recommended that the complete Output Board be returned to a Hewlett-Packard Service Center.
- Output Control** Q400, Q402, Q403 and Q405 form the cascode output stage driven by the amplifier.  
The cascode has a double heatsink arrangement. You can run the board with the first heatsink removed, but not the second one, which takes the form of a mounting plate for the devices.  
Base and collector voltages on these transistors should be  $\pm 21.5$  V
- Offset Control**
1. Select various Offset settings on the instrument and check that voltages are available from U500 pin 1 (high impedance), U510B pin 7, and the emitters of Q500 and Q501
  2. Check that U502A pin 1 and U502B pin 7 follow U501B pin 7 voltage changes
  3. Check that U503A pin 1 and U503B pin 7 follow U501B pin 7 voltage changes
  4. Check transistors associated with this circuit
- Output Enable**
1. Check that output signals are available from U600C pin 8 and U601B pin 7.
  2. Check U602



## HP 8110A Error Messages and Status Register contents

**Error Messages** The following is a list of all error messages issued by HP 8110A, and a table showing the contents of status registers.

**SCPI Standard Error** Standard error, HP-IB message, Local message, Description

- |             |  |
|-------------|--|
| <b>-100</b> | <p>Command header error</p> <p>HP-IB message = "Instrument in LOCAL LOCKOUT mode"</p> <p>Local message = "Instrument in LOCAL LOCKOUT mode"</p> <p>Description:</p> <p>The Local key was pressed on the front panel while the Instrument was set to Local lockout.</p>             |
| <b>-102</b> | <p>Syntax error</p> <p>HP-IB message = "[device-dependent info]"</p> <p>Local message = "[device-dependent info]"</p> <p>Description:</p> <p>An unrecognized command or data type was encountered; for example, a string was received when the device does not accept strings.</p> |
| <b>-131</b> | <p>Invalid suffix</p> <p>HP-IB message = "Channel out of range"</p> <p>Local message = "Channel out of range"</p> <p>Description:</p> <p>The channel suffix given with a channel sensitive command is out of range.</p>  |

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Character data not allowed

HP-IB message = "No MIN/MAX allowed while warnings are active"

Local message = "No MIN/MAX while warnings are active"

Description:

An attempt was made to set a parameter to MIN/MAX resp. to ask for the MIN/MAX of a parameter while warnings were active.

This does not work because other parameters on which the MIN/MAX result depends might already be outside no-warn range.

-148

Character data not allowed

HP-IB message = "No MIN/MAX allowed while checks are off"

Local message = "No MIN/MAX while checks are off"

Description:

An attempt was made to set a parameter to MIN/MAX resp. to ask for the MIN/MAX of a parameter while checks were switched off.

This does not work because other parameters on which the MIN/MAX result depends might already be outside no-warn range.

-200

Execution error

HP-IB message = "No signal at CLK-IN could be detected for frequency measurement"

Local message = "No signal detected at CLK-INput"

Description:

An attempt was made to measure the external clock frequency but no signal was detectable on the clock-in connector.

- 200** Execution error  
HP-IB message = "Frequency at CLK-INput too low."  
Local message = "Frequency at CLK-INput too low."  
Description:  
An attempt was made to measure the external clock frequency but the detected signal frequency was too low to allow an accurate measurement. (Currently the limit is 1000 Hz.)
- 200** Execution error  
HP-IB message = "Frequency at CLK-INput too high."  
Local message = "Frequency at CLK-INput too high."  
Description:  
An attempt was made to measure the external clock frequency but the detected signal frequency was too high to allow an accurate measurement.
- 200** Execution error  
HP-IB message = "Product- or Serial Nr. is wrong."  
Local message = "Product- or Serial Nr. is wrong."  
Description:  
The header of the calibration data stream contains a product number ( 6 Char.) or a serial number (10 Char.). The length of these strings will be checked by the firmware.
- 200** Execution error  
HP-IB message = "Security violation"  
Local message = "Security violation"  
Description:  
An attempt was made to switch the display ON, while security was on.

- 211**                    Trigger ignored  
                           HP-IB message = "Trigger signal ignored"  
                           Local message = "MANUAL key ignored"

Description:  
 The MANUAL trigger function is not supported by all modes. The TRG or GET HPIB commands have the same functionality as the MANUAL key.
- 221**                    Settings conflict  
                           HP-IB message = "Width [chan] > period"  
                           Local message = "Width [chan] > period"

Description:  
 [chan] = channel number  
 Width for one of the two channels exceeds period.
- 221**                    Settings conflict  
                           HP-IB message = "Delay [chan] > period"  
                           Local message = "Delay [chan] > period"

Description:  
 [chan] = channel number  
 Delay for one of the two channels exceeds period.
- 221**                    Settings conflict  
                           HP-IB message = "Edge in incompatible with width in [chan]"  
                           Local message = "Edge in incomp. to width in [chan]"

Description:  
 [chan] = channel number
- 221**                    Settings conflict  
                           HP-IB message = "Too many parameters in of period/width [chan]"  
                           Local message = "Too many param. in of per/width [chan]"

Description:  
 [chan] = channel number

- 221** Settings conflict  
HP-IB message = "Ext-Width mode only until 20V amplitude"  
Local message = "Ext-Width mode only until 20V amplitude"  
Description:  
External width mode is only possible, if the amplitude is < 20V, because of power problems.
- 221** Settings conflict  
HP-IB message = "Pattern mode only until 20V amplitude"  
Local message = "Pattern mode only until 20V amplitude"  
Description:  
Pattern mode is only possible, if the amplitude is < 20V, because of power problems.
- 221** Settings conflict  
HP-IB message = "Single pulse max dutycycle 15 percent if amplitude > 20V"  
Local message = "Single puls max dutyc 15 percent if ampl > 20V"  
Description:  
In Single pulse mode maximum dutycycle is 15 percent, if the amplitude is over 20V, because of power problems.
- 221** Settings conflict  
HP-IB message = "Double pulse max dutycycle 7 percent if amplitude > 20V"  
Local message = "Double pulse max dutyc 7 percent if ampl > 20V"  
Description:  
In Single pulse mode maximum dutycycle is 7 percent, if the amplitude is over 20V, because of power problems.

- 222**                    Data out of range  
 HP-IB message = "Parameter out of hard limits"  
 Local message = "Parameter out of hard limits"  
 Description:  
 This is the generic "Parameter out of range" error. It is issued when more specific information is not available.
- 222**                    Data out of range  
 HP-IB message = "Limit reached - allowed [range]"  
 Local message = "Limit reached - allowed [range]"  
 Description:  
 [range] = range of parameter
- 222**                    Data out of range  
 HP-IB message = "[param] out of absolute limits"  
 Local message = "[param] out of absolute limits"  
 Description:  
 [param] = parameter name  
 This error is issued when a parameter is outside its absolute limits.
- 222**                    Data out of range  
 HP-IB message = "[param] on channel [chan] out of hard limits"  
 Local message = "[param] on channel [chan] out of hard limits"  
 Description:  
 [param] = parameter name, [chan] = channel number  
 This error is issued when a parameter is outside its hardware limits.
- 222**                    Data out of range  
 HP-IB message = "[loc] Wrong Location Nr. - allowed [loc range]"  
 Local message = "[loc] Wrong Location Nr. - [loc range]"  
 Description:  
 [loc] = location number, [loc range] = location range

- 222 Data out of range  
HP-IB message = "BURST\_CNT\_RANGE"  
Local message = "BURST of: 2 to 65536"
- 222 Data out of range  
HP-IB message = "PATT\_CNT\_RANGE"  
Local message = "PATTERN length: 2 to 4096"
- 222 Data out of range  
HP-IB message = "PERIOD\_RANGE"  
Local message = "Per: 6.65 ns to 999 ms (999 s with PLL)"
- 222 Data out of range  
HP-IB message = "TRG\_PER\_RANGE"  
Local message = "PLL Per: 6.650 to 999.0 s"
- 222 Data out of range  
HP-IB message = "DELAY\_RANGE [chan]"  
Local message = "[chan] Delay: 0.0 ns to 999 ms"
- Description:  
[chan] = channel number
- 222 Data out of range  
HP-IB message = "DOUBLE\_RANGE(%1)"  
Local message = "[chan] DoubleDelay: 6.6 ns to 999 ms"
- Description:  
[chan] = channel number
- 222 Data out of range  
HP-IB message = "WIDTH\_RANGE [chan]"  
Local message = "[chan] Width: 3.3 ns to 999 ms"
- Description:  
[chan] = channel number
- 222 Data out of range  
HP-IB message = "LEAD\_EDGE\_RANGE [chan]"  
Local message = "[chan] Leading Edge: 2.00 ns to 200 ms"
- Description:  
[chan] = channel number

- 222** Data out of range  
 HP-IB message = "TRAIL\_EDGE\_RANGE [chan]"  
 Local message = "[chan] Trailing Edge: 2.00 ns to 200 ms"  
 Description:  
 [chan] = channel number
- 222** Data out of range  
 HP-IB message = "LOAD\_IMP\_RANGE [chan]"  
 Local message = "[chan] into Load: 0.1 Ohm to 999 kOhm"  
 Description:  
 [chan] = channel number
- 222** Data out of range  
 HP-IB message = "TOTAL\_LOAD\_OHM\_RANGE [chan]"  
 Local message = "TOTAL\_LOAD\_OHM\_RANGE [chan]"  
 Description:  
 [chan] = channel number
- 222** Data out of range  
 HP-IB message = "HIL\_VOLT\_RANGE [chan]"  
 Local message = "[chan] High level: -19.8 V to 20.0 V"  
 Description:  
 [chan] = channel number
- 222** Data out of range  
 HP-IB message = "HIL\_AMP\_RANGE [chan]"  
 Local message = "[chan] High level: -396 mA to 400 mA"  
 Description:  
 [chan] = channel number



- 222** Data out of range  
HP-IB message = "LOL\_VOLT\_RANGE [chan]"  
Local message = "[chan] Low level: -20.0 V to 19.8 V"  
Description:  
[chan] = channel number
- 222** Data out of range  
HP-IB message = "LOL\_AMP\_RANGE [chan]"  
Local message = "[chan] Low level: -400 mA to 396 mA"  
Description:  
[chan] = channel number
- 222** Data out of range  
HP-IB message = "HIL\_LIM\_VOLT\_RANGE [chan]"  
Local message = "[chan] High-V Limit: -19.8 V to 20.0 V"  
Description:  
[chan] = channel number
- 222** Data out of range  
HP-IB message = "LOL\_LIM\_VOLT\_RANGE [chan]"  
Local message = "[chan] Low-V Limit: -20.0 V to 19.8 V"  
Description:  
[chan] = channel number
- 222** Data out of range  
HP-IB message = "HIL\_LIM\_AMP\_RANGE [chan]"  
Local message = "[chan] High-A Limit: -792 mA to 800 mA"  
Description:  
[chan] = channel number

- 222** Data out of range  
 HP-IB message = "LOL\_LIM\_AMP\_RANGE [chan]"  
 Local message = "[chan] Low-A Limit: -800 mA to 792 mA"  
 Description:  
 [chan] = channel number
- 222** Data out of range  
 HP-IB message = "Trigger too fast - will skip bursts"  
 Local message = "Trigger too fast - will skip bursts"
- 222** Data out of range  
 HP-IB message = "Trigger too fast - will skip pattern"  
 Local message = "Trigger too fast - will skip pattern"
- 222** Data out of range  
 HP-IB message = "OUTPUT [chan]: Width > Period"  
 Local message = "OUTPUT [chan]: Width > Period"  
 Description:  
 [chan] = channel number
- 222** Data out of range  
 HP-IB message = "OUTPUT [chan]: Delay > Period"  
 Local message = "OUTPUT [chan]: Delay > Period"  
 Description:  
 [chan] = channel number
- 222** Data out of range  
 HP-IB message = "Overlap at OUTPUT [chan]: Width > DoubleDelay"  
 Local message = "Overlap at OUT [chan]: Width > DoubleDelay"  
 Description:  
 [chan] = channel number

- 222** Data out of range  
HP-IB message = "Overlap at OUTPUT [chan]:  
DoubleDelay + Width > Period"  
Local message = "Overlap at OUT [chan]:  
Double+Width > Period"  
Description:  
[chan] = channel number
- 222** Data out of range  
HP-IB message = "OUTPUT [chan]: High Level <  
Low Level"  
Local message = "OUTPUT [chan]: High Level <  
Low Level"  
Description:  
[chan] = channel number
- 222** Data out of range  
HP-IB message = "OUTPUT [chan]: High-V limit  
< Low-V Limit"  
Local message = "OUTPUT [chan]: High-V Limit  
< Low-V Limit"  
Description:  
[chan] = channel number
- 222** Data out of range  
HP-IB message = "OUTPUT {chan}: High-A  
Limit < Low-A Limit"  
Local message = "OUTPUT [chan]: High-A Limit  
< Low-A Limit"  
Description:  
[chan] = channel number
- 222** Data out of range  
HP-IB message = "OUTPUT {chan}: High Level  
> High-Volt Limit"  
Local message = "OUTPUT [chan]: High Level >  
High-Volt Limit"  
Description:  
[chan] = channel number

- 222** Data out of range  
 HP-IB message = "Added High Levels 1+2 > High-Volt Limit"  
 Local message = "Added High Levels 1+2 > High-Volt Limit"
- 222** Data out of range  
 HP-IB message = "OUTPUT [chan]: High Level > High-Amp Limit"  
 Local message = "OUTPUT [chan]: High Level > High-Amp Limit"
- Description:  
 [chan] = channel number
- 222** Data out of range  
 HP-IB message = "Added High Levels 1+2 > High-Amp Limit"  
 Local message = "Added High Levels 1+2 > High-Amp Limit"
- 222** Data out of range  
 HP-IB message = "OUTPUT [chan]: Low Level < Low-Voltage Limit"  
 Local message = "OUTPUT [chan]: Low Level < Low-Voltage Limit"
- Description:  
 [chan] = channel number
- 222** Data out of range  
 HP-IB message = "Added Low Levels 1+2 < Low-Voltage Limit"  
 Local message = "Added Low Levels 1+2 < Low-Voltage Limit"
- 222** Data out of range  
 HP-IB message = "OUTPUT [chan]: Low Level < Low-Ampere Limit"  
 Local message = "OUTPUT [chan]: Low Level < Low-Ampere Limit"
- Description:  
 [chan] = channel number

- 222** Data out of range  
HP-IB message = "Added Low Levels 1+2 < Low-Ampere Limit"  
Local message = "Added Low Levels 1+2 < Low-Ampere Limit"
- 222** Data out of range  
HP-IB message = "OUTPUT [chan]: can't achieve High level"  
Local message = "OUTPUT [chan]: can't achieve High level"  
Description:  
[chan] = channel number
- 222** Data out of range  
HP-IB message = "OUTPUT [chan]: can't achieve Low level"  
Local message = "OUTPUT [chan]: can't achieve Low level"  
Description:  
[chan] = channel number
- 222** Data out of range  
HP-IB message = "OUTPUT [chan]: can't achieve Amplitude"  
Local message = "OUTPUT [chan]: can't achieve Amplitude"  
Description:  
[chan] = channel number
- 222** Data out of range  
HP-IB message = "Amplitude [chan] too small \\  
resolution )"  
Local message = "Amplitude [chan] too small \\  
resolution )"  
Description:  
[chan] = channel number
- 222** Data out of range  
HP-IB message = "Added Amplitudes 1+2 too large"  
Local message = "Added Amplitudes 1+2 too large"

**-222** Data out of range  
 HP-IB message = “No Trigger on BOTH when period = PLL/CLK”  
 Local message = “No Trigger on BOTH when period = PLL/CLK”

**-222** Data out of range  
 HP-IB message = “Can’t calc. Delay [chan]: PERIOD UNKNOWN”  
 Local message = “Can’t calc. Delay [chan]: PERIOD UNKNOWN”

Description:

[chan] = channel number

**-222** Data out of range  
 HP-IB message = “Can’t calc. Phase [chan]: PERIOD UNKNOWN”  
 Local message = “Can’t calc. Phase [chan]: PERIOD UNKNOWN”

Description:

[chan] = channel number

**-222** Data out of range  
 HP-IB message = “Can’t calc. DoubleDelay [chan]: PERIOD UNKNOWN”  
 Local message = “Can’t calc. DblDel [chan]:PERIOD UNKNOWN”

Description:

[chan] = channel number

**-222** Data out of range  
 HP-IB message = “Can’t calc. Dutycycle [chan]: PERIOD UNKNOWN”  
 Local message = “Can’t calc. DutyCycle [chan]: PERIOD UNKNOWN”

Description:

[chan] = channel number

- 222** Data out of range  
HP-IB message = "Can't calc. TrailDelay [chan]:  
DELAY UNKNOWN"  
Local message = "Can't calc. TrailDelay [chan]:  
DELAY UNKNOWN"  
Description:  
[chan] = channel number
- 222** Data out of range  
HP-IB message = "Can't calc. Edge [chan]:  
WIDTH UNKNOWN"  
Local message = "Can't calc. Edge [chan]:  
WIDTH UNKNOWN"  
Description:  
[chan] = channel number
- 222** Data out of range  
HP-IB message = "OUTPUT [chan]: No Double  
Pulses in PATTERN mode"  
Local message = "OUT [chan]: No Double Pulses  
in PATTERN mode"  
Description:  
[chan] = channel number
- 222** Data out of range  
HP-IB message = "PLL can't trigger  
PULSESTREAM"  
Local message = "PLL can't trigger  
PULSESTREAM"
- 222** Data out of range  
HP-IB message = "PLL cannot be used as a  
GATE source"  
Local message = "PLL cannot be used as a GATE  
source"
- 222** Data out of range  
HP-IB message = "PLL cannot be used as  
EXT-WIDTH source"  
Local message = "PLL cannot be used as  
EXT-WIDTH source"

- 222** Data out of range  
 HP-IB message = "Cannot use PLL / CLK-INput twice"  
 Local message = "Cannot use PLL / CLK-INput twice"
- 222** Data out of range  
 HP-IB message = "Period too small [chan]"  
 Local message = "Period too small [chan]"  
 Description:  
 [chan] = channel number
- 222** Data out of range  
 HP-IB message = "Width [chan] too small"  
 Local message = "Width [chan] too small"  
 Description:  
 [chan] = channel number
- 222** Data out of range  
 HP-IB message = "Delay [chan] too small"  
 Local message = "Delay [chan] too small"  
 Description:  
 [chan] = channel number
- 222** Data out of range  
 HP-IB message = "Double delay [chan] too small"  
 Local message = "Double delay [chan] too small"  
 Description:  
 [chan] = channel number
- 223** Too much data  
 HP-IB message = "[device-dependent info]"  
 Local message = "[device-dependent info]"  
 Description:  
 An unrecognized command or data type was encountered for example, a string was received when the device does not accept strings.



- 224**                    Illegal parameter value  
HP-IB message = "Invalid key code [key code]"  
Local message = "Invalid key code [key code]"  
Description:  
SYSTEM:KEY command was used with illegal key code.
- 240**                    Hardware error  
HP-IB message = "Serial EEPROM read/write error"  
Local message = "Serial EEPROM read/write error"
- 241**                    Hardware missing  
HP-IB message = "[board] - Board not installed"  
Local message = "[board] - Board not installed"  
Description:  
[board] = board name
- 241**                    Hardware missing  
HP-IB message = "Required optional product is not installed"  
Local message = "Optional product is not installed"  
Description:  
This error is generated when a command is sent to the instrument that requires a hardware option that has not been installed.
- 241**                    Hardware missing  
HP-IB message = "PLL-Opt for frequency measurement is not installed"  
Local message = "PLL-Opt for freq. measurement missing"  
Description:  
An attempt was made to measure the external clock frequency but the necessary hardware (PLL option) is not installed.
- 250**                    Mass storage error  
HP-IB message = "Specified drive not found"  
Local message = "Specified drive not found"

- 250** Mass storage error  
HP-IB message = "Drive A: Memory Card error"  
Local message = "Drive A: Memory Card error"  
Description:  
Internal Error.
- 250** Mass storage error  
HP-IB message = "Drive A: Can't load more Subdirectories"  
Local message = "Drive A: Can't load more Subdirectories"  
Description:  
The maximum internal nesting level of subdirectories has been reached.
- 252** Missing media  
HP-IB message = "Drive A: Missing Memory Card"  
Local message = "Drive A: Missing Memory Card"  
Description:  
The card is not inserted correctly.
- 253** Corrupt media  
HP-IB message = "Drive A: Memory Card corrupt"  
Local message = "Drive A: Memory Card corrupt"  
Description:  
There are wrong values of boot block or of Card Information Structure.
- 254** Media full  
HP-IB message = "Drive A: Memory Card full"  
Local message = "Drive A: Memory Card full"  
Description:  
No more free memory is available on card.
- 255** Directory full  
HP-IB message = "Drive A: Directory on Memory Card full"  
Local message = "Drive A: Directory full"  
Description:  
The root directory is full.

- 256** File name not found  
HP-IB message = "Drive A: File Name on Memory Card not found"  
Local message = "Drive A: File Name not found"  
Description:  
The ordered file or directory does not exist.
- 256** File name not found  
HP-IB message = "Drive A: File sizes don't\match"  
Local message = "Drive A: File sizes don't\match"  
Description:  
The size of the ordered file does not match settings.
- 257** File name error  
HP-IB message = "Drive A: File name wrong"  
Local message = "Drive A: File name wrong"  
Description:  
The filename does not correspond to DOS conventions.
- 257** File name error  
HP-IB message = "Permission denied"  
Local message = "Permission denied"  
Description:  
An attempt was made to do one of the following:
- delete a directory
  - copy a directory
  - load a directory to setting, or
  - change directory to a file.
- 258** Media protected  
HP-IB message = "Drive A: Memory Card write protected"  
Local message = "Drive A: Memory Card write protected"

- 258**                      Battery low
- HP-IB message = "Drive A: Memory Card battery is low"
- Local message = "Drive A: Memory Card battery is low"
- Description:
- The battery of the Memory Card should be replaced.
- 310**                      System error
- HP-IB message = "Driver complains after parameter restore from core"
- Local message = "Error after parameter restore from core"
- Description:
- A hardware driver returned an error after the total restore of all instrument parameters to the last known to be in good state.
- A possible cause for this error is a hardware fault.
- 310**                      System error
- HP-IB message = "CHECK OFF not allowed, use \*RST"
- Local message = "CHECK OFF not allowed, use AUTOSET"
- Description:
- An attempt was made to switch on the global parameter check via command. This is not allowed. The only way to switch checks on again is to issue a \*RST command.

-311

Memory error

HP-IB message = "Power up state corrupt, set to \*RST state"

Local message = "Power up state corrupt, set to \*RST"

Description:

The signature check performed on the instruments parameter store at power up, failed.

Possible reasons are:

- The instrument was switched off during a parameter update
- The battery used to buffer the instruments RAM needs replacement
- The instruments RAM is defective.

-311

Memory error

HP-IB message = "Pattern block corrupt, set to \*RST state"

Local message = "Pattern corrupt, set to \*RST"

Description:

The signature check performed on the instruments pattern block at power up, failed.

Possible reasons are:

- The instrument was switched off during a parameter update
- The battery used to buffer the instruments RAM is empty
- The instruments RAM is defective.

-314

SAVe/recall memory lost

HP-IB message = "[rem/loc] Setting [no] corrupt"

Local message = "[rem/loc] Setting [no] corrupt"

Description:

[rem/loc] = remote or local, [no] = number input]

Save/Recall memory lost. Indicates that the nonvolatile data saved by the \*SAV command has been lost.

- 314**                   SAVE/recall memory lost  
 HP-IB message = “[rem/loc] Setting [no] Pattern corrupt”  
 Local message = “[rem/loc] Setting [no] Pattern corrupt”  
 Description:  
 [rem/loc] = remote or local, [no] = number input  
 Save/Recall memory lost. Indicates that the nonvolatile data saved by the \*SAV command has been lost. In this case only the pattern block in the selected setting is corrupt.
- 314**                   SAVe/recall memory lost  
 HP-IB message = “[rem/loc] Setting [no] Firmware revision nr. incompatible”  
 Local message = “[rem/loc] Setting [no] Firmware rev. incompat.”  
 Description:  
 [rem/loc] = remote or local, [no] = number input  
 Each firmware issue has a revision number. The instrument is trying to read a setting with an incompatible revision number.
- 314**                   SAVe/recall memory lost  
 HP-IB message = “[rem/loc] Setting [no] Error check conflict”  
 Local message = “[rem/loc] Setting [no] Error check conflict”  
 Description:  
 [rem/loc] = remote or local, [no] = number input  
 The error check switch in the specified setting is OFF but the internal error check is ON. The instrument cannot recall this setting.

- 314**                   SAVE/recall memory lost  
HP-IB message = “[rem/loc] Setting [no]  
Instrument configuration incompatible”  
Local message = “[rem/loc] Setting [no] Config.  
incompatible”  
Description:  
[rem/loc] = remote or local, [no] = number input  
Every stored setting contains the instrument  
configuration. The stored configuration does not  
correspond to the actual instrument configuration.
- 330**                   Selftest failed  
HP-IB message = “Selftest error: Microprocessor  
board failed”  
Local message = “Selftest error: Microproc. board  
failed”  
Description:  
Hardware on the Microprocessorboard does not work.
- 330**                   Selftest failed  
HP-IB message = “ROM test failed”  
Local message = “ROM test failed”  
Description:  
Flash EPROM test failed on Microprocessorboard.
- 330**                   Selftest failed  
HP-IB message = “RAM test failed”  
Local message = “RAM test failed”  
Description:  
Static RAM test failed on Microprocessorboard.
- 330**                   Selftest failed  
HP-IB message = “Crystal Reference for uP lost”  
Local message = “Crystal Reference for uP lost”  
Description:  
A loss of crystal reference has been detected and the  
VCO is running at approximately half of maximum  
speed, determined from an internal voltage reference.  
Normally the external crystal frequency is VCO  
reference.

**-330**

Selftest failed

HP-IB message = "VCO for uP has not locked"

Local message = "VCO for uP has not locked"

Description:

The VCO is enabled, but has not yet locked. Normally the VCO would have locked on to the desired frequency.

**-330**

Selftest failed

HP-IB message = "Unexpected Reset of uP"

Local message = "Unexpected Reset of uP"

Description:

The reset was caused by one of the following:

- the powerup reset circuit
- the software watchdog circuit
- the system protection submodule halt monitor
- a loss of frequency reference to the clock submodule
- the test submodule

Normally the last reset was caused by an external signal or by the CPU executing a reset instruction.

**-330**

Selftest failed

HP-IB message = "Internal Serial Device Bus failed"

Local message = "Internal Serial Device Bus failed"

Description:

Internal serial device bus traffic over feedback path has failed.

**-330**

Selftest failed

HP-IB message = "[device-dependent info]"

Local message = "[device-dependent info]"

**-330**

Selftest failed

HP-IB message = "SELFTEST uP-BOARD OK"

Local message = "SELFTEST uP-BOARD OK"



- 330** Selftest failed  
HP-IB message = "SELFTEST: SIGNAL  
BOARDS OK"  
Local message = "SELFTEST: SIGNAL BOARDS  
OK"
- 330** Selftest failed  
HP-IB message = "SELFTEST FAILED"  
Local message = "SELFTEST FAILED"
- 330** Selftest failed  
HP-IB message = "No input signal at channel  
board %5"  
Local message = "No input signal at channel  
board %5"  
Description:  
There is no input signal to a channel board.
- 330** Selftest failed  
HP-IB message = "Ch [chan no]: Failure in  
DELAY circuitry"  
Local message = "Ch [chan no]: Failure in DELAY  
circuitry"  
Description:  
[chan no] = channel number  
The Delay TIGER IC may be defective.
- 330** Selftest failed  
HP-IB message = "Ch [chan no]: Failure in  
WIDTH circuitry"  
Local message = "Ch [chan no]: Failure in  
WIDTH circuitry"  
Description:  
[chan no] = channel number  
The Width TIGER IC may be defective.

- 330**                   Selftest failed
- HP-IB message = "Ch [chan no]: Failure in SLOPE circuitry"
- Local message = "Ch [chan no]: Failure in SLOPE circuitry"
- Description:
- [chan no] = channel number
- The SLOPE (SLAVE) circuitry may be defective.
- 330**                   Selftest failed
- HP-IB message = "Ch [chan no]: Failure in AMPLIFIER or OFFSET circuitry"
- Local message = "Ch [chan no]: Failure in AMP/OFFS circuitry"
- Description:
- [chan no] = channel number
- The AMPLIFIER or the OFFSET circuitry may be defective.
- 330**                   Selftest failed
- HP-IB message = "Ch 1: No output signal PERIOD TIGER"
- Local message = "Ch 1: No output signal PERIOD TIGER"
- Description:
- An output signal cannot be found by the selftest following the Period circuitry.
- 330**                   Selftest failed
- HP-IB message = "Ch 2: No output signal PERIOD TIGER"
- Local message = "Ch 2: No output signal PERIOD TIGER"
- Description:
- An output signal cannot be found by the selftest following the Period circuitry.

- 330** Selftest failed  
HP-IB message = "No output signal PERIOD TIGER"  
Local message = "No output signal PERIOD TIGER"  
Description:  
An output signal cannot be found by the selftest following the period circuitry.
- 330** Selftest failed  
HP-IB message = "Failure in TRIGGER OUTPUT circuitry"  
Local message = "Failure in TRIGGER OUTPUT circuitry"  
Description:  
An output signal cannot be found by the selftest for the TRIGGER OUTPUT AMPLIFIER.
- 800** The file Header isn't right  
HP-IB message = "File isn't a demo file "  
Local message = "File isn't a demo file "
- 801** There are some unexpected characters  
HP-IB message = "SYNTAX ERROR: ROW: [no] "  
Local message = "SYNTAX ERROR: ROW: [no] "  
Description:  
[no] = row number
- 802** Couldn't write that key code  
HP-IB message = "Couldn't execute Key: [no] "  
Local message = "Couldn't execute Key: [no] "  
Description:  
[no] = key number
- 803** Demofile is bigger than read buffer  
HP-IB message = "Demo file too big "  
Local message = "Demo file too big "

**Register Usage** The HP 8110A firmware uses the Standard Event Status, Operation Status, and Questionable Status registers for reporting instrument status, in accordance with the SCPI standard. The following table lists the bits used in each register, and what they are used for.

**Table 4-3. Bits Used in SCPI Registers**

| Register                       | Bit | Description   |
|--------------------------------|-----|---|
| STANDARD_EVENT_STATUS_REGISTER | 0   | Set when inst. has completed all pending operations |
|                                | 0   | Set to indicate that instrument has powered-up      |
| OPERATION_STATUS_REGISTER      | 1   | Set when inst. starts changing its output signals   |
|                                | 1   | Cld. when inst. finishes changing output signals    |
|                                | 2   | Set when inst. starts changing its range            |
|                                | 2   | Cleared when inst. finishes changing its range      |
|                                | 4   | Set when inst. starts a frequency measurement       |
|                                | 4   | Cld. when inst. finishes frequency measurement      |
| QUESTIONABLE_STATUS_REGISTER   | 0   | Set the QUESTIONable STATUS bit for VOLTage         |
|                                | 0   | Clear the QUESTIONable STATUS bit for VOLTage       |
|                                | 1   | Set the QUESTIONable STATUS bit for CURRent         |
|                                | 1   | Clear the QUESTIONable STATUS bit for CURRent       |
|                                | 2   | Set the QUESTIONable STATUS bit for TIME            |
|                                | 2   | Clear the QUESTIONable STATUS bit for TIME          |
|                                | 5   | Set the QUESTIONable STATUS bit for VOLTage         |
|                                | 5   | Clear the QUESTIONable STATUS bit for VOLTage       |



## Disassembly and Reassembly

---

This chapter enables you to disassemble the HP 8110A 150MHz Pulse Generator down to the levels necessary for removal and replacement of faulty subassemblies.

Some of the subassemblies need to be removed in a specific order, and the instructions have been written with this in mind.

Reassembly uses the removal steps in reverse, unless otherwise noted.

The instructions can also be used in reverse to provide the steps needed for retrofitting subassemblies.

A flowchart shows the order of steps needed to get to a specific part of the instrument.

## Terms Used and What They Mean

Some of the terms used in this chapter can be misleading in the wrong context. For example, the word *replacement* can refer to the act of changing a faulty subassembly, *or* replacing a working one after it has been removed from the instrument.

Here are some of the terms used in this chapter, and what we mean by them:

|                 |  |
|-----------------|--|
| <b>Fit</b>      | To attach a subassembly to the instrument, usually taken to mean a subassembly that was not there before (see <i>Retrofit</i> )              |
| <b>Refit</b>    | To put a subassembly back into the instrument, after removal for any reason  |
| <b>Replace</b>  | To remove a faulty subassembly, and fit a new (working) one  |
| <b>Remove</b>   | To take any subassembly (working or not) out of the instrument   |
| <b>Retrofit</b> | To attach a subassembly to the instrument, in this case, to provide function(s) that were not fitted to the instrument when it was purchased |

---

## The Tools You Need

The following tools enable all fixings to be removed and replaced:

- Medium cruciform screwdriver (case handles, etc)
- Small cruciform screwdriver (PC boards, etc)
- 6mm diameter nut driver (stand-off pillars supporting Output board 2)
- 7mm diameter nut driver (HP-IB board)
- 12mm diameter nut driver (RPG Head unit)
- Medium size long-nose pliers (power switch actuating rod, etc)
- Thin-bladed screwdriver, or knife (removing self-adhesive trim strips)

Inside the HP 8110A

Take a look at Figure 5-1. It shows the top view of an instrument with the case removed, with a full complement of PC boards.

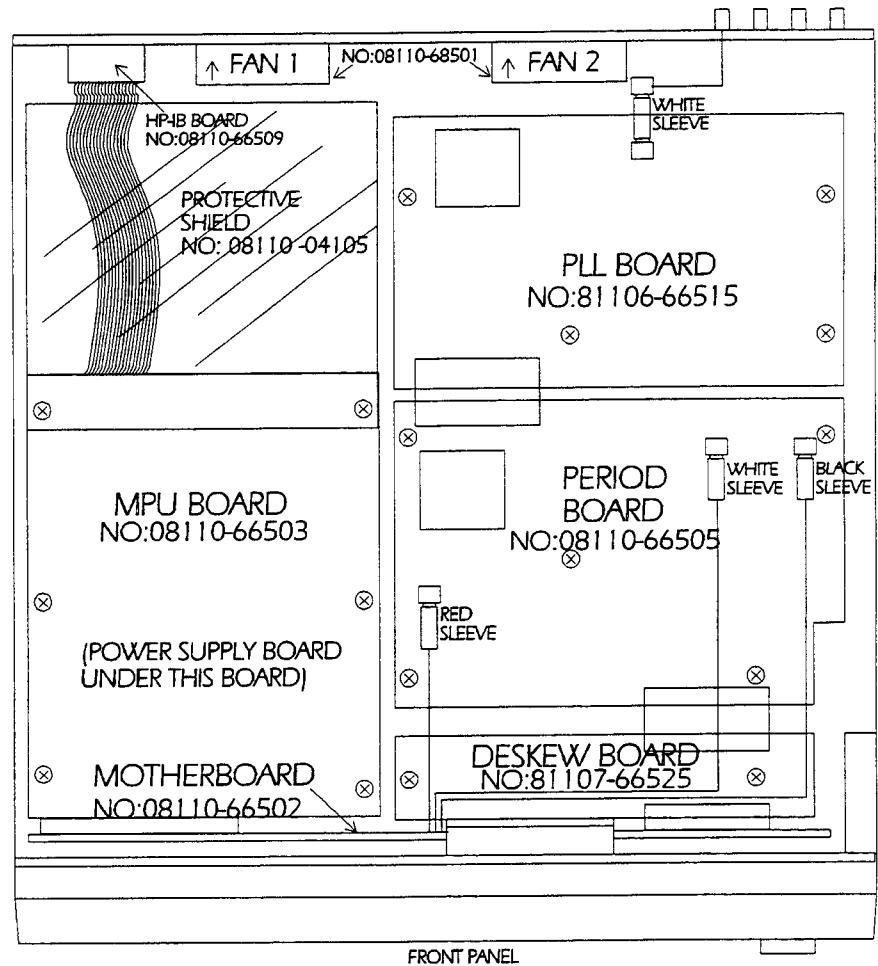


Figure 5-1. Top View of HP 8110A

Underneath the Microprocessor (MPU) board is the Power Supply board (shown in Figure 5-8). On the underside of the chassis there are 1 or 2 Output boards (Figure 5-9 and Figure 5-10). This represents a fully fitted instrument. The instrument you are about to service may have several combinations of boards.

The Standard HP 8110A contains:

- Power Supply Unit
- MPU board
- Period board
- Output 1 board

In addition, the instrument may have been optionally fitted with, or retrofitted with some or all of the following boards:



## HP 8110A Service Guide

- PLL board
- Output 2 board
- Deskew board

Also, the BNC Input/Output connectors can be on the front or the rear panel, according to original customer requirements.

## Sequence of Operations

The flowchart in Figure 5-2 shows how to get to a specific part of the HP 8110A by following the necessary steps. The chart works from the top down. Actions that are shown on the same level in the chart can be performed in any order, but must **all** be completed before going on to the next step. Several routes are possible, depending on what you want to remove from the instrument.

Depending on the options available in your instrument, some boards may not be fitted. Pass any missing boards in the flowchart and continue until you reach the subassembly you want to remove.

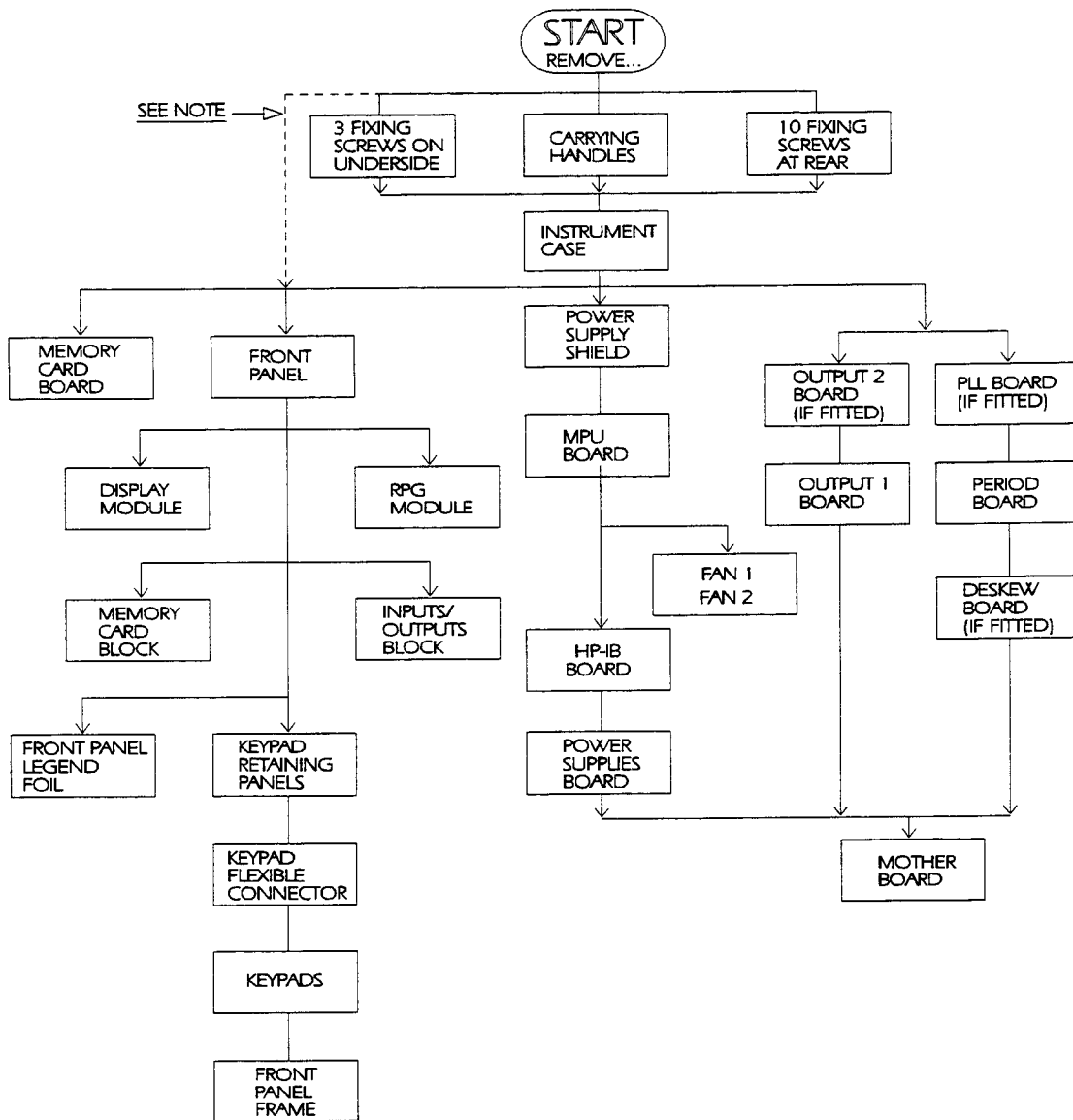


Figure 5-2. Flowchart Showing The Steps Needed for Replacement or Retrofit

**Note**



If you want to remove the Display module, the Input/Output block, the Memory Card block or the Front Panel subassemblies, take the fast-path in the above figure, shown as a dotted-line.

---

## Instructions for Replacing or Retrofitting HP 8110A Subassemblies

---

**Caution**

Disconnect the instrument from the mains power before disassembly!

---

The following sections show you how to remove and refit subassemblies. Generally, refitting is the reverse of removal, but where this differs, notes are included for guidance. Retrofitting uses the steps in reverse, in the same way as refitting.

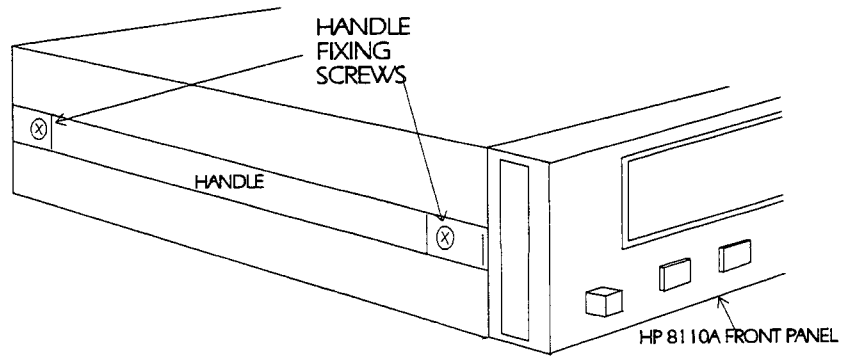
As a general rule, do not tighten PC board fixing screws until all the screws have been inserted and partially tightened. This helps to avoid flexing the board by securing it unevenly.

Diagrams show where the fixing screws are located, but depending on the options fitted to the instrument you are working on, the diagrams may not be identical. For example, some HP 8110A versions have the BNC connectors on the rear panel, while others have the BNC connectors on the front panel. Both positions have been shown in the diagrams.

Note the position of all cables when you remove boards, as incorrect reassembly can cause damage to the cables. Also, noise levels can be degraded by wrong positioning.

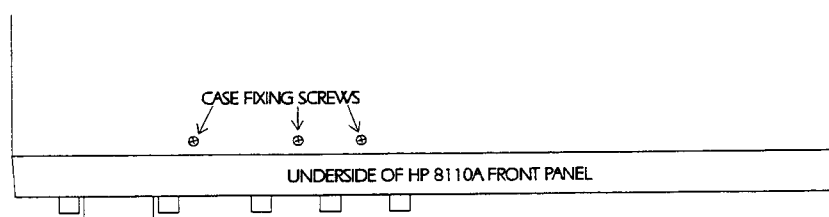
## Removing the Instrument Case

1. Remove the carrying handles from the case by removing 2 screws from each side of the case. Both sides have the same fixings:



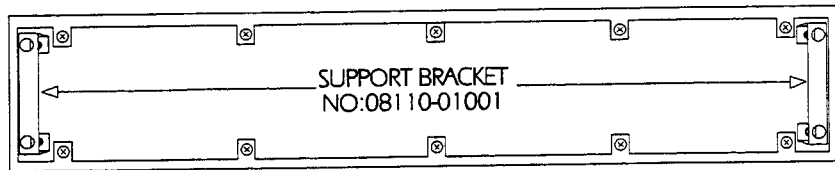
**Figure 5-3. Removing the Carrying Handles**

2. Remove the 3 screws securing the underside of the case to the chassis. Figure 5-4 shows their position



**Figure 5-4.  
Underside View of Front Panel Showing Case Fixing Screws**

3. Remove the 10 screws securing the instrument case to the rear panel:



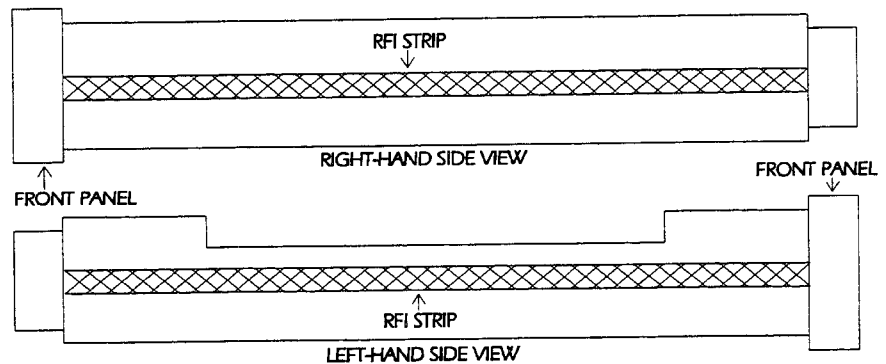
**Figure 5-5. Rear Panel Showing Case Fixing Screws**

4. Stand the instrument on the rear support brackets (shown in Figure 5-5) and slide the case back from the front panel by a firm movement
5. Lay the instrument on the workbench and completely remove the case by sliding it back over the chassis away from the front panel, or by pulling the chassis from the case

**Note**



Both sides of the chassis are fitted with self-adhesive RFI spring-contacts, 10 on the right-hand side, and 7 on the left-hand side, as shown in Figure 5-6:



**Figure 5-6. RFI Spring-Contacts fitted to the Sides of the Chassis**

If any of these spring-contacts become damaged they must be replaced before re-fitting the instrument case. You can order a pack of 20 replacement spring-contacts under No: 8160-0672.

### Removing Boards Mounted on the Upper Side of the Chassis

Figure 5-7 gives a general view of the HP 8110A from the top of the chassis. The fixing screws for the boards are shown. The Power Supply board is under the MPU board, and is shown in Figure 5-8.

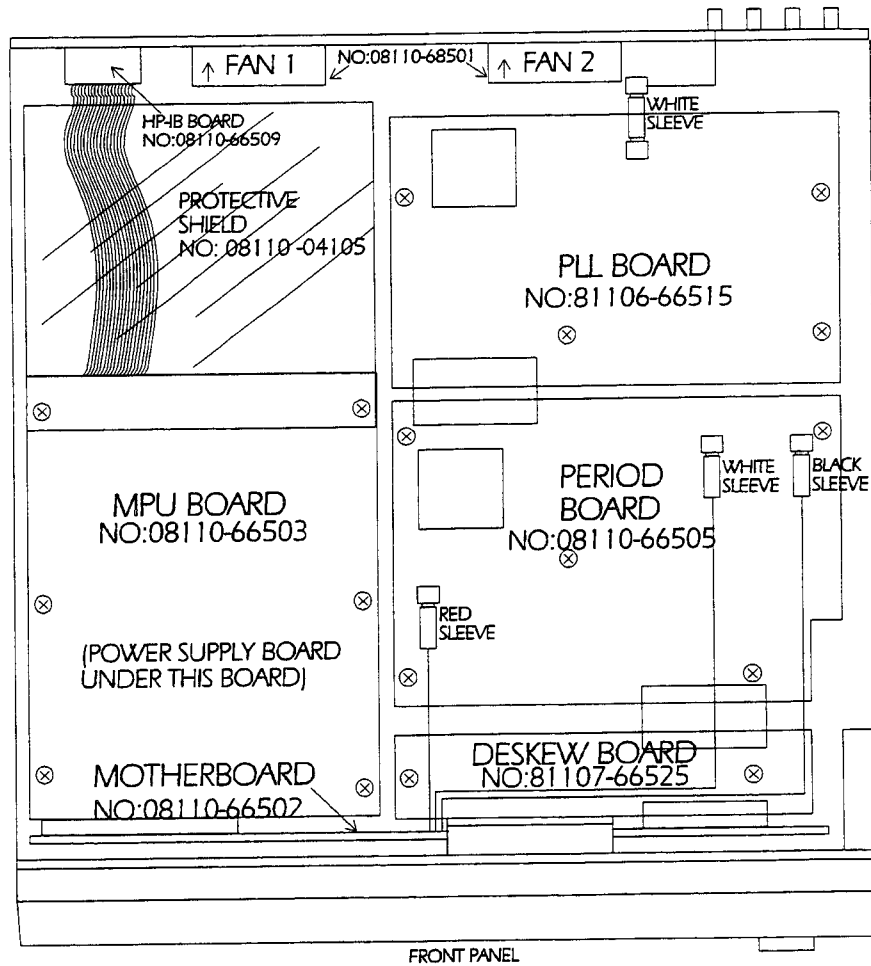


Figure 5-7. Top View of HP 8110A

## Removing the Microprocessor Board

Referring to the general top-view diagram Figure 5-7, proceed as follows:

1. Remove the 2 screws securing the Protective Shield and remove the shield
2. Remove the remaining 4 screws securing the MPU board to the chassis, and lay the board behind the unit
3. Disconnect the HP-IB Ribbon cable from the MPU board



## Removing the Period Board

Referring to the general top-view diagram Figure 5-7, proceed as follows:

### Standard Instruments

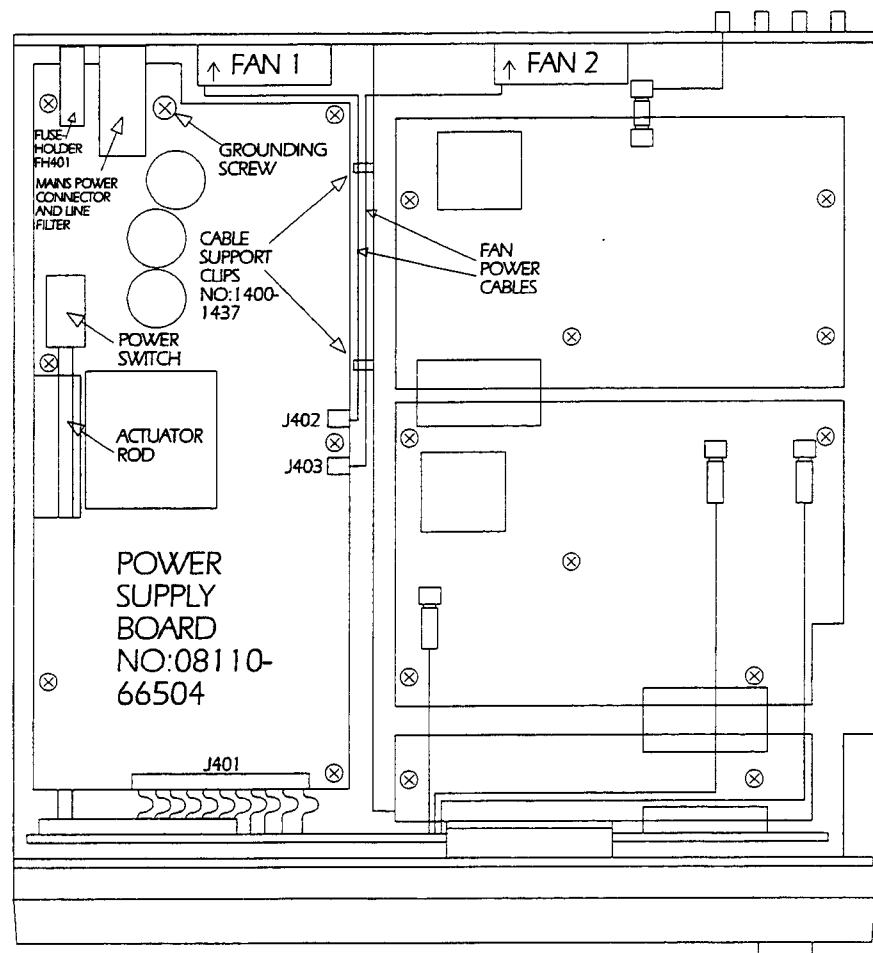
1. Disconnect the following cables, noting their position and order:
  - Red sleeved cable: Trigger In
  - White sleeved cable: Strobe Out
  - Black sleeved cable: Trigger Out
2. Remove the 5 screws securing the Period board to the chassis
3. Remove the Period board by sliding it away from the Motherboard connector

### Instruments with Original Options, or Retrofitted Options

1. Disconnect the white sleeved cable: PLL Reference In
2. Remove the 4 screws securing the PLL board to the chassis
3. Remove the PLL board by sliding it away from the Period board connector
4. Disconnect the following cables, noting their position and order:
  - Red sleeved cable: Trigger In
  - White sleeved cable: Strobe Out
  - Black sleeved cable: Trigger Out
5. Remove the 9 screws securing the Period board to the chassis
6. Remove the Period board by sliding it away from the Deskew board connector
7. Remove the 2 screws securing the Deskew board to the chassis
8. Remove the Deskew board by sliding it away from the Motherboard connector

## Removing the Power Supply Board

Figure 5-8 shows the position of the Power Supply board and its fixings:



**Figure 5-8. Top View of HP 8110A with MPU board Removed**

### Note



The HP-IB board and its cable must be removed first to prevent obstruction when removing the Power Supply board.

Remove the Power Supply board as follows:

1. Remove the 2 hexagonal stand-offs securing the HP-IB board and its cable to the chassis, and remove the HP-IB board
2. Remove the 2 screws securing the Power Inlet at the rear chassis. These screws are longer than the fixings used for the boards. Note that the Power Inlet is also connected to the PC board
3. Remove the **Grounding Screw** and washer
4. Remove the actuator rod from the power switch (see Figure 5-8 for its position) using the long-nosed pliers

5. Remove the 6 screws securing the Power Supply board to the chassis
6. Disconnect the two fan power connectors J402 and J403 (see Figure 5-8 for their positions), noting which plug goes to which connector
7. Remove the board this way:

**Caution**



---

The Power Supply board is heavy! Take care not to flex the board when moving it

---

- Slide the board a small amount toward the Motherboard to clear the power inlet
- Lift the end of the PC board nearest the rear panel, and raise it above the rear panel
- Carefully, pull the board back until the ribbon cable connected to J401 (see Figure 5-8 for position of J401) becomes fairly straight.
- Remove the connector from J401
- Lift out the Power Supply board

## Replacing or Refitting the Power Supply Board

1. Lay the Power Supply board inside the chassis with the Power Inlet end propped up on the rear panel. Connect the Motherboard ribbon-cable connector to J401 (see Figure 5-8 for position of J401)
2. Slide the board forward and lower it into position
3. Replace the 2 screws securing the power inlet to the rear panel **but do not tighten them yet**
4. Replace the 6 screws securing the PC board **but do not tighten them yet**
5. Tighten the 2 screws securing the power inlet
6. Tighten the 6 screws securing the PC board
7. Replace the **Grounding Screw** with its washer and tighten it fully
8. Reconnect the two fan power connectors J402 and J403 (see Figure 5-8 for their positions), ensuring that each plug is connected to the correct connector
9. Reconnect the power switch actuating rod and check that it operates smoothly
10. Replace the HP-IB subassembly, ensuring that the narrow side of the 'D' connector is uppermost. Replace and tighten the 2 hexagonal stand-offs

## Removing Output Boards

Standard instruments are fitted with only one Output board, but an instrument may have a second Output board, originally fitted as an option, or retrofitted at a later date.

The Output boards are fitted to the underside of the instrument, as shown in Figure 5-9. Output 1 board is always fitted and is secured by 6 hexagonal standoffs. When there are 2 Output boards the second board is mounted directly above the first by 6 screws fastening into the hexagonal standoffs that secure Output board 1.

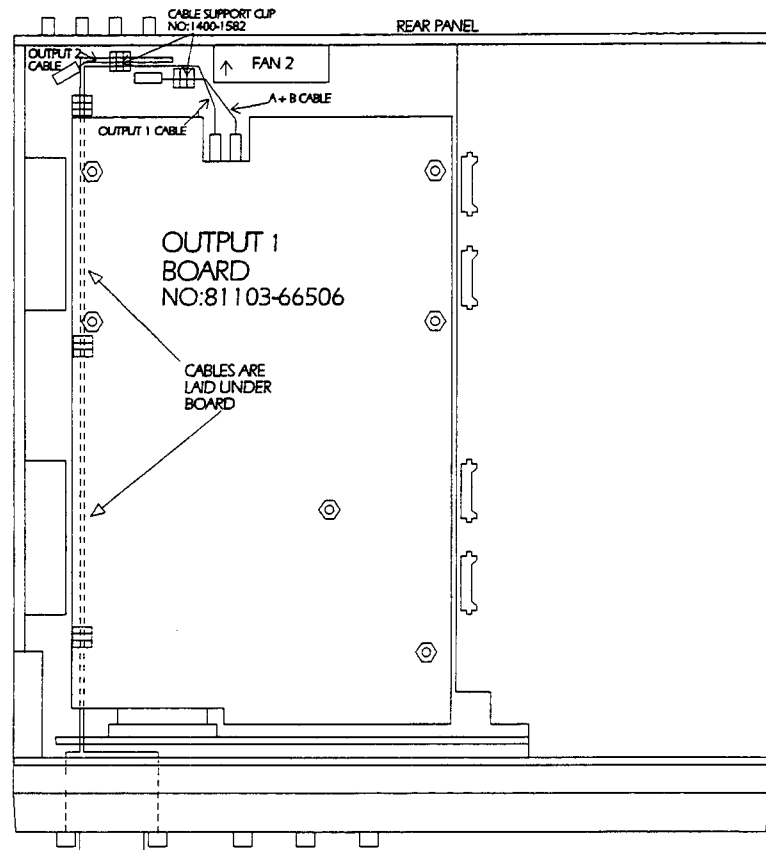


Figure 5-9. Underside View of HP 8110A showing Output 1 board

### Instruments Fitted with Output 1 Board Only

1. Disconnect the output cable from the board
2. Remove the 6 hexagonal standoffs securing Output 1 board to the chassis using a 6mm nut driver
3. Remove the board by sliding it toward the rear panel just sufficiently to clear its supports, and lifting it out

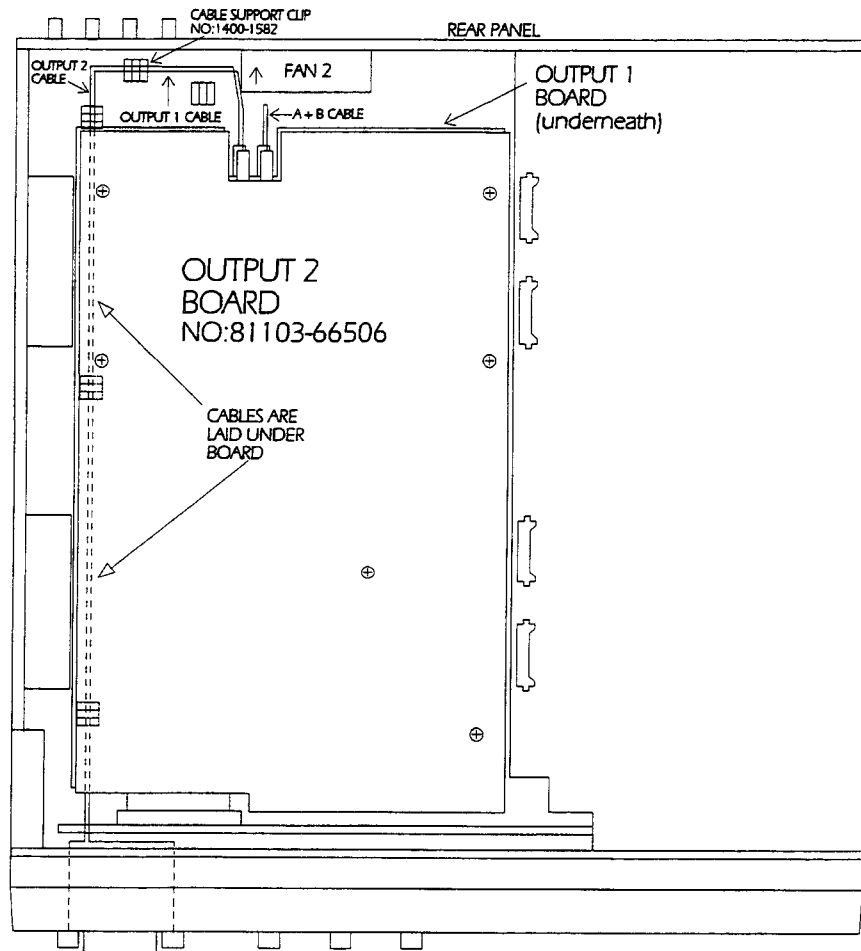
**Caution**



If you slide the board back too far, some components may be damaged.

### Instruments Fitted with Output 1 Board and Output 2 Board

Remove the boards as shown in Figure 5-9 and then Figure 5-10



**Figure 5-10. Underside View of HP 8110A showing Output 2 board**

1. Disconnect the output cable from the Output 2 board
2. Disconnect the A+B cable from the board Output 2 board

3. Remove the 6 screws securing the Output 2 board to the chassis via the hexagonal standoffs
4. Remove the board by sliding it toward the rear panel just sufficiently to clear its supports, and lifting it out

**Caution**



---

If you slide the board back too far, some components may be damaged.

---

5. Disconnect the output cable from the Output 1 board
6. Disconnect the A+B cable from the Output 1 board
7. Remove the 6 hexagonal standoffs securing Output 1 board to the chassis using a 6mm nut driver
8. Remove the board by sliding it toward the rear panel just sufficiently to clear its supports, and lifting it out

**Caution**



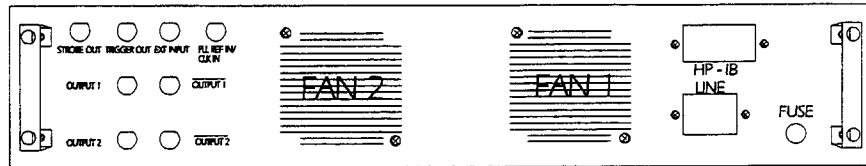
---

If you slide the board back too far, some components may be damaged.

---

## Removing the Fans

The following procedure is identical for each of the fans: Figure 5-11 shows the position of the fans and their fixing screws on the rear panel



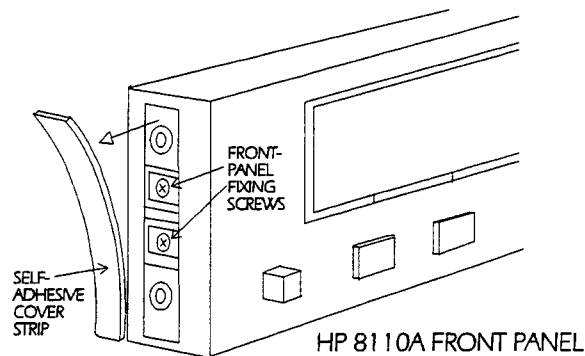
**Figure 5-11. View of the Rear Panel Showing the Position of the Fans**

You can also see the position of the fans in Figure 5-7 and Figure 5-8.

1. First remove:
  - a. The instrument case
  - b. The MPU board and Protective Shield
2. Disconnect the supply cable on the Power Supply board
3. Release the supply cable from the cable clamps
4. Remove the fan

## Removing the Front Panel

1. Remove the 2 self-adhesive side trims. These cover the Front Panel fixing screws. See Figure 5-12 for the position of the trims



**Figure 5-12. Front Panel Fixing Screws**

2. Remove the 4 screws (2 on each side of the Front Panel) securing the Front Panel to the chassis
3. Pull the Front Panel forward from the chassis and disconnect the long ribbon cable connected to the Motherboard connector on the front of the chassis
4. Remove the Front Panel

The replaceable subassemblies of the Front Panel are:

- Ribbon-cable connecting the Front Panel to the Motherboard
- Ribbon-cable connecting the RPG module to the Display module
- Display module
- RPG module
- RPG knob
- RPG Head unit
- Key pad retaining panels
- Key pad flexible connector
- Large Key pad
- Small Key pad
- Front Panel Legend Foil
- Front Panel frame

Figure 5-13 shows a rear view of the HP 8110A Front Panel. For clarity, the 2 ribbon-cables are not shown.



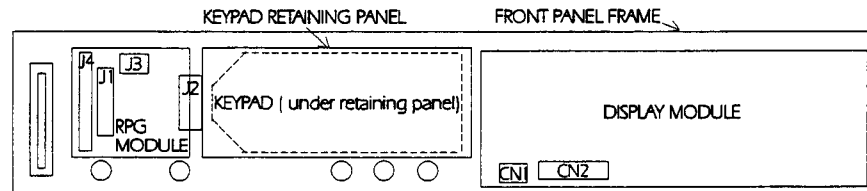


Figure 5-13. Front Panel Subassemblies

### How to Remove PC Boards from Plastic Support Clips

Some of the Front Panel subassemblies are held in position by plastic support clips. Remove them as follows:

1. Using a knife or other suitable tool, gently release the PC board from its support clips, starting with the clips at one corner of the board and working along the board, raising it slightly as each clip is released. Move the clips just sufficiently to release the board.
2. When both ends of the board and one side have been released from the clips the board can be slid out from the clips on the remaining side.

#### Caution



---

Do not use excessive pressure on PC board support clips, as they may become damaged.

---

The Front Panel Subassemblies

Figure 5-14 shows the Front Panel subassemblies removed from the Front Panel frame. The large and small Key pads are shown still in position on the frame.

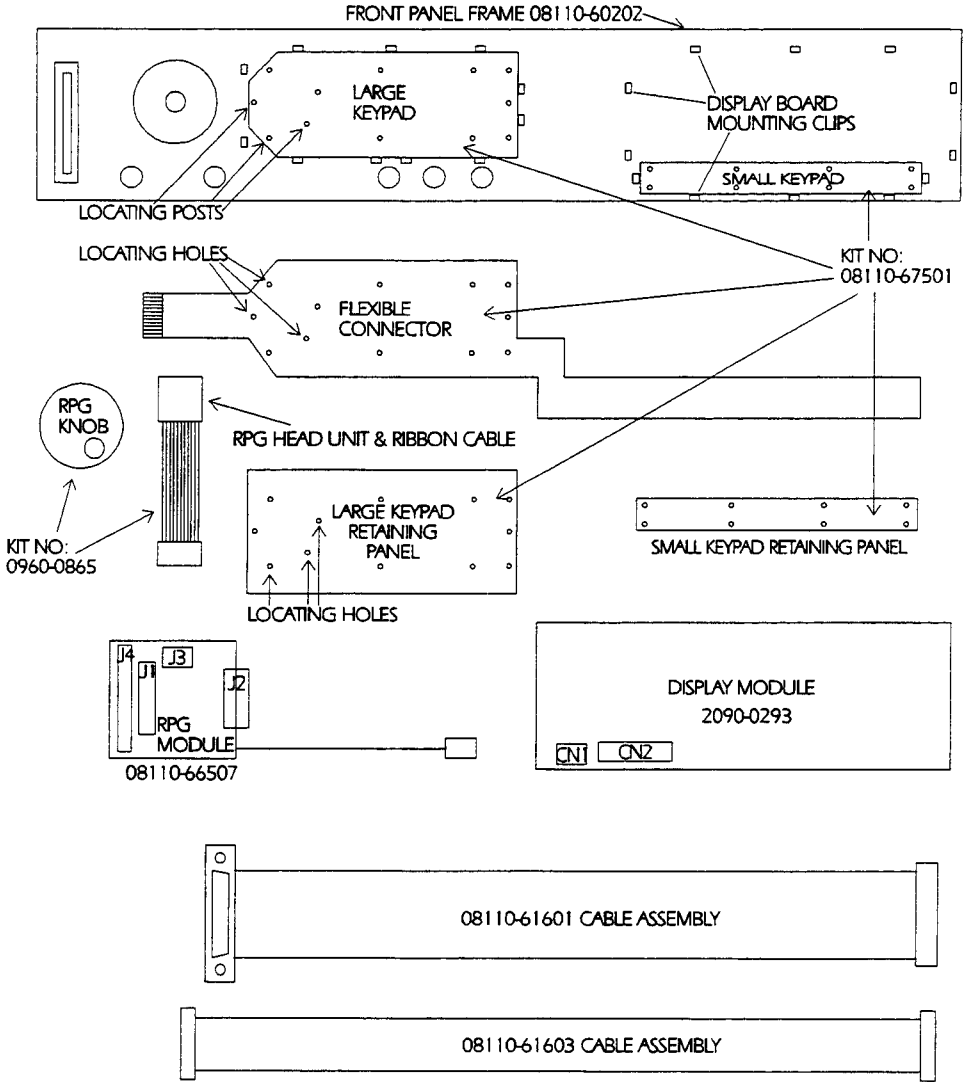


Figure 5-14. Front Panel Subassemblies

## Removing the Front Panel Subassemblies

Disassemble the Front Panel until you reach the subassembly you want to replace, as follows:

1. Ribbon-cable connecting the Front Panel to the Motherboard
  - a. Disconnect the Ribbon cable from J4
  - b. Remove the Ribbon cable
2. Ribbon-cable connecting the RPG module to the Display module
  - a. Disconnect one end from J1 on the RPG module
  - b. Disconnect the other end from CN2 on the Display module
  - c. Remove the Ribbon cable
3. Display module
  - a. Disconnect from CN1, the cable coming from the RPG module
  - b. Release the module from its plastic support clips (see “How to Remove PC Boards from Plastic Support Clips”) above)
  - c. Remove the Display module
4. RPG module
  - a. If not already done, disconnect and remove Ribbon cables connected to J4 and J1
  - b. If not already done, disconnect the cable going from the RPG module to CN1 on the Display module
  - c. Disconnect the Ribbon cable from J3. This cable connects to the Head unit and is folded under the RPG module and trapped there to accommodate the length of the Ribbon cable
  - d. Slide the cover of J2 toward the large Key pad to release the flexible connector, and remove the connector from J2
  - e. Release the module from its plastic support clips (see “How to Remove PC Boards from Plastic Support Clips”)
  - f. Remove the RPG module
5. RPG knob
  - a. Using gentle, steady pressure, pull the knob off the RPG Head unit shaft. There are no retaining screws
6. RPG Head unit
  - a. Using a 12mm nut driver, remove the nut that secures the RPG Head unit to the Front Panel
  - b. Remove the washer
  - c. Remove the RPG Head unit

7. Key pad retaining panels The 2 Keypad securing panels are removed by the same method:
  - a. Release the panel from its plastic support clips and locating posts (see “How to Remove PC Boards from Plastic Support Clips”)
  - b. Remove the panel
8. Key pad flexible connector
  - a. Remove carefully from the locating posts securing the flexible connector to the Front Panel frame (see “How to Remove PC Boards from Plastic Support Clips”)
9. Large Key pad
  - a. Holding the rubber Key pad at each end, lift the Key pad clear of the Front Panel frame, disengaging the keys from their cut-outs and the locating posts (see “How to Remove PC Boards from Plastic Support Clips”)
10. Small Key pad
  - a. Holding the rubber Key pad at each end, lift the Key pad clear of the Front Panel frame, disengaging the keys from their cut-outs and the locating posts (see “How to Remove PC Boards from Plastic Support Clips”)
11. Front Panel Legend foil

**Caution**




---

Be sure that you want to remove the Front Panel foil, as it is extremely unlikely that you will be able to refit the original foil. A new foil, Part No: 08110-40202, will be required.

---

- a. Remove by prising up one corner to allow a firm grip on the foil and pull up from the Front Panel frame until completely freed

## Replacing or Refitting the Front Panel Subassemblies

In general, this is the reverse of removing, but where replacing or refitting differs in any way, it is noted in this section

### How to Fit PC Boards into Plastic Support Clips

1. Locate one side of the PC board in its support clips
2. Press one end of the board steadily down on its clips while moving the clips back from the board just enough to allow the board to 'click' into position
3. Repeat step 2 for the other side, and the remaining end of the board

#### Caution



---

Do not use excessive pressure on PC board support clips, as they may become damaged.

---

### Points to Observe when Refitting or Replacing Front Panel Subassemblies

1. Display module
  - a. If you are replacing the Display module, remove the protective film from the display
  - b. Using a dry, clean cloth, gently clean the surface of the display
2. RPG Head unit
  - a. Fold the Ribbon cable in a concertina above the unit to use up the extra length, before fitting the RPG module. Allow just sufficient cable showing at the top of the unit to connect tidily with J3 on the RPG module, which then fits over the Head unit, holding the folded cable in position
  - b. Secure the unit to the Front Panel frame using the 12mm nut and washer. Take care not to over-tighten the 12mm nut, as the mounting bush may be damaged
  - c. Press the knob firmly onto the spindle, making sure that the flat on the spindle is aligned with the corresponding flat inside the knob
  - d. Rotate the knob to check that it runs smoothly
3. RPG module
  - a. Ensure that the LEDs are correctly positioned above their apertures. If not, move slightly with a screwdriver or other suitable tool until the positioning is correct
4. Large and small Key pads
  - a. If you are replacing one or both Key pads, you will see that the Key pad kit No: 08110-67501 contains both keypads, attached together as one piece. Separate the small pad from the large one by gently tearing the two sections apart

- b. When you have finished fitting the Key pads, press each of the pads in turn to check that they operate freely

#### 5. Front Panel Legend Foil

**Caution**



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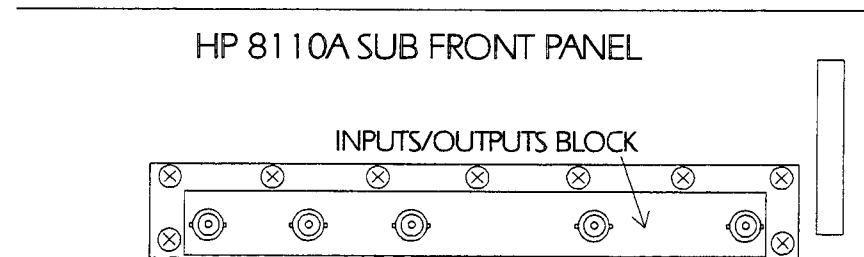
Take great care when attaching a new foil. If you misalign the foil, you may not be able to re-attach it after removal, as it is extremely likely to be damaged in the process. If you damage the foil you will need another new one.

---

- a. Lay the new foil with its protective backing in place, on top of the Front Panel frame, in the correct position
- b. Using adhesive tape, secure the foil in position for just less than half its length
- c. Raise the free end of the foil and peel off a half section of the protective backing sheet
- d. Carefully lower the free end of the foil to the Front Panel frame and smooth it into firm contact. Avoid the inclusion of air-bubbles by smoothing the foil from the centre toward the end of the Front Panel frame. The adhesive is immediately effective and the foil cannot now be moved.
- e. Remove the adhesive tape and the remaining half of the foil protective backing sheet and smooth the foil into contact with the other half of the Front Panel frame

## Removing the Inputs/Outputs Block

1. First remove:
  - a. The instrument case
  - b. The Front Panel
2. Disconnect cables:
  - a. Output 2 cable from Output 2 board, if this board is fitted
  - b. Output 1 cable from Output 1 board
  - c. Trigger In from the Timing board
  - d. Trigger Out from the Timing board
  - e. Strobe Out from the Timing board
3. Carefully pull back all the cables, removing them from cable clamps and mountings, noting their positions
4. Remove 9 screws securing the Inputs/Outputs Block to the chassis and remove the block. Figure 5-15 shows the positions of the fixing screws



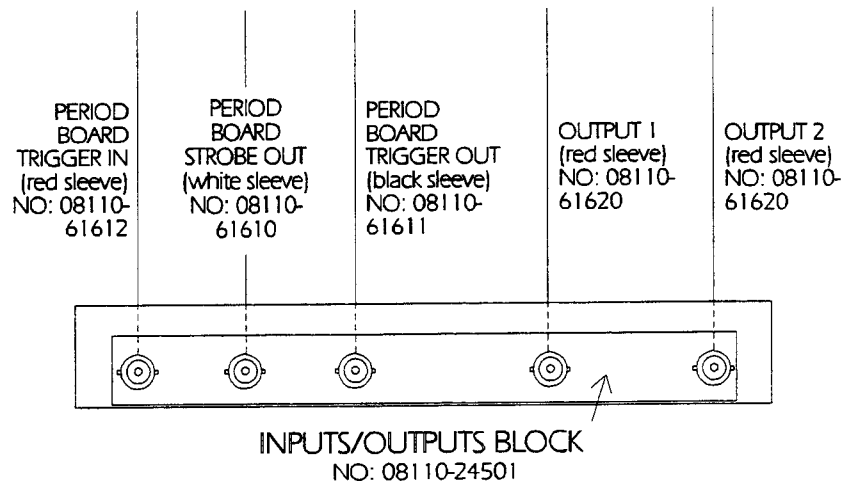
**Figure 5-15. Inputs/Outputs Block Showing the Fixing Screws**

You can now replace any of the BNC connectors with their associated cables, as follows:

## Replacing or Refitting the Inputs/Outputs Block and Cables

Mechanically, replacing or refitting the Input/Output block is the reverse of removal. But the following points should be observed:

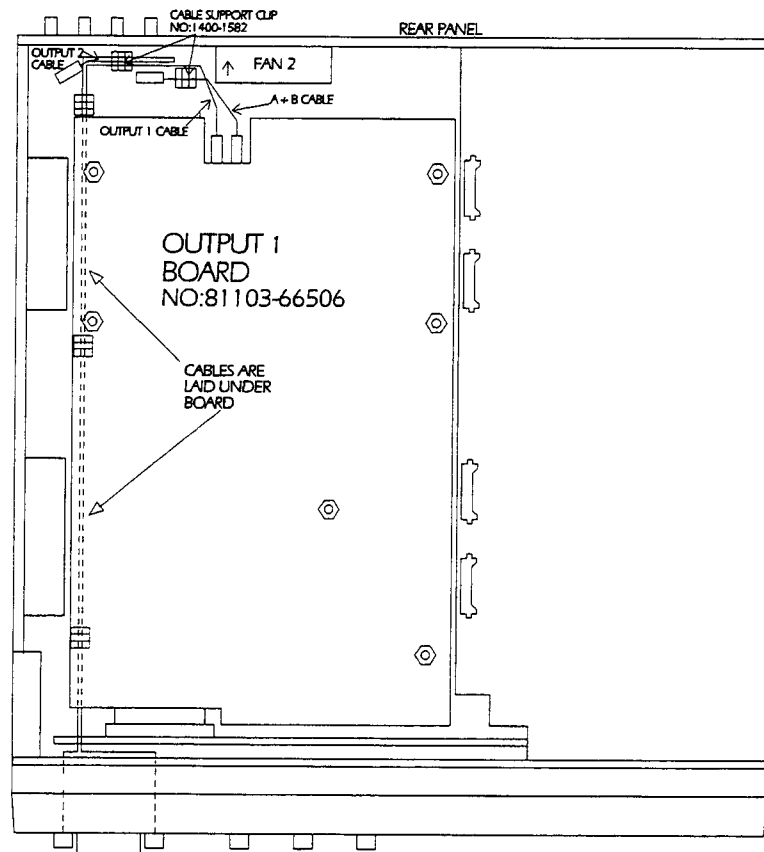
1. When changing input or output cable assemblies, note that there is a flat area on each BNC connector, and a corresponding flat in the chassis fixing hole. Align these before fitting the BNC connector and cable
2. The following figure gives the numbers of the replacement cable/BNC connector assemblies:



**Figure 5-16. Inputs/Outputs Block Showing the Cables**

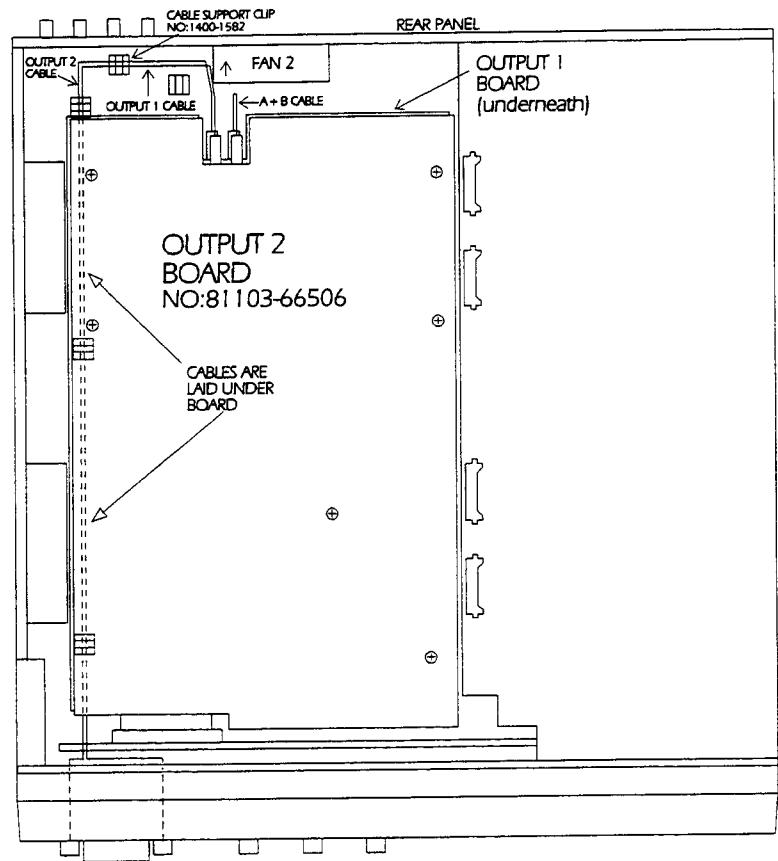
3. Lay the cables as follows:
  - a. Output cables pass through the Motherboard and under Output board 1, and then to the rear panel.
    - If Output 1 board only, is fitted, fold Output 2 cable as shown in Figure 5-17 and secure it by the cable support clip. Output 1 cable goes directly to Output 1 board. Press the plug firmly home into the connector on the board





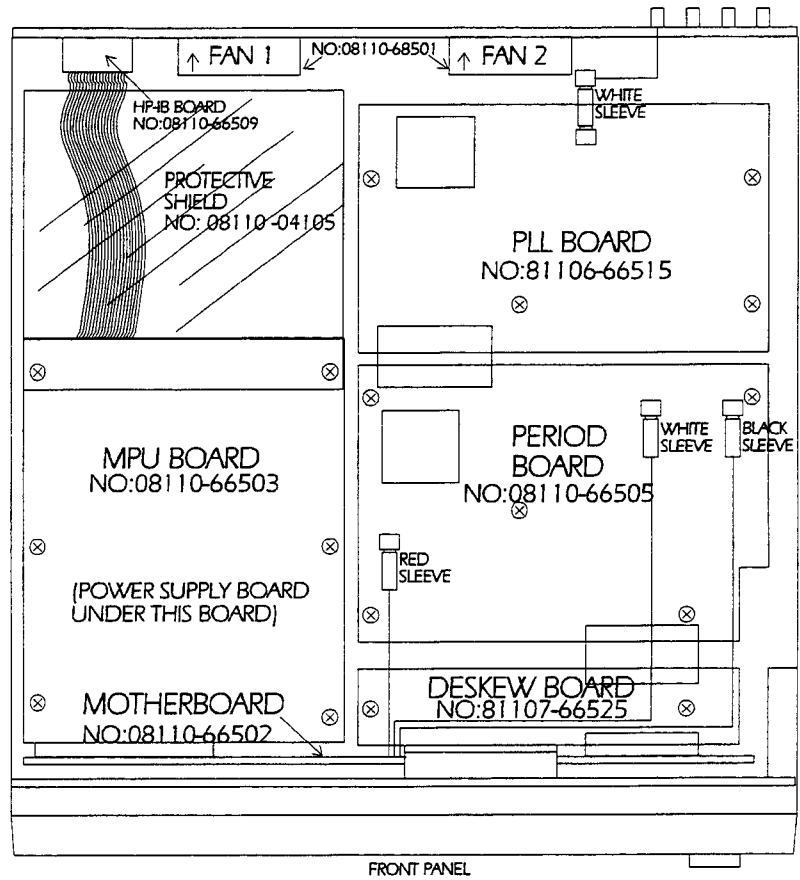
**Figure 5-17. Output 1 board Only Fitted**

- If Output 1 and Output 2 boards are both fitted, press Output 1 cable into the cable support clip and then to Output 1 board. Press the plug firmly home into the connector on the board. Secure Output 2 cable in the clip next, and then to Output 2 board, as shown in Figure 5-18. Press the plug firmly home into the connector on the board



**Figure 5-18. Output 1 and Output 2 boards fitted**

4. Lay the remaining 3 cables to the Period board as follows:
  - a. Pass all 3 cables behind the Motherboard, thus bringing them to the top of the chassis. They emerge as shown in the following figure:



**Figure 5-19. Position of Period board Cables**

- b. Lay the cable with the red sleeve directly to its connector and press the plug firmly home
- c. Lay the remaining 2 cables along behind the Front Panel and bend to connect directly to the 2 connectors. Press the plugs firmly home into the connectors

## Removing the Memory Card Connector Board

1. Remove the instrument case
2. Disconnect the 2 ribbon cables that connect to the Motherboard
3. Remove the 2 screws securing the Memory Card Connector board to the chassis (see Figure 5-20 and Figure 5-21 for their position)

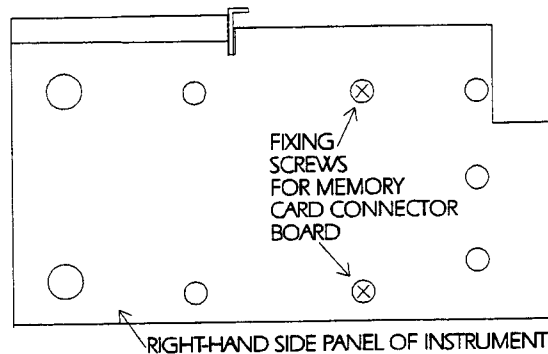


Figure 5-20. Memory Card Connector board Chassis Fixing Screws

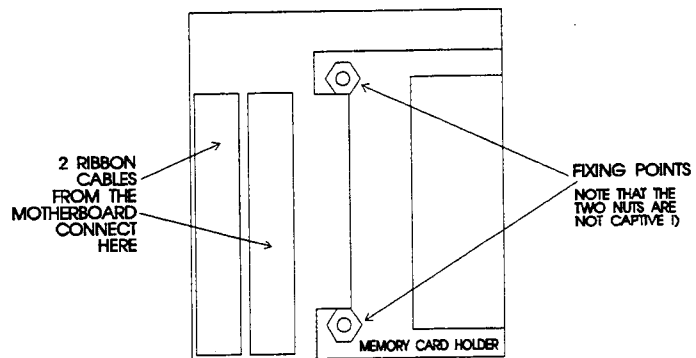


Figure 5-21. Memory Card Connector board Fixings

### Caution



The nuts used with these screws are not attached to the Memory Card Connector board, and so may be easily lost. It is recommended that you attach the nuts and screws together, to lessen the danger of losing them.

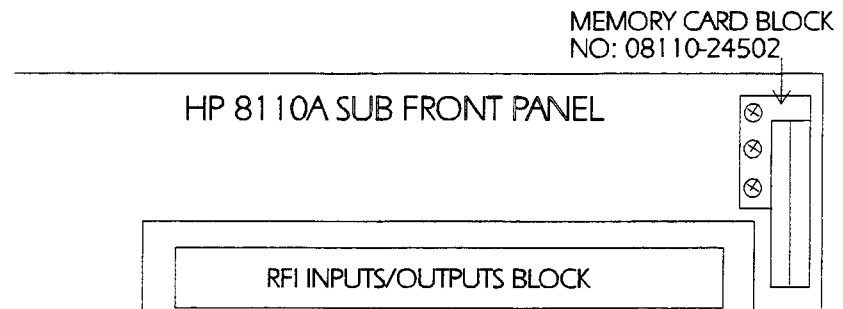
4. Remove the Memory Card Connector board

## Replacing or Refitting the Memory Card Connector Board

This is the reverse of removal, except that it is advisable to locate the 2 nuts in their receptacles on the Memory Card Connector board before putting the board back in position

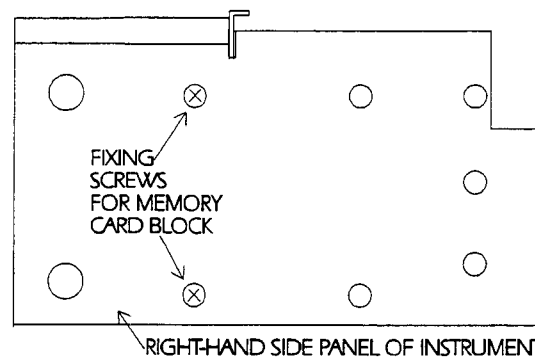
## Removing the Memory Card Block

1. First remove:
  - a. The instrument case
  - b. The Front Panel
2. Remove 3 screws securing the Memory Card Block to the chassis sub Front Panel Figure 5-22 shows the location of these screws



**Figure 5-22. Memory Card Connector board Front Fixings**

3. Remove 2 screws securing the Memory Card Block to the side of the chassis Figure 5-23 shows the location of these screws

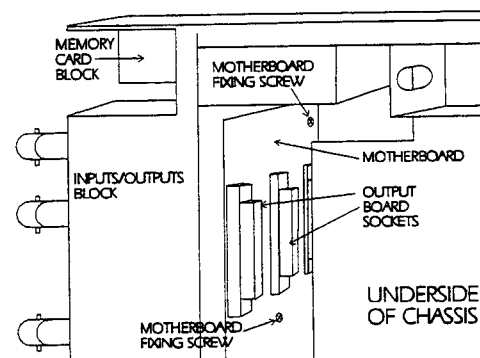


**Figure 5-23. Memory Card Connector board Side Fixings**

4. Remove the Memory Card Block

## Removing the Motherboard

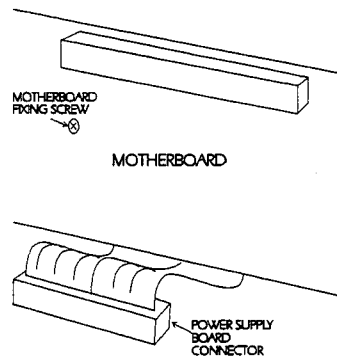
1. First remove:
  - a. The instrument case
  - b. The Microprocessor board
  - c. The HP-IB board
  - d. The Power Supply board
  - e. The PLL board (if fitted)
  - f. The Period board
  - g. The Deskew board (if fitted)
  - h. The Output 1 board
  - i. The Output 2 board (if fitted)
  - j. The Front Panel
2. Remove the 2 cables connecting the Memory Card Connector board
3. Remove the 2 screws securing the Motherboard to the rear of the chassis sub front panel (see Figure 5-24 for the position of these screws)



**Figure 5-24.**

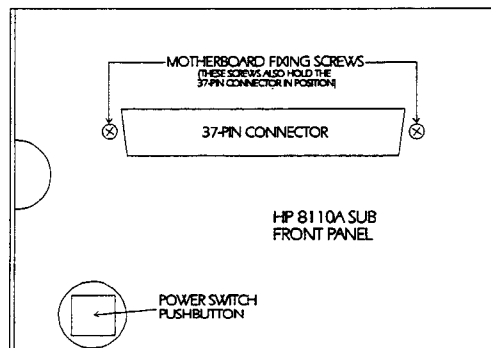
**Two of Three Motherboard Fixing Screws on Rear of Sub Front Panel**

4. Remove the single screw securing the Motherboard to the rear of the chassis sub front panel (see Figure 5-25 for the position of this screw)



**Figure 5-25.**  
**One of Three Motherboard Fixing Screws on Rear of Sub Front Panel**

5. Remove the 2 screws securing the Motherboard to the front of the chassis sub front panel (see Figure 5-26 for the position of these screws)
6. Remove the RFI shield that fits on the 37-pin D connector. Put this in a safe place for use during reassembly



**Figure 5-26.**  
**Motherboard Fixing Screws on Front of Sub Front Panel**

7. Carefully move any cables obstructing the removal of the Motherboard, and tilting the board down at the Memory Card Connector board end of the chassis, pull the board out at the Output board side of the chassis

## Replacing or Refitting the Motherboard

Replacing or refitting the Motherboard is the reverse of removing, but it is important to remember to fit the RFI Shield, Part No. 8160-0562 between the 37-pin D connector and the chassis sub front panel.

## Replaceable Parts

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### Exchange Parts List

#### Exchange Boards

**Table 6-1.**

| Board            | Original Bd Number | Exchange Bd Number |
|------------------|--------------------|--------------------|
| 10 V/2 ns Output | 81103-66506        | 81103-69506        |

#### Replacement Boards

**Table 6-2.**

| Board               | Original Bd Number | Replacement Bd Number |
|---------------------|--------------------|-----------------------|
| Microprocessor      | 08110-66503        | 08110-66503           |
| Power Supply        | 08110-66504        | 08110-66504           |
| Period              | 08110-66505        | 08110-66505           |
| PLL/Ext Clock In    | 81106-66515        | 81106-66515           |
| Multichannel Deskew | 81107-66525        | 81107-66525           |



HP 8110A Parts List

Table 6-3.

| Ref  | HP Part #   | CD | Qty    | Description      | Man'f | Part #                |
|------|-------------|----|--------|------------------|-------|-----------------------|
| A2   | 08110-66502 | 0  | 1      | BD AY MOTHER     | 28480 | 08110-66502           |
| A3   | 08110-66403 | 0  | 1      | BD AY MICRO PRCR | 28480 | 08110-66403           |
| A4   | 08110-66504 | 2  | 1      | BD AY PWR SPLY   | 28480 | 08110-66504           |
| A5   | 08110-66505 | 3  | 1      | BD AY PERIOD     | 28480 | 08110-66505           |
| A9   | 08110-66509 | 7  | 1      | BD AY HPIB       | 28480 | 08110-66509           |
| A7   | 08110-66507 | 5  | 1      | BD AY LED RPG KE | 28480 | 08110-66507           |
| A8   | 08110-66508 | 6  | 1      | BD AY MEM-CARD C | 28480 | 08110-66508           |
| DS1  | 2090-0293   | 6  | 1      | DISPLAY MODULE   | 11908 | GU256X64-315          |
| MP1  | 08110-60101 | 3  | 1      | CHASSIS AY       | 28480 | 08110-60101           |
| MP2  | 08110-67501 | 1  | 1      | KEYPAD KIT       | 28480 | 08110-67501           |
| MP3  | 08110-60201 | 4  | 1      | FRONT FRAME      | 28480 | 08110-60201           |
| MP4  | 08110-64101 | 1  | 1      | COVER AY         | 28480 | 08110-64101           |
| MP5  | 08110-40202 | 3  | 1      | PANEL FRNT       | 28480 | 08110-40202           |
| MP6  | 08110-24501 | 1  | 1      | CONN.CASE        | 28480 | 08110-24501           |
| MP7  | 08110-04105 | 9  | 1      | COVER SAFETY     | 28480 | 08110-04105           |
| MP8  | 08110-24502 | 2  | 1      | MEMORY CARD TUBE | 28480 | 08110-24502           |
| MP9  | 08110-04104 | 8  | 1.5000 | COVER-INSULATION | 28480 | 08110-04104           |
| MP10 | 8160-0797   | 0  | 1      | RFI STRP-FINGERS | 11432 | 187RF8CO70-51.4 MM LG |
| MP11 | 8160-0797   | 0  | 1      | RFI STRP-FINGERS | 11432 | 187RF8CO70-51.4 MM LG |
| MP15 | 8160-0568   | 3  | 0.3600 | RFI STRP-FINGERS | 02034 | 375P80                |
| MP16 | 0460-1336   | 3  | 0.0150 | TAPE-INDL .5IN   | 04726 | Y-444                 |
| MP20 | 1400-1582   | 6  | 1      | CLIP-CABLE       | 12999 | NOVA KS ACC01         |
| MP21 | 1400-1582   | 6  | 1      | CLIP-CABLE       | 12999 | NOVA KS ACC01         |
| MP22 | 1400-1582   | 6  | 1      | CLIP-CABLE       | 12999 | NOVA KS ACC01         |
| MP23 | 1400-1582   | 6  | 1      | CLIP-CABLE       | 12999 | NOVA KS ACC01         |
| MP30 | 0363-0125   | 0  | 1      | RFI STRP-FINGERS | 03647 | 97-555                |
| MP31 | 0363-0125   | 0  | 1      | RFI STRP-FINGERS | 03647 | 97-555                |
| MP50 | 08110-68501 | 3  | 1      | Fan Assy 624     | 28480 | 08110-68501           |
| MP51 | 08110-68501 | 3  | 1      | Fan Assy 624     | 28480 | 08110-68501           |
| MP54 | 8160-0562   | 7  | 1      | RFI GASKET       | 03746 | 572019-00103-70       |
| MP56 | E2900-47401 | 9  | 1      | KNOB RPG CURSOR  | 28480 | E2900-47401           |
| MP60 | 1400-1437   | 0  | 1      | CLAMP-CABLE      | 12247 | 742 171               |
| MP61 | 1400-1437   | 0  | 1      | CLAMP-CABLE      | 12247 | 742 171               |
| MP70 | 5040-9352   | 4  | 1      | CAP FIBER DIAM.  | 28480 | 5040-9352             |
| MP71 | 08168-24756 | 6  | 1      | SPACER SHOCK ABS | 28480 | 08168-24756           |

Table 6-3. (continued)

| Ref   | HP Part #   | CD | Qty | Description      | Man'f | Part #        |
|-------|-------------|----|-----|------------------|-------|---------------|
| MP105 | 0624-0413   | 3  | 1   | SCR-TPG 8-16     | 05610 | 224-41390-382 |
| MP106 | 0624-0413   | 3  | 1   | SCR-TPG 8-16     | 05610 | 224-41390-382 |
| MP107 | 0624-0413   | 3  | 1   | SCR-TPG 8-16     | 05610 | 224-41390-382 |
| MP108 | 0624-0413   | 3  | 1   | SCR-TPG 8-16     | 05610 | 224-41390-382 |
| MP120 | 0380-0643   | 3  | 1   | STDF-HEX .255-IN | 02685 |               |
| MP121 | 0380-0643   | 3  | 1   | STDF-HEX .255-IN | 02685 |               |
| MP122 | 2190-0321   | 3  | 1   | WSHR-LK INTL T   | 04805 | 1708-00       |
| MP123 | 2190-0321   | 3  | 1   | WSHR-LK INTL T   | 04805 | 1708-00       |
| MP124 | 1251-7999   | 4  | 1   | DUST COVER       | 04068 | 474-11-91-707 |
| MP190 | 2950-0035   | 8  | 1   | NUT-HEX-DBL-CHAM | 04567 |               |
| MP191 | 2950-0035   | 8  | 1   | NUT-HEX-DBL-CHAM | 04567 |               |
| MP192 | 2950-0035   | 8  | 1   | NUT-HEX-DBL-CHAM | 04567 |               |
| MP193 | 2950-0035   | 8  | 1   | NUT-HEX-DBL-CHAM | 04567 |               |
| MP194 | 2950-0035   | 8  | 1   | NUT-HEX-DBL-CHAM | 04567 |               |
| MP195 | 2190-0102   | 8  | 1   | WSHR-LK INTL T   | 04805 | 1922-01       |
| MP196 | 2190-0102   | 8  | 1   | WSHR-LK INTL T   | 04805 | 1922-01       |
| MP197 | 2190-0102   | 8  | 1   | WSHR-LK INTL T   | 04805 | 1922-01       |
| MP198 | 2190-0102   | 8  | 1   | WSHR-LK INTL T   | 04805 | 1922-01       |
| MP199 | 2190-0102   | 8  | 1   | WSHR-LK INTL T   | 04805 | 1922-01       |
| MP200 | 1460-1345   | 5  | 1   | TILT STAND       | 00359 |               |
| MP201 | 1460-1345   | 5  | 1   | TILT STAND       | 00359 |               |
| MP202 | 5001-0538   | 8  | 1   | TRIM STRIP       | 28480 | 5001-0538     |
| MP203 | 5001-0538   | 8  | 1   | TRIM STRIP       | 28480 | 5001-0538     |
| MP204 | 5041-8801   | 8  | 1   | FOOT             | 28480 | 5041-8801     |
| MP205 | 5041-8801   | 8  | 1   | FOOT             | 28480 | 5041-8801     |
| MP206 | 5041-8822   | 3  | 1   | FOOT REAR,N-SKID | 28480 | 5041-8822     |
| MP207 | 5041-8822   | 3  | 1   | FOOT REAR,N-SKID | 28480 | 5041-8822     |
| MP208 | 5041-8819   | 8  | 1   | STP HNDL FRNT    | 28480 | 5041-8819     |
| MP209 | 5041-8819   | 8  | 1   | STP HNDL FRNT    | 28480 | 5041-8819     |
| MP210 | 5041-8820   | 1  | 1   | STP HNDL REAR    | 28480 | 5041-8820     |
| MP211 | 5041-8820   | 1  | 1   | STP HNDL REAR    | 28480 | 5041-8820     |
| MP212 | 5062-3703   | 3  | 1   | STRAP HANDLE     | 28480 | 5062-3703     |
| MP213 | 5062-3703   | 3  | 1   | STRAP HANDLE     | 28480 | 5062-3703     |
| MP214 | 08110-01001 | 8  | 1   | REAR FOOT        | 28480 | 08110-01001   |
| MP215 | 08110-01001 | 8  | 1   | REAR FOOT        | 28480 | 08110-01001   |

Table 6-3. (continued)

| Ref   | HP Part # | CD | Qty | Description      | Man'f | Part #             |
|-------|-----------|----|-----|------------------|-------|--------------------|
| MP216 | 0515-1239 | 2  | 1   | SCR-MACH M5X0.8  | 01125 |                    |
| MP217 | 0515-1239 | 2  | 1   | SCR-MACH M5X0.8  | 01125 |                    |
| MP218 | 0515-1239 | 2  | 1   | SCR-MACH M5X0.8  | 01125 |                    |
| MP219 | 0515-1239 | 2  | 1   | SCR-MACH M5X0.8  | 01125 |                    |
| MP220 | 5021-2840 | 1  | 1   | KEY-LOCK-FOOT    | 28480 | 5021-2840          |
| MP221 | 5021-2840 | 1  | 1   | KEY-LOCK-FOOT    | 28480 | 5021-2840          |
| MP222 | 5021-2840 | 1  | 1   | KEY-LOCK-FOOT    | 28480 | 5021-2840          |
| MP223 | 5021-2840 | 1  | 1   | KEY-LOCK-FOOT    | 28480 | 5021-2840          |
| MP230 | 5041-0531 | 5  | 1   | KEY              | 28480 | 5041-0531          |
| MP231 | 5040-1148 | 0  | 1   | SHAFT-SHORT/GRAY | 28480 | 5040-1148          |
| MP232 | 5040-1135 | 5  | 1   | COUPLER PWR SW   | 28480 | 5040-1135          |
| MP240 | 6960-0016 | 0  | 1   | PLUG-HOLE        | 01924 | 207-080501-01-0101 |
| MP241 | 6960-0016 | 0  | 1   | PLUG-HOLE        | 01924 | 207-080501-01-0101 |
| MP242 | 6960-0016 | 0  | 1   | PLUG-HOLE        | 01924 | 207-080501-01-0101 |
| MP243 | 6960-0016 | 0  | 1   | PLUG-HOLE        | 01924 | 207-080501-01-0101 |
| MP250 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5  | 09908 |                    |
| MP251 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5  | 09908 |                    |
| MP252 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5  | 09908 |                    |
| MP253 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5  | 09908 |                    |
| MP254 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5  | 09908 |                    |
| MP255 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5  | 09908 |                    |
| MP256 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5  | 09908 |                    |
| MP257 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5  | 09908 |                    |
| MP258 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5  | 09908 |                    |
| MP259 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5  | 09908 |                    |
| MP260 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5  | 09908 |                    |
| MP261 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5  | 09908 |                    |
| MP262 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5  | 09908 |                    |
| MP263 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5  | 09908 |                    |
| MP264 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5  | 09908 |                    |
| MP265 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5  | 09908 |                    |
| MP266 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5  | 09908 |                    |
| MP267 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5  | 09908 |                    |
| MP268 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5  | 09908 |                    |
| MP269 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5  | 09908 |                    |

Table 6-3. (continued)

| Ref   | HP Part # | CD | Qty | Description     | Man'f | Part # |
|-------|-----------|----|-----|-----------------|-------|--------|
| MP270 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP271 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP272 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP273 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP274 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP275 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP276 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP277 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP278 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP279 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP280 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP281 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP282 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP283 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP284 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP285 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP286 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP287 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP288 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP289 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP290 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP291 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP292 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP293 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP294 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP295 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP296 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP297 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP298 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP299 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP300 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP301 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP302 | 0515-0886 | 3  | 1   | SCR-MACH M3X0.5 | 09908 |        |
| MP310 | 0515-1111 | 9  | 1   | SCR-MACH M3X0.5 | 01125 |        |
| MP311 | 0515-1111 | 9  | 1   | SCR-MACH M3X0.5 | 01125 |        |

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Table 6-3. (continued)

| Ref   | HP Part #   | CD | Qty    | Description      | Man'f | Part #         |
|-------|-------------|----|--------|------------------|-------|----------------|
| MP312 | 0535-0025   | 4  | 1      | NUT-HEX DBL-CHAM | 06691 |                |
| MP313 | 0535-0025   | 4  | 1      | NUT-HEX DBL-CHAM | 06691 |                |
| MP320 | 0515-0887   | 4  | 1      | SCR-MACH         | 09908 |                |
| MP321 | 2190-0008   | 3  | 1      | WSHR-LK EXT T    | 04805 | 1806-00        |
| MP330 | 0515-0897   | 6  | 1      | SCR-MACH M3X0.5  | 09908 |                |
| MP331 | 0515-0897   | 6  | 1      | SCR-MACH M3X0.5  | 09908 |                |
| MP350 | 6960-0041   | 1  | 1      | PLUG-HOLE        | 03480 | 2643 (BLACK)   |
| MP351 | 6960-0041   | 1  | 1      | PLUG-HOLE        | 03480 | 2643 (BLACK)   |
| MP352 | 6960-0041   | 1  | 1      | PLUG-HOLE        | 03480 | 2643 (BLACK)   |
| MP353 | 6960-0041   | 1  | 1      | PLUG-HOLE        | 03480 | 2643 (BLACK)   |
| MP354 | 6960-0041   | 1  | 1      | PLUG-HOLE        | 03480 | 2643 (BLACK)   |
| MP355 | 6960-0041   | 1  | 1      | PLUG-HOLE        | 03480 | 2643 (BLACK)   |
| MP356 | 6960-0041   | 1  | 1      | PLUG-HOLE        | 03480 | 2643 (BLACK)   |
| MP357 | 6960-0041   | 1  | 1      | PLUG-HOLE        | 03480 | 2643 (BLACK)   |
| MP360 | 9320-5334   | 2  | 1      | LBL-LNE-PTR      | 12236 |                |
| MP361 | 08110-49301 | 1  | 1      | CUSHION TOP      | 28480 | 08110-49301    |
| MP362 | 08110-49302 | 2  | 1      | CUSHION BOTTOM   | 28480 | 08110-49302    |
| MP363 | 9211-6803   | 1  | 1      | CTN-CORR RSC     | 09525 |                |
| MP364 | 9223-0514   | 4  | 2.5000 | TAPE-INDL 80MM   | 07036 | OPTIMAL S      |
| MP365 | 9230-0028   | 0  | 1      | ENVELOPE-PKG-LST | 05250 |                |
| MP370 | 08110-91012 | 0  | 1      | USER GUIDE ENGLI | 28480 | 08110-91012    |
| MP380 | 8110A #0B2  | 0  | 0      | ADD MNL OPERATIN | 28480 | 8110A #0B2     |
| MP381 | 8110A #1BP  | 0  | 0      | MIL STD 45662A   | 28480 | 8110A #1BP     |
| MP382 | 8110A #1CM  | 0  | 0      | RACK MOUNT KIT   | 28480 | 8110A #1CM     |
| MP383 | 8110A #1CN  | 0  | 0      | HANDLE KIT       | 28480 | 8110A #1CN     |
| MP384 | 8110A #1CP  | 0  | 0      | RACK MOUNT & HAN | 28480 | 8110A #1CP     |
| MP385 | 8110A #1CR  | 0  | 0      | RACK SLIDE KIT   | 28480 | 8110A #1CR     |
| MP386 | 8110A #UEJ  | 0  | 0      | CUSTOMER UPGRADE | 28480 | 8110A #UEJ     |
| MP387 | 8110A #UN2  | 0  | 0      | Rearpanel-Option | 28480 | 8110A #UN2     |
| MP388 | 8110A #W32  | 0  | 0      | 3 YEAR CUST RET  | 28480 | 8110A #W32     |
| MP389 | 8110A #W50  | 0  | 0      | 5 YEAR CUST RET  | 28480 | 8110A #W50     |
| SW1   | 0960-0865   | 1  | 1      | OPT-ENDCR        | 01542 | HRPG-AD32 #11C |
| W1    | 08110-61603 | 2  | 1      | Cable Assy RPG-L | 28480 | 08110-61603    |
| W2    | 08110-61601 | 0  | 1      | Cable Assy Displ | 28480 | 08110-61601    |
| W3    | 08110-61620 | 3  | 1      | Cable Assy Outpu | 28480 | 08110-61620    |

Table 6-3. (continued)

| Ref | HP Part #   | CD | Qty    | Description      | Man'f | Part #      |
|-----|-------------|----|--------|------------------|-------|-------------|
| W4  | 08110-61620 | 3  | 1      | Cable Assy Outpu | 28480 | 08110-61620 |
| W5  | 08110-61625 | 8  | 1      | Cable Assy A+B M | 28480 | 08110-61625 |
| W6  | 08110-61610 | 1  | 1      | Cable Assy Strob | 28480 | 08110-61610 |
| W7  | 08110-61611 | 2  | 1      | Cable Assy Trigg | 28480 | 08110-61611 |
| W8  | 08110-61612 | 3  | 1      | Cable Assy Trigg | 28480 | 08110-61612 |
| W9  | 8120-1689   | 7  | 0.5000 | CA-ASSY          | 08674 |             |

HP 81103A Parts List

Table 6-4.

| Ref    | HP Part #   | CD | Qty | Description     | Man'f | Part #       |
|--------|-------------|----|-----|-----------------|-------|--------------|
| A6/A26 | 81103-66506 | 9  | 1   | BD AY OUTPUT    | 28480 | 81103-66506  |
| MP1    | 0380-1965   | 4  | 1   | STDF-HEX 25-MM  | 02121 | BR5172-25-34 |
| MP2    | 0380-1965   | 4  | 1   | STDF-HEX 25-MM  | 02121 | BR5172-25-34 |
| MP3    | 0380-1965   | 4  | 1   | STDF-HEX 25-MM  | 02121 | BR5172-25-34 |
| MP4    | 0515-0886   | 3  | 1   | SCR-MACH M3X0.5 | 09908 |              |
| MP5    | 0515-0886   | 3  | 1   | SCR-MACH M3X0.5 | 09908 |              |
| MP6    | 0515-0886   | 3  | 1   | SCR-MACH M3X0.5 | 09908 |              |
| MP7    | 9320-5334   | 2  | 1   | LBL-LNE-PTR     | 12236 |              |

HP 81106A Parts List

Table 6-5.

| Ref | HP Part #   | CD | Qty | Description      | Man'f | Part #      |
|-----|-------------|----|-----|------------------|-------|-------------|
| A15 | 81106-66515 | 3  | 1   | BD AY PLL        | 28480 | 81106-66515 |
| MP1 | 0515-0886   | 3  | 1   | SCR-MACH M3X0.5  | 09908 |             |
| MP2 | 0515-0886   | 3  | 1   | SCR-MACH M3X0.5  | 09908 |             |
| MP3 | 0515-0886   | 3  | 1   | SCR-MACH M3X0.5  | 09908 |             |
| MP4 | 0515-0886   | 3  | 1   | SCR-MACH M3X0.5  | 09908 |             |
| MP5 | 2190-0383   | 7  | 1   | WSHR-LK INTL T   | 04604 | 1317        |
| MP6 | 2190-0102   | 8  | 1   | WSHR-LK INTL T   | 04805 | 1922-01     |
| MP7 | 2950-0035   | 8  | 1   | NUT-HEX-DBL-CHAM | 04567 |             |
| W1  | 08110-61613 | 4  | 1   | Cable Assy BNC-S | 28480 | 08110-61613 |



## HP 81107A Parts List

Table 6-6.

| Ref | HP Part #   | CD | Qty | Description      | Man'f | Part #      |
|-----|-------------|----|-----|------------------|-------|-------------|
| A25 | 81107-66425 | 5  | 1   | BD AY DESKEW SMT | 28480 | 81107-66425 |
| E1  | 9320-5334   | 2  | 1   | LBL-LNE-PTR      | 12236 |             |
| MP1 | 0515-0886   | 3  | 1   | SCR-MACH M3X0.5  | 09908 |             |
| MP2 | 0515-0886   | 3  | 1   | SCR-MACH M3X0.5  | 09908 |             |

## Functional Description

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This chapter tells you how the HP 8110A works, starting with a general overview of the functional units in the instrument, followed by a detailed description of each unit. At the start of each detailed description reference is made to the schematic diagram where this section can be found. However, the schematics are not included with this manual. If you want a set of schematics, these are optionally available (CLIP Part No: 08110-91031), and can be ordered from your local Hewlett Packard office.

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### Introduction

At the highest level, each functional block is represented by a PC board performing a specific task. Depending on the instrument fit, there may be several combinations of boards.

The Standard HP 8110A contains:

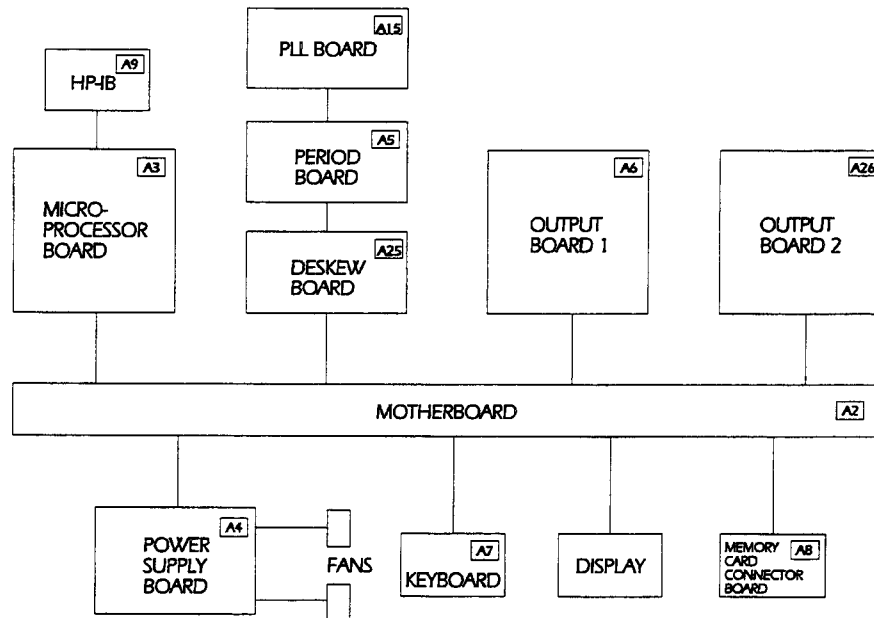
- Power Supply Unit
- MPU board
- Period board
- Output 1 board
- Memory Card board

In addition, the instrument may have been optionally fitted with, or retrofitted with some or all of the following boards:

- PLL board
- Output 2 board
- Deskew board

## The Functional Units

Figure 7-1 shows the basic functional units in a fully fitted instrument.



**Figure 7-1. The HP 8110A Functional Units**

The following is a list of the functional units in a fully fitted HP 8110A, together with a brief note of the functions they perform:

| Unit              | Function  |
|-------------------|---|
| Power Supply Unit | This provides all the main supplies needed by the instrument  |
| MPU board         | The Microprocessor controls the other functional units in the instrument  |
| Keyboard          | User commands are passed to the Microprocessor from the Keyboard  |
| Display board     | The Display gives visual information on the way the HP 8110A has been set up and what it is doing   |
| Period board      | This unit establishes the period used with waveforms generated in the instrument  |
| PLL board         | This provides an optional very accurate, stable clock for the instrument  |
| Deskew board      | This Board is optionally fitted to instruments with 2 Output Channels. It allows the output from the Period Board to be split into two paths, each capable of being delayed to a maximum of 30ns to minimize inter-channel delay (skew), before being passed to the Output Boards |

**Output 1 Board**

This board generates the output waveforms. Further delay (if required) is applied to the signal, and then the output waveform is constructed by defining the pulsewidth, the leading and trailing edge risetimes and the amplitude. The output waveforms are then passed to the HP 8110A output sockets.

**Output 2 Board**

This board performs the same tasks as the Output 1 Board, providing a second output channel. It is optional

**HP-IB Interface**

This interface facilitates communication with external equipment

**Memory Card**

The Memory Card provides a means of updating control firmware and instrument settings

## Power Supply Unit

For the purpose of this description the Power Supply can be thought of as being in 2 parts: The Primary Section, or input section, and the Secondary Section, or output section.

### Caution



---

Some voltages on the Primary Section of the Power Supply are dangerous and can kill. For your own safety do not touch these parts. Using an isolating transformer may prevent these voltages from being fatal, but electrical shocks from the unit can cause serious discomfort, especially on capacitors C406, C407 and C408 (see diagram in “Troubleshooting” chapter for their position).

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Figure 7-2 shows the functional units in the Power Supply Unit, with the Primary Section on the left of the diagram and the Secondary Section on the right. These have been numbered for easy cross-reference between the description and the diagram.

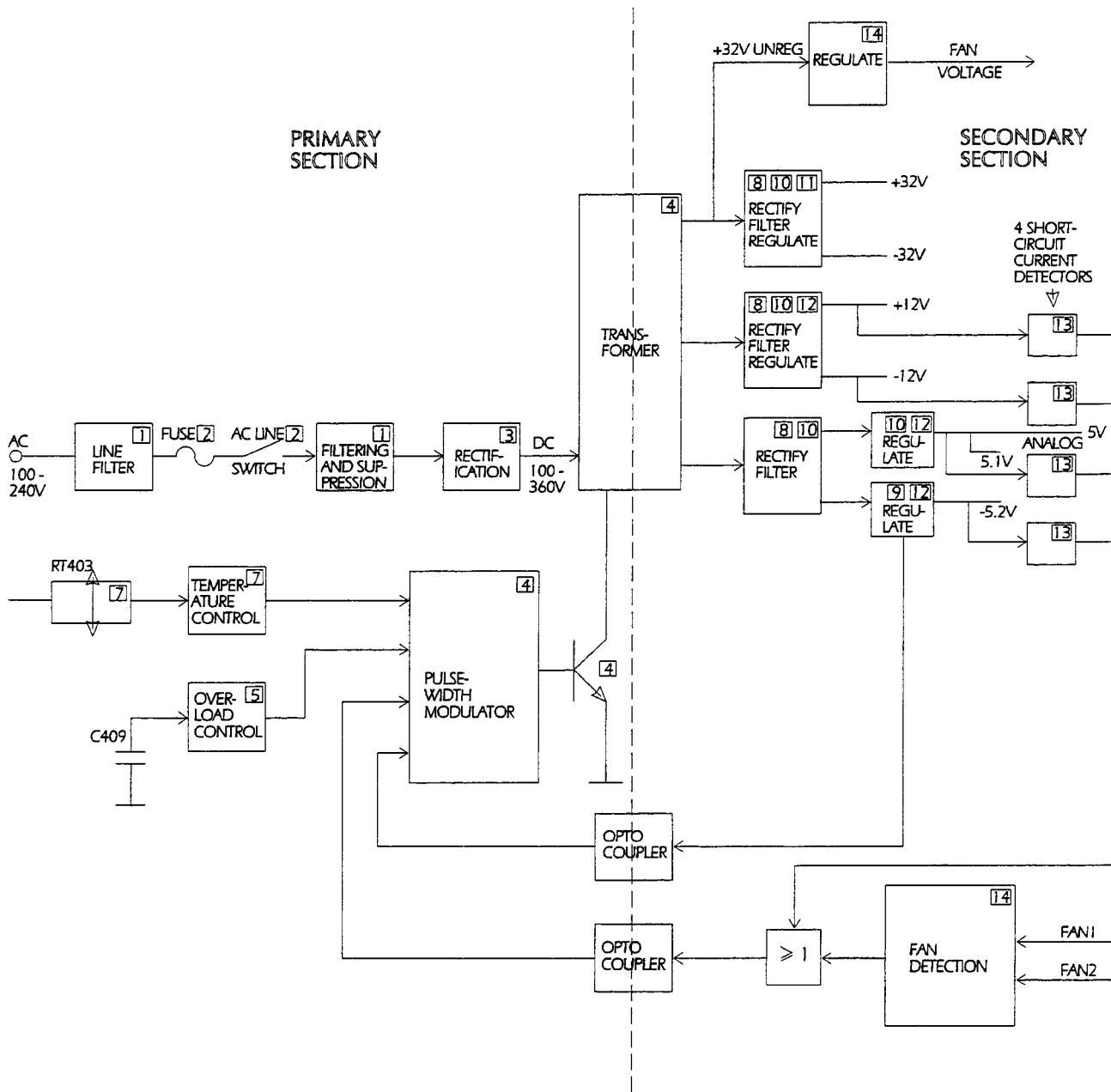


Figure 7-2. The Power Supply Functional Units

## Functional Units on the PC Board

The Power Supply functional units, and what they do, are as follows:

| Unit   | Function  |
|--|---|
| Primary Section:   |   |
| 1-Filtering and Overvoltage Protection                   | Ensures that transient and overvoltage damage is prevented  |
| 2-Fuse and Switch  | Provides Surge current protection and connection to AC power.   |
| 3-Bridge Rectifier and Blocking Capacitor                | Rectifies and smooths AC input  |
| 4-PWM Control Unit, Switching Transistor and Transformer | The Pulse-Width Modulation Control Unit controls the Switching Transistor, which transfers power into the Transformer |
| 5-Overload Protection                                    | Monitors and controls overload conditions   |
| 6-'Soft-start' at Power-up                               | Ensures that voltages are gradually increased for protection of the power supply and the instrument                   |
| 7-Temperature Control                                    | Shuts down the power supply if the fans cannot maintain a safe operating temperature                                  |
| Secondary Section:                                       |   |
| 8-Rectifier & Filter for DC Supplies                     | Rectifies AC power and filters switching noise  |
| 9- -5.2V Supply  | Direct power controlled supply  |
| 10- $\pm 32V$ , $\pm 12V$ , $+5.1V$ Supplies             | Linear power controlled supply  |
| 11- +32V Regulator Gate Supply                           | Operates +32V regulator   |
| 12-Overvoltage Protection                                | Transzorb diode protection for overvoltages   |
| 13-Short-circuit Current Detection                       | Controls excessive current dissipation  |
| 14-Fan Control & Short Circuit Monitoring                | Ensures that the fans are operating correctly   |

---

## Primary Section

This is the part of Figure 7-2 shown on the left of the dotted-line.

## Filtering and Overvoltage Protection

This section is on schematic 4A

A line filter FL401 suppresses conducted RFI on the AC input lines.

RFI generated by the switching components of the power supply is prevented from conduction back into the AC lines by C401, C402, C403, C404, LP401, and CE406, CE407, CE408.

Power line peaks are suppressed by the varistor XS401, preventing overvoltage on capacitors CE406, CE407, CE408.

## Fuse and Switch

This section is on schematic 4A

Fuse F401 is fitted in the phase line for protection. It is the only power line fuse.

Switch SW401 is a double-pole switch which connects, or disconnects the switching power supply from the ac power.

## Bridge Rectifier and Blocking Capacitor

This section is on schematic 4A

Depending on the AC power input (90 VAC to 264 VAC) a rectified DC voltage from 100 VDC to 360 VDC is generated by the rectifier CR401 and smoothed by the capacitors CE406, CE407, CE408. No line selector switch is required as power conversion is done in one line-voltage range.

## PWM Control Unit, Switching Transistors, and Transformer

This section is on schematic 4A

The transformer provides electrical isolation between the primary voltage/power and the secondary voltage/power. The physical behaviour of the transformer compares to a choke with a single primary winding  $N_p$ , and one or more secondary windings  $N_{sek}$ . When the switching transistors Q404, Q405 are switched on by the PWM control unit U401, the primary winding of the transformer is connected to the rectified DC voltage (100 VDC to 360 VDC) for the 'on-time'.

Due to the secondary winding polarity and the rectifying diodes CR408, CR409, CR421, CR422, CR423 and CR424, the primary winding is charged. There is no power transmission during the 'on-time'.

When the switching transistors are off during the 'off-time', the power charge in the primary winding is transferred into the secondary windings.



Duty cycle is controlled by the PWM control unit U401. Additionally, the PWM control unit protects the power supply using integrated protection circuitry, e.g.: 'Soft-start', Foldback behaviour, Temperature control, monitoring short-circuits in the secondary section, and switching off the power supply in cases of under-voltage and overvoltage at the power input (pin 6 of U401).

The 'on-time' is controlled, ensuring that the secondary output voltages are constant, and independent from the connected load and the AC power input.

A new switching cycle begins when the power stored in the transformer primary windings is completely transferred to the secondary windings.

### **Overload Protection**

This section is on schematic 4B

The PWM control unit internally reproduces the drain current of the switching transistors, using C409. A voltage comparable to the drain current is applied to pin 2 of U401. At a certain level a controlled shutdown of the power supply is performed, providing overload protection.

### **'Soft-start' at Power-up**

This section is on schematic 4A

Capacitor C411 connected to pin 7 of U401 provides for a gradual increase of the output voltages when the instrument is powered-up, due to reduced 'on-time' of the switching transistors while C411 is charging.

### **Temperature Control**

This section is on schematic 4A

In addition to the built-in temperature control of the PWM control unit, an external temperature control is also available. The RT403 (known as MOXIE) is placed at a critical temperature point. As temperature increases, the resistance of RT403 decreases, taking Q402 base to GND. This causes the power input, pin 6, of U401 to drop below the minimum operating voltage. In this way U401 causes the complete shutdown of the power supply. LED DS401 illuminates to indicate this condition.

---

## Secondary Section

This is the part of Figure 7-2 shown on the right of the dotted-line.

### Rectifier and Filter for DC Supplies

This section is on schematics 4A and 4B

Diodes CR408, CR409, CR421, CR422, CR423, CR424 are blocking during 'on-time'. The diodes are forward-biased during 'off-time', resulting in half-wave rectification in the secondary section. The unregulated voltage is smoothed by electrolytic capacitors and filtered by LC networks.

The regulator stage is followed by a second LC filter stage.

### -5.2 V Supply: Direct Power Controlled

This section is on schematic 4B

The -5.2 V DC output is directly power-controlled. The output voltage is applied to pin 1 of the PWM control unit, via the opto-coupler CP402. The voltage applied to pin 1 of U401 determines the 'on-time'. The -5.2 V DC is regulated in the secondary section by the regulator VR406.

### $\pm 32$ V, $\pm 12$ V, +5.1 V Supplies: Linear Power Controlled

This section is on schematics 4A and 4B

The  $\pm 32$  V,  $\pm 12$  V, and +5.1 V DC outputs are power controlled by FET transistors operating as series-pass elements. The +32 V is used as gate supply voltage for the series-pass element in all other supplies. All of the voltages are regulated: VR 403 (+12 V), VR 404 (-12 V), VR 405 (+5.1 V), VR 410 (+32 V), and VR 411 (-32 V).

### +32 V Regulator Gate Supply

This section is on schematic 4A

For correct operation of the +32 V regulator the gate supply voltage must be at least 10 V higher than the 32 V output at CE434. The voltage is doubled with the circuitry consisting of C443, CR430, CR431, R430, CE444, and Zener diode Z404. To protect VR401 from overvoltage (>40 V), Z410 is added.

**Overvoltage Protection**

This section is on schematic 4B

Transzorb diodes XS403, XS404, XS405, XS406 provide overvoltage protection for the loads connected to the +5.1 V, -5.2 V and  $\pm 12$  V supplies.

**Table 7-1.  
Power Supply and Components Cross-References**

|                            | DC Supply                             |                                       |                                       |                                       |   |                               |
|----------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---|-------------------------------|
|                            | +32V                                  | -32V                                  | +12V                                  | -12V                                  | +5.1V                                       | -5.2V                         |
| <b>Components:</b>         |                                       |                                       |                                       |                                       |   |                               |
| <b>Rectifier</b>           | CR408                                 | CR409                                 | CR421                                 | CR422                                 | CR423                                       | CR424                         |
| <b>Blocking capacitor</b>  | CE433                                 | CE435                                 | CE460                                 | CE464                                 | CE468<br>CE469                              | CE475<br>CE476                |
| <b>Filter 1</b>            | CE434<br>L403<br>L404                 | CE436<br>L405<br>L406                 | CE461<br>L411<br>L412                 | CE465<br>L413<br>L414                 | CE470<br>CE471<br>L415<br>L416              | CE477<br>L417<br>L418         |
| <b>Series-pass element</b> | Q406                                  | Q407                                  | Q411                                  | Q412                                  | Q413  | n/a                           |
| <b>Regulator</b>           | VR401                                 | VR402                                 | VR403                                 | VR404                                 | VR405                                       | VR406                         |
| <b>Filter 2</b>            | CE438<br>C437<br>C441<br>L407<br>L408 | CE440<br>C439<br>C442<br>L409<br>L410 | CE463<br>C462<br>C454<br>L423<br>L424 | CE467<br>C468<br>C455<br>L425<br>L426 | CE473<br>C457<br>L419,L420<br>CE474<br>C456 | CE479<br>C458<br>L421<br>L422 |
| <b>Overvoltage protect</b> | n/a                                   | n/a                                   | XS403                                 | XS404                                 | XS405                                       | XS406                         |

**Short-Circuit Current Protection**

This section is on schematic 4B

$\pm 32$  V is protected by primary overload protection.

Short-circuit current protection is provided for the +5.1 V, -5.2V and  $\pm 12$  V DC power supplies. Q414, Q415, Q416 and Q417 are connected as OR gates, one for each of the regulators.

These transistors monitor the current through their associated inductors (L412 (+12 V) L413 (-12 V), L419/20 (+5.1 V), and L417/21 (-5.2 V)) by sensing a voltage drop across the inductor when a short-circuit occurs, switching the transistor ON.

Any transistor that is switched ON takes R496 low, switching Q410 ON, operating the opto-coupler OP401. The short-current signal 'SHORT' is electrically isolated via opto-coupler CP401. The high-level signal 'SHORT' fires the thyristor Q408, causing the anode voltage of the thyristor to be taken to GND.

The anode of the thyristor is connected to the power input (pin 6) of the PWM control unit through LED DS402, so causing the IC U401 to switch OFF. This results in shutdown of the complete power supply. LED DS402 illuminates to indicate this condition.

Due to holding current the thyristor is held ON for 1 minute. This means that the power supply cannot power-up again until it has been switched OFF for 1 minute.

## **Fan Control and Detection**

This section is on schematic 4B

The two fans are temperature controlled. The NTC resistor RT404 sets the output voltage of the fan control circuitry, depending on the internal temperature, varying the supply voltage to the fans. The fan power supply operates in the range +14 V DC (with the fans rotating slowly) to +30 V DC, with the fans at full speed.

To protect all the PC Boards from thermal damage a detection circuit checks whether the two fans are working correctly (signals 'FAN1', and 'FAN2').

### **Fan Under-Current Detection**

Usually the fans draw a current  $\geq 50$  mA. If the current in the fan supply lines is less than this (for example, if one or both fans are not connected, U403C and (or) U403D switch OFF. These transistors are in series, behaving as an AND gate. If either transistor is OFF it breaks the negative bias on Q409, allowing it to switch ON. This in turn brings down the base of Q410, switching it ON.

The 'TURN-OFF' signal is transferred via the opto-coupler OP401 to the thyristor Q408, which shorts the power input of U401 via LED DS402, causing the power supply to shut down. The LED illuminates to indicate this.

### **Fan Over-Current Detection**

If fan current exceeds about 150% of normal consumption, it is assumed that the fans are blocked. U403A and U403B behave as an OR gate so that if excessive fan current switches either one ON, the base of Q410 is brought down, switching it ON.

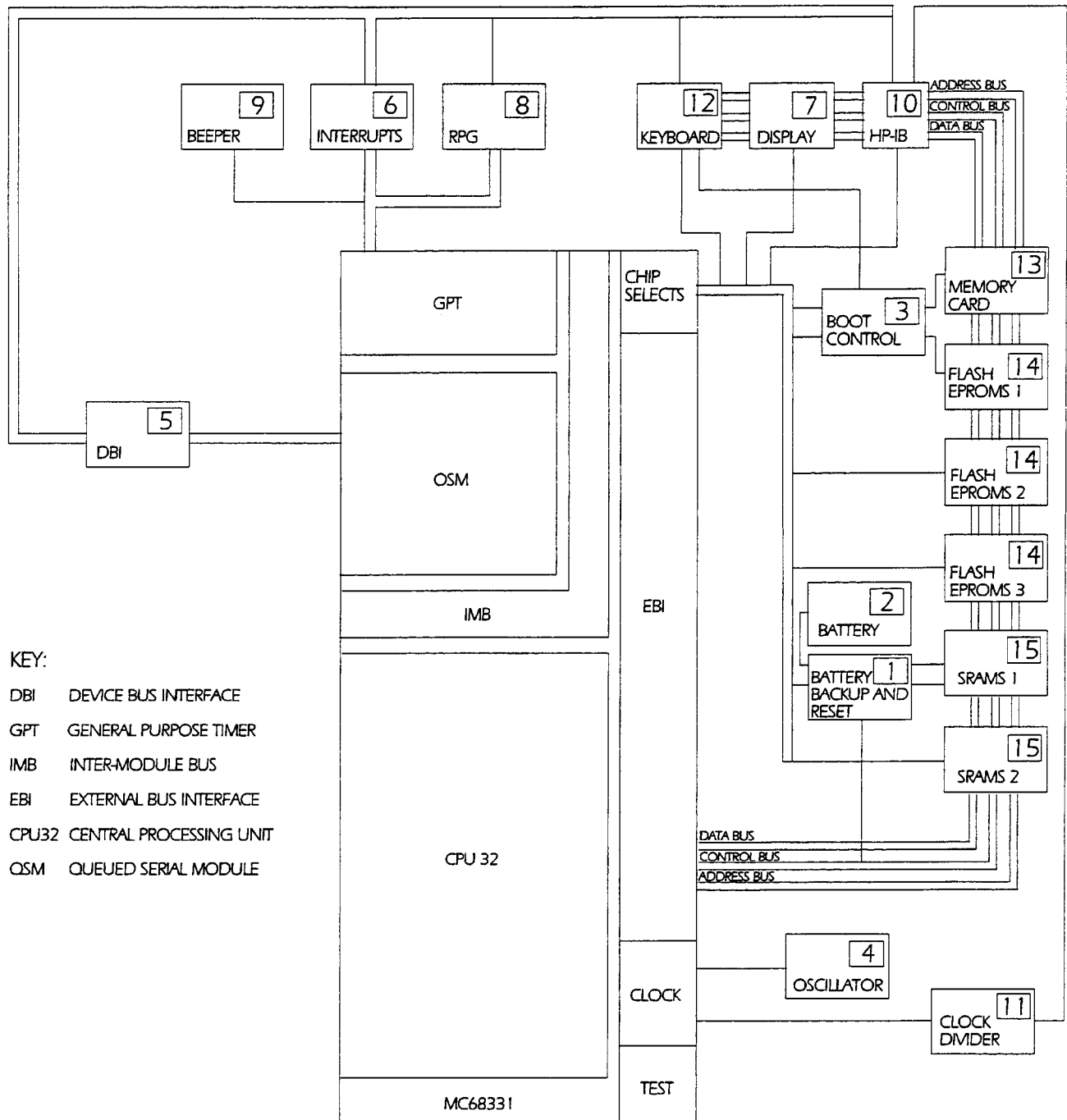
The 'TURN-OFF' signal is transferred via the opto-coupler OP401 to the thyristor Q408, which shorts the power input of U401 via LED DS402, causing the power supply to shut down. The LED illuminates to indicate this.

## The Microprocessor Board

The MPU Board controls the HP 8110A. It receives data from Flash EPROMs and battery-backed Static RAM, the Keyboard and the HP-IB interface. It communicates with the boards in the instrument through the DBI (Device Bus Interface). The MPU Board is designed around the MC68331 Microprocessor.

Figure 7-3 shows the functional units inside the Microprocessor and how they relate to the units on the Microprocessor Board. These have been numbered for easy cross-reference between the description and the diagram.

The MC68331 Microprocessor



- KEY:
- DBI DEVICE BUS INTERFACE
  - GPT GENERAL PURPOSE TIMER
  - IMB INTER-MODULE BUS
  - EBI EXTERNAL BUS INTERFACE
  - CPU32 CENTRAL PROCESSING UNIT
  - OSM QUEUED SERIAL MODULE

Figure 7-3. The Microprocessor Board Functional Units

The main functional units on the Microprocessor IC are:

- CPU22 - Central Processing Unit
- QSM - Queued Serial Module
- GPT - General purpose Timer
- SIM - System Integration Module
- IMB - Intermodule Bus

The units communicate internally using the IMB

## Functional Units on the PC Board

The Microprocessor PC Board functional units, and what they do, are as follows:

| Unit                           | Function  |
|--------------------------------|---|
| 1-Battery Backup and Reset     | Sets conditions during power-up   |
| 2-Battery                      | Supports the Static RAMs when the instrument is not powered   |
| 3-Boot Control                 | Decides whether to boot the Microprocessor from the Flash EPROMs or from the Memory Card  |
| 4-Oscillator                   | Provides clock pulses for the Microprocessor  |
| 5-DBI                          | Device Bus Interface: Sends data to the boards in the instrument and reads status lines   |
| 6-Interrupts                   | Signal to the Microprocessor that a device or functional unit needs attention   |
| 7-Display                      | Shows the status of the instrument, and displays waveforms  |
| 8-RPG                          | Rotary Pulse Generator: Provides another way of entering data in addition to the keyboard   |
| 9-Beeper                       | Gives an audible warning tone and makes a 'click' when a key is pressed   |
| 10-HP-IB Interface             | Gives a means of accessing the instrument externally for uploading and downloading of data, or for control                        |
| 11-Clock Divider               | Provides clock pulses for the HP-IB   |
| 12-Keyboard                    | This is the instrument's user interface   |
| 13-Memory Card Connector Board | Contains buffers for the Memory Card. The memory card contains battery-backed RAMs containing different firmware and store/recall |

data settings to that held in the Flash EEPROMs

14-Flash EPROMs Contain the firmware that is used to specify and control the HP 8110A

15-Static RAMs Contain data that is regularly changing

More detailed descriptions of the functional units follow:

## Battery Backup and Reset

This section is on schematic 3A.

When power is first applied to the Microprocessor Board, the timer formed by U13 and associated components holds the MPU Reset line down for a period exceeding 100ms. This allows time for a general MPU reset and a longer period for the MPU clock PLL to stabilise.

The Static RAMS (3E) are backed by the battery when power is not being applied to the instrument, and during reset. U13 disconnects the battery and enables the Power Supply via Q1 when the instrument is powered, and after reset.

## Boot Control

This section is on schematic 3A.

If the front panel numeric keys **1** and **3** are held pressed during switch-on, the system is Booted from the Memory Card instead of the Flash EPROMS.

U29B gates the two keyboard signals together and sets D flipflop U27A. Data from the flipflop controls the multiplexer U14, which enables the Memory Card buffered control signals (U31).

If these keys are not pressed during switch-on, U29 enables the Flash EPROMs.

During MPU reset the general-purpose IO lines are regarded as input lines. After reset they are configured as required by taking low certain lines on the MPU Databus, which are then used as mode select lines for the general-purpose IO lines. In this case, lines 4 and 9 are taken low by U39A, U39D and U39E.

## Oscillator

This section is on schematic 3A.

The MPU is clocked by an internal PLL oscillator, using an external crystal. The crystal oscillates at 32.768kHz, producing final operating frequencies of 8.38MHz during reset and 16.78MHz during normal operation. The crystal, Y1, is tuned by R10/R11 and C47, C48.



## Device Bus Interface

This section is on schematic 3A.

The DBI (Device Bus Interface) is implemented with an ISIS (Integrated Serial Internal Support) IC on each board. Decoder U26 provides enable signals for each of these, up to a maximum of 5. The MPU communicates serially with the DBI through its internal Queued Serial Module (QSM).

## Interrupts

This section is on schematic 3A.

The General Purpose Timer (GPT) handles the following external interrupts:

- Keyboard
- Rotary Pulse Generator (RPG)
- HP-IB
- Device Bus Interface (DBI).

When any of these devices have data, they signal this to the MPU on these inputs. Two additional interrupts are used by the MPU:

- Beeper Stop
- PSOS tick - PSOS is an operating system used by the Microprocessor. The 'tick' provides a real-time interrupt for such tasks as scheduling.

## Display

### Enabling

This section is on schematic 3A.

This description does not cover the Display Unit, which can be considered as a replaceable unit.

The Display is blanked at system initialisation to prevent the display of random information. It is activated by writing to U24 to set signal LDISBL.

Shift register U23 controlling U33 provides correct setup and hold times between Read/Write and Valid Data Bus. Additionally, the software waits  $2\mu\text{s}$  between each Read/Write cycle. Resistors R20 - R22 reduce overshoot.

### Buffering

This section is on schematic 3D.

The main reason for buffering is to disable the data bus if this bus is used for access other than to the display unit. This is because only lines inside the shielded case should toggle - thus minimising RFI. Control signals are also buffered. Buffering is provided by U20 to restore data rise and fall times due to the action of RFI filtering.

The Memory Card is also buffered for similar reasons, as well as to prevent damage to the instrument in the event of accidental misuse of the Memory Card Connector.

**RPG** This section is on schematic 3D.

This description does not cover the RPG, which can be considered as a replaceable unit.

U43C buffers the RPG interrupt signal. U43D provides the MPU with a buffered directional signal.

**Beeper** This section is on schematic 3A.

Drive for the beeper comes directly from the MPU and from inverter U40A. When the MPU gives a high output level, U40A takes the other side of the beeper low. The reverse applies when the MPU gives a low output level, reversing the beeper across the power supply at the frequency that the MPU pin toggles. The firmware provides a number of frequencies for the beeper.

**HP-IB Interface** This section is on schematic 3B.

U28 divides the system clock frequency by 4 to produce the HP-IB clock at approximately 4.2MHz. U10 is the HP-IB controller. The LDRD (Low Data Read) signal is inverted by U40B to become HDRD (High Data Read). The Databus is buffered by U21. Data and control lines are buffered by U11 and U12.

**Keyboard** This section is on schematic 3C.

Whenever a key is pressed an interrupt signal is generated by gate U38.

U25 sequentially latches data to produce 4 columns with a 'travelling' low level. If a key is pressed it connects a column to one of 8 rows formed by the inputs to latch U22. By reading the 12 bit 'word' thus formed, the MPU can calculate which key was pressed, as each key has a unique row-column combination

## Memory Card Connector Board

This section is on schematic 3D.

This description does not cover the Memory Card, which can be considered as a replaceable unit.

Buffering of Address and Data buses is provided by U15 - U19

**Flash EPROMs**

This section is on schematic 3E.

These EPROMs contain the current version of firmware used in the HP 8110A, but can be superceded by firmware stored on a Memory Card, which can take precedence at Bootup. The MPU can download a copy of the firmware in the Memory Card to the Flash EPROMs. Q2 and Q3 provide current for programming the EPROMs.

**Static RAMs**

This section is on schematic 3E.

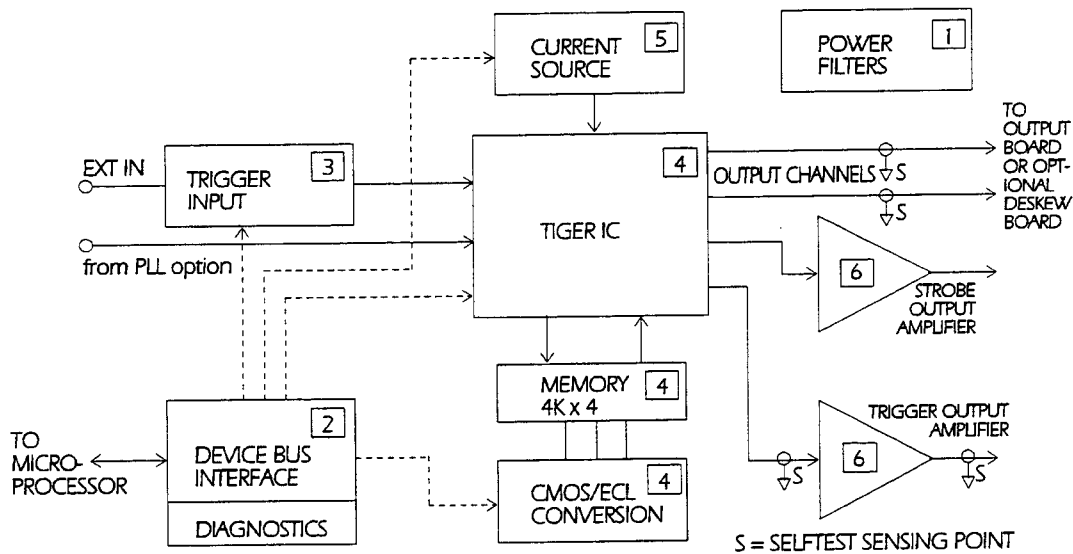
These RAMs contain data that varies during HP 8110A operation. U2 and U3 contain data that must be retained, such as configuration information. This RAM IC is battery-backed to retain data during reset or after switch off.

U4 and U5 are not normally loaded.

## Period Board

The Period Board is based on the TIGER (TIming GEnerator)IC. The TIGER is basically an astable oscillator when it is running without external drive or triggering, or as a monostable when triggered from a source external to the Period Board. External triggering can be from a PLL Board inside the HP 8110A (optional), providing greater accuracy and stability, or from a source external to the instrument, provided by the user. The width of the output pulses is varied by the control current. The TIGER is also capable of burst-firing, producing a specified number of pulses.

Figure 7-4 shows the functional units on the Period board. These have been numbered for easy cross-reference between the description and the diagram.



**Figure 7-4. The Period Board Functional Units**

The units, and what they do, are as follows:

| Unit  | Function   |
|---|--|
| 1-Power Filters                             | Noise is removed from power applied to the Period board.   |
| 2-Device Bus Interface & Diagnostics        | The Period board uses the Device Bus Interface (DBI) to communicate with the microprocessor. Selftest is also performed in this functional block   |
| 3-Trigger Input                             | An external trigger signal is processed  |
| 4-TIGER IC, Memory, and CMOS/ECL Conversion | This is the heart of the Period Board, based on the TIGER IC. The output signals are generated here for further processing by the Width Board, the Deskew Board (when fitted) and 1 or 2 |

Output Boards, depending on the options fitted in the instrument.

5-TIGER Current Source

This controls the period of the generated signals.

6-Trigger and Strobe Outputs

These outputs are conditioned before being made available at the output of the instrument.

More detailed descriptions of the functional units follow:

### **Power Filters**

This section is on schematic 5A.

It provides filtering and decoupling of the power supplies needed by the Period Board.

RF is decoupled by 4 networks, each comprising 2 small-value capacitors placed either side of an inductor wound on a ferrite bead.

Ripple decoupling is provided by electrolytic capacitors following the RF decoupling networks.

### **Device Bus Interface & Diagnostics**

This section is on schematic 5B.

#### **Device Bus Interface**

This functional unit uses a DBI (Device Bus Interface) IC to communicate with the Microprocessor. This IC is driven serially, buffered through U201.

#### **EEPROM Data**

An EEPROM stores specific information about the Period Board, such as its serial number and calibration data. At switch-on the Microprocessor compares its data with this EEPROM and if differences show, uploads data from the EEPROM. In this way the HP 8110A becomes aware of changes in the instrument (for example a PC Board change).

#### **Diagnostics**

The output from the TIGER IC is received by the ISIS IC and presented to U204, a D-A converter. The output from the D-A converter is then scaled to produce positive-going outputs by U205 and U206, and passed to U207, an A-D converter. The diagnostic software can then check that the TIGER IC is working correctly.

**Trigger Input** This section is on schematic 5C.  
It conditions an externally applied trigger signal.

#### External Trigger Signal

The external Trigger signal enters through J301. The input impedance is switchable to either 50 $\Omega$  or a high impedance in the region of 10k $\Omega$ , using Q301, relay K301 and associated components.

#### Comparator

U301 is a fast comparator that shapes the incoming trigger signal and sets it to ECL levels. CR301 and CR302 provide input overload protection for U301.

#### Threshold Generation

The threshold at which the fast comparator, U301 operates, is set by the linear 8-bit D-A converter U302. The voltage range of the DAC being set by U304A and U304D to make it compatible with U301. The digital information controlling U301 can be set on the instrument by the user, or sent in on the HP-IB interface.

The differential output signals from the differential amplifier U301 are passed to QP301 where they are combined and converted to EECL levels and sent to the TIGER IC.

**TIGER IC** This section is on schematic 5D.

It contains the TIGER IC and its associated circuitry. The TIGER IC is controlled over the DBI (in functional unit 5B).

U402 is a RAM IC that stores data for burst operation of the TIGER IC. The data is received initially by the DBI and passed to the RAM after CMOS/ECL conversion in multiplexers U403 and U404. The TIGER IC addresses the RAM when data operation is required.

The TIGER IC has 4 outputs:

1. Channel 1
2. Channel 2
3. Strobe
4. Trigger

These are connected to the diagnostic circuitry through R403 - R406.

Power regulation is provided by U405 (+5 V) and U406 (-5 V)

## TIGER Current Source

This section is on schematic 5E.

The TIGER IC is current-controlled. The greater the current, the shorter the period. The current source is divided into 2 sections, a low current path and a high current path. The low current path provides 10% of that provided by the high current path.

### Control

Control is provided by a D-A converter, U503. To obtain the correct relationship between the digital control data and the current needed for controlling the TIGER IC, the DAC must operate in 1/x mode. Instead of applying feedback to pin 16 on U503, it is applied to pin 15, causing 1/x operation. Pin 16 is given a voltage reference via U501 and U502A.

The output of the DAC is applied to U501B which is connected to the drain of Q501. Current flowing through Q501 is mirrored through Q502, providing the high-current path. Q503 acts in the same way, except that choice of resistor R514 limits current flow to 10% of the current through Q502, thus providing the low-current path.

The low-current path is permanently connected to the TIGER IC and the high-current path is switched by U505 between 0 V and the output, depending on the required period range. The high-current path is used for ranges <10 ns.

## Trigger and Strobe Outputs

This section is on schematic 5F.

It provides TTL or ECL compatibility for the Trigger and Strobe outputs. This is done by switching the range of output voltage in an output stage consisting of two differential amplifiers.

As the Trigger and Strobe output stages are identical, only the circuitry for the Trigger output will be described.

Multiplexer U601 provides switching signals to transistors Q605 and Q607. When Q605 is on it switches resistors in parallel to increase the current flowing through the first differential amplifier and when Q607 is on it switches Q604 off in the second differential amplifier, thus setting the stage to operate at ECL levels. Q608 is also switched off at this point, and Q606 is conducting.

When the output stage is required to operate at TTL levels Q608 is switched on and this biases Q606 off. Q605 and Q607 are switched off by U601.

PLL Board

Figure 7-5 shows the functional units on the PLL board. These have been numbered for easy cross-reference between the description and the diagram.

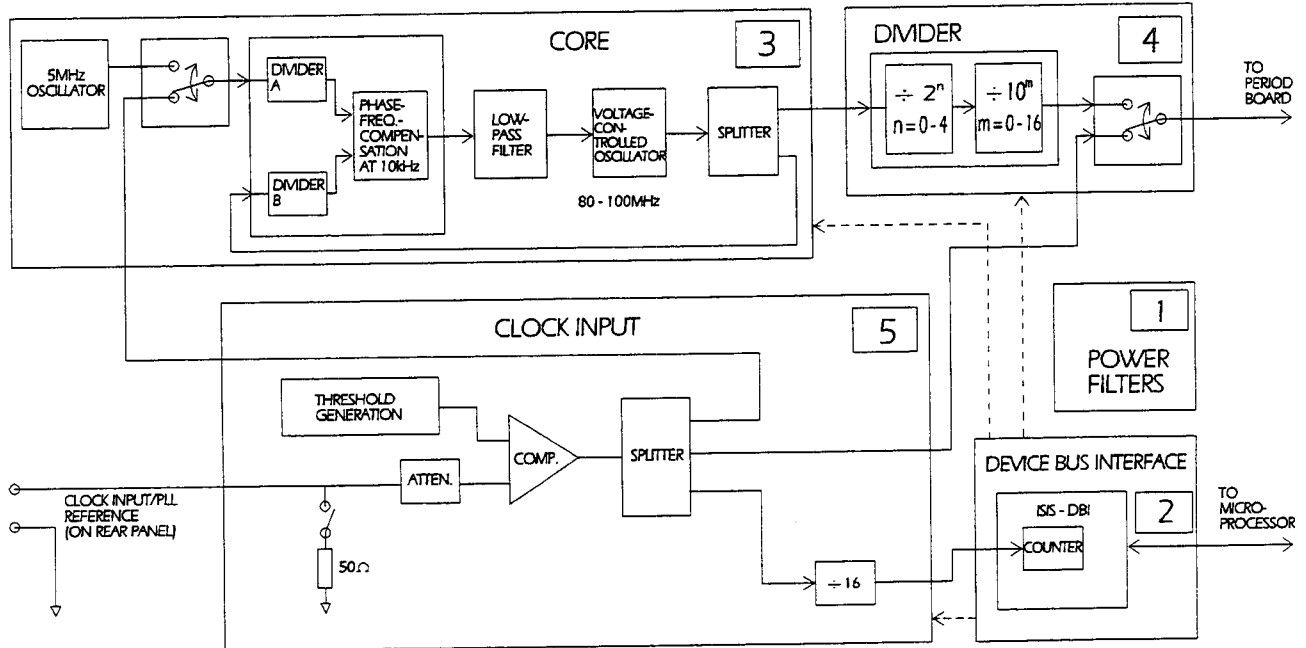


Figure 7-5. The PLL Board Functional Units

The units, and what they do, are as follows:

| Unit            | Function  |
|-----------------|---|
| 1-Power Filters | The Power Filters remove noise from power applied to the PLL Board                        |
| DBI             | The Device Bus Interface communicates with the Microprocessor                             |
| 2-PLL Core      | This provides an accurate, stable clock for the PLL Board                                 |
| 3-Divider       | Divides frequency for lower ranges  |
| 4-Clock Input   | This conditions an external clock that can replace, or synchronize the PLL internal clock |

More detailed descriptions of the functional units follow:



## Power Filters and Device Bus Interface

This section is on schematic 15A.

A DBI (Device Bus Interface) IC is used to communicate with the Microprocessor. This IC is driven serially, buffered through U107.

An EEPROM stores specific information about the PLL Board, such as its serial number and calibration data. At switch-on the Microprocessor compares its data with this EEPROM and if differences show, uploads data from the EEPROM. In this way the HP 8110A becomes aware of changes in the instrument (for example a PC Board change).

Multiplexers U103 - U106 convert the ISIS CMOS output signals to ECL.

### PLL Core

This section is on schematic 15B.

Y251 is a 5MHz oscillator. It receives a stabilised power supply from regulator U206. U251 switches the output of the oscillator to drive the loop, or an external clock supplied by the user.

The reference clock signal is applied to U203, the PLL IC. Inside this IC the clock signal is passed through a divider. A second divider processes the output from a VCO, U201, and the two divided signals are phase-compared, producing an output voltage over an active Low-pass filter, U204B. The range of voltage output from this filter is limited by U204A, to make it suitable for controlling the varactor diodes CR201 - CR208. These diodes vary in capacity to control the frequency of the VCO, which is then fed back to the loop for frequency comparison. In this way the VCO is locked to a reference signal, providing a conditioned output signal, regardless of whether input is from the internal oscillator, or from an external source.

U202 splits the output of the VCO into two paths, one for feedback comparison, and one for output to a divider chain (described in 15C).

The following regulators provide onboard power supplies:

|      |   |
|------|---|
| U205 | -5V for VCO   |
| U206 | +5V for 5MHz oscillator                                       |
| U207 | +5V, general  |
| U208 | +24V, general   |
| U209 | -5V for U202 (splitter) and the corresponding output pulldown |

The VCO power supply (U205) can be switched on by Q251, Q252, and the 5MHz oscillator power supply can be switched on by Q253 and Q254, under software control to provide power when the internal oscillator is required.

**Divider** This section is on schematic 15C.

It provides a division which, together with the PLL Core frequency, gives the required output frequency. A switch selects the divided output, or the external clock.

Register U311 is loaded from the DBI with data that sets the operating speed of the dividers. If the speed is above 10MHz, the divisions are carried out at ECL levels, and if below 10MHz, at ECL and TTL levels. U301 and U303 perform the necessary switching.

The signal from the PLL Core is first divided in U302 and then converted to CMOS by the Schmitt Trigger, U305D, before being applied to the prescaler U306. The signal is then divided by the programmable dividers, U307 - U309.

The output signal must be ECL compatible, regardless of division ratio, so it is passed through U311 to achieve this.

**Clock Input** This section is on schematic 15D.

It conditions externally applied Clock signals.

#### **External Clock Signal**

The external Clock signal enters through J401. The input impedance is switchable to either 50Ω or a high impedance in the region of 10kΩ, using Q401, relay K401 and associated components.

#### **Comparator**

U404B is a comparator that shapes the incoming trigger signal. CR402 and CR403 provide input overload protection for U404B.

#### **Threshold Generation**

The threshold at which the comparator, U404B operates, is set by the linear 12-bit D-A converter U402. The voltage range of the DAC being conditioned by U403A to make it compatible with U404B.

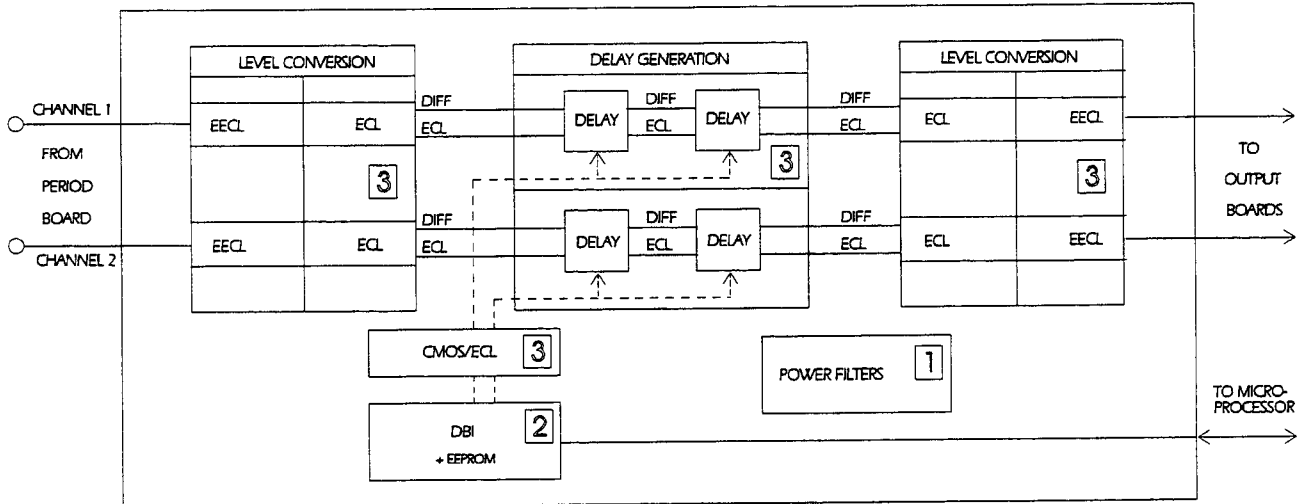
**External Clock Distribution.** A splitter, U405, provides 3 output paths for the external clock:

1. A direct output to the Period Board
2. An output to the PLL Core circuitry to substitute the oscillator reference signal
3. An output to a divide-by-16 circuit to measure the frequency of the input signal.

The divide-by-16 circuit is produced by U452A and U452B (dividing by 4) and the counter U453. This signal is available for measuring external clock frequency.

## Deskew Board

Figure 7-6 shows the functional units on the Deskew board. These have been numbered for easy cross-reference between the description and the diagram.



**Figure 7-6. The Deskew Board Functional Units**

The units, and what they do, are as follows:

| Unit   | Function   |
|--|--|
| 1-Power Filters  | Noise is removed from power applied to the Deskew Board.   |
| 2-Device Bus Interface and control-signal conditioning | The Deskew Board uses this to communicate with the Microprocessor  |
| 3-Level Conversion and Delay path                      | The signal from the Period Board is at EECL levels and is converted to ECL levels for the delays. The outputs of the delays are then reconverted to EECL levels for driving the Output Boards. |

More detailed descriptions of the functional units follow:

**Power Filters**

This section is on schematic 25A.

This functional unit removes noise from the power supplies. Also, U100 provides buffering for serial input signals applied to the DBI IC (25B).

**Device Bus Interface**

This section is on schematic 25B.

This functional unit uses a DBI IC to communicate with the Microprocessor. This IC is driven serially, buffered through U100.

An EEPROM stores specific information about the Deskew Board, such as its serial number and calibration data. At switch-on the Microprocessor compares its data with this EEPROM and if differences show, uploads data from the EEPROM. In this way the HP 8110A becomes aware of changes in the instrument (for example a PC Board change).

The DBI output lines control the delays (25C) and are taken through analog switches to provide ECL conversion.

**Delays**

This section is on schematic 25C.

provides delays of up to 30ns consisting of two channels to deskew the Output Boards. As the 2 Delay paths are identical, only the circuitry for Channel 1 will be described.

U301 provides level conversion from EECL levels to ECL levels for driving the Delay ICs.

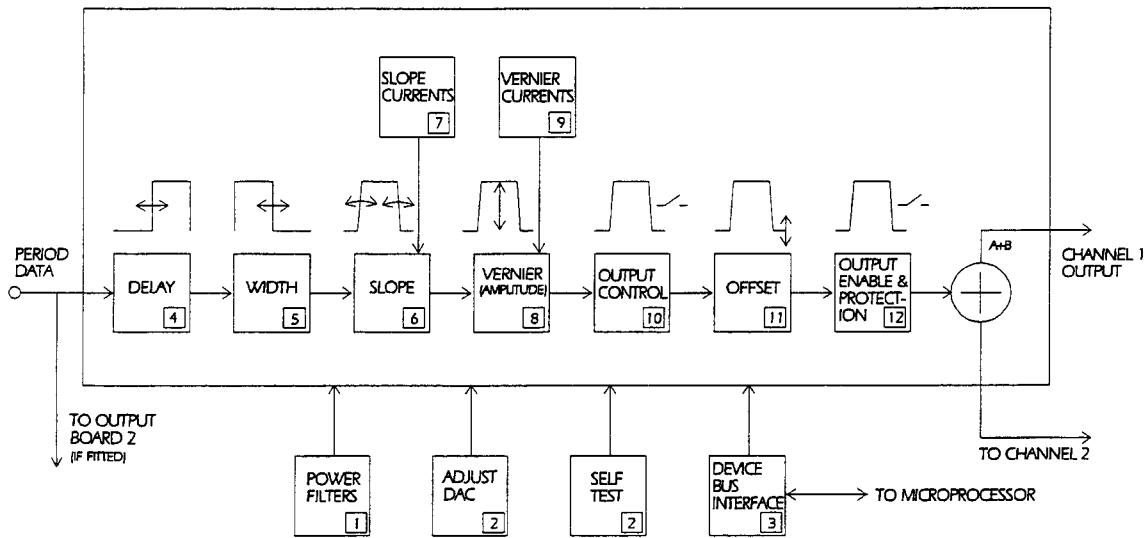
The Delays, U302 and U303 are in series in the signal line, but are controlled together so that a delay set on U302 is also set on U303. Each of the ICs can be programmed to give a maximum delay of 15ns, giving a total maximum delay of 30ns. The Delays can be programmed in both coarse and fine steps.

A differential amplifier (Q301 and Q302 and associated components) provides conversion back to EECL levels.

## Output Board

As Output 1 and Output 2 boards are functionally similar, a description is given only of Output 1 board. The Output Board receives a 50% duty cycle signal from the Period Board, or where two output channels are fitted, from the optional Deskew Board. The signal is first delayed and then width is set. The slopes of the leading and trailing edges are then set, followed by the amplitude vernier and the output amplifier. Finally, the offset voltage level is set. These parameters are controlled by data from the Device Bus Interface sent in response to Front Panel controls.

Figure 7-7 shows the functional units on the Output board. These have been numbered for easy cross-reference between the description and the diagram.



**Figure 7-7. The Output Board Functional Units**

The units, and what they do, are as follows:

| Unit                      | Function   |
|---------------------------|--|
| 1-Power filters           | Noise is removed from power applied to the Output board and additional voltages are produced               |
| 2-Selftest and Adjust DAC | The instrument checks that it is functional. The Adjust DAC adjusts voltages to meet calibration settings  |
| 3-Device Bus Interface    | The Output Board uses this to communicate with the Microprocessor  |
| 4-Delay Generator         | This section provides delay after the period pulse. The Deskew Board (if fitted) provides additional delay |

- 5-Width Generator  
This section sets the width of the Output pulse
- 6-Slope Generator  
This circuitry produces the leading and trailing edge slopes of the output waveform
- 7-Slope Currents  
This circuitry controls the Slope Generator performance
- 8-Variable Amplitude Generator  
This circuitry controls the amplitude of the output waveform
- 9-Vernier Currents  
This circuitry provides current for the Variable Amplitude Generator
- 10-Output Control  
This section sets the output conditions and the relationship between the two channels, when a second channel is fitted
- 11-Offset Generator  
This sets the offset voltage for the output waveform
- 12-Output Enable and Protection  
This circuitry enables the output when conditions are correct, and protects the output from damage when they are not.

More detailed descriptions of the functional units follow:

### **Power Filters**

This section is on schematic 6A.

The Power Supplies to the Output Board are filtered for noise and additional voltages are generated.

U1 provides +15V from the +32V line for supplying Op-amps.

U3 provides -15V from the -32V line for supplying Op-amps.

U2 provides a precise +5V reference, and -5V reference is derived from this by U100A and associated components.

### **Selftest and Adjust DAC**

This section is on schematic 6C.

At switch-on the Selftest section checks that the Microprocessor is working. If the Microprocessor is OK no error message is displayed. A complete selftest is performed when requested from the Front Panel or by HP-IB command. The various signal blocks are also checked for output. The output signals are applied to multiplexer U70 and are selected in turn via its 3 address lines. The selected signal is then buffered in U71A and applied to U72 for A-D conversion. The resulting data is compared by the microprocessor to fall within acceptable upper and lower limits.

The adjust DAC, U73, consists of 8 DACs that receive EEPROM data from the Microprocessor to provide adjustment voltages for the slope performance, overshoot, and output power limiting. These voltages are in the range +3 V to -3 V.

### Device Bus Interface

This section is on schematic 6B.

This functional unit uses a DBI IC to communicate with the Microprocessor. This IC is driven serially, buffered through U53.

An EEPROM stores specific information about the Output Board, such as its serial number and calibration data. At switch-on the Microprocessor compares its data with this EEPROM and if differences show, uploads data from the EEPROM. In this way the HP 8110A becomes aware of changes in the instrument (for example a PC Board change).

U54 extends the addressing capability of the interface.

### Delay Generator

This section is on schematic 6D.

Delay is produced by a TIGER IC operating as a monostable flipflop.

The TIGER IC is controlled by current. The greater the current, the shorter the delay period. The current source is divided into 2 sections, a low current path and a high current path. The low current path provides 10% of that provided by the high current path.

#### Control

Control is provided by a D-A converter, U102. To obtain the correct relationship between the digital control data and the current needed for controlling the TIGER IC, the DAC must operate in 1/x mode. Instead of applying feedback to pin 16 on U102, it is applied to pin 15, producing the 1/x performance. Pin 16 is given a voltage reference via U100C.

The output of the DAC is applied to U100B which is connected to the source of Q100. Current flowing through Q100 is mirrored through Q101, providing the high-current path. Q103 acts in the same way, except that choice of resistor R124 limits current flow to 10% of the current through Q101, thus providing the low-current path.

The low-current path is permanently connected to the TIGER IC and the high-current path is switched by U155 between 0 V and the TIGER, depending on the required delay range.

**Width Generator** This section is on schematic 6E.

Taking the delayed pulse as the starting point, the output pulse is now generated at a specified width. Operation of this section is functionally similar to that of the Delay Generator, with DAC U152 providing a reference voltage for the operation of Q150, Q151 and Q153. U155 performs the current range switching.

### Variable Amplitude and Slope Generator

This section is on schematic 6F.

It uses a SLAVE (SLOpe Amplifier VERNier) IC to generate the leading and trailing edge ramps of the output waveform.

The SLAVE IC generates highly stable, accurately controlled ramps using a single integrated capacitor, plus external capacitors and external current sources.

The ECL differential signal from the Width Generator is buffered and input to the slope generator. Capacitors C212 to C217 are switched by Q200 - Q201 and Q202A, B and C. Each capacitor represents a slowing of the ramp by a factor of 10. The final (slowest) stage is provided by the capacitance multiplier formed by U220 and associated components, giving a gain of 100. This avoids the use of a relatively large electrolytic capacitor. Reed relay K220 switches this stage.

**Slope Currents** This section is on schematic 6G.

There are 2 separate slope currents applied: fast and slow. The fast slope current makes use of an integrated capacitor in the SLAVE IC, and enables fast slope times in the range of <2 to 20ns. Fast and slow slope currents are sourced to and sunk from the SLAVE IC, using similar circuitry. Only the current sourcing circuitry is described here:

DAC U250, buffered by U252 provides a reference voltage at the emitter of Q250. The current flow is mirrored by Q251 and Q252, the fast and slow slope current generators.

**Vernier currents** This section is on schematic 6H.

It provides precise control of waveform amplitude.

Multiplexer U304 selects 1, 2 or 3 current sources, depending on the range required:



**Table 7-2. Waveform Amplitude and Current Sources**

| Vernier range | Large source | Medium source | Small source |
|---------------|--------------|---------------|--------------|
| 0.1V - 0.39V  | off          | off           | on           |
| 0.4V - 1.99V  | off          | on            | on           |
| 2.0V - 10.0V  | on           | on            | on           |

DAC U300, buffered by U301C and U302D sets a reference voltage at Q300 collector. This is applied to Multiplexer U304 and switched to the current sources that are **on**. Current sources that are **off** are connected through U304 to a fixed reference voltage at R306. This applies a high current to the vernier cell causing it to switch off.

Good common mode rejection is provided by running the circuitry from a single +5V supply.

Other circuitry in this functional unit provides Alpha control for the SLAVE IC to stabilise gain against temperature.

**Output Control**

This section is on schematic 6I.

The HP 8110A output is developed across a cascode stage. This is monitored by a level sense line using R403 and diodes CR400 and CR401, and with a power sense line using R404 and R405.

When there is no external load attached, but the instrument is operating, relay K401 connects a load comprising L405, R406 - R411 and C407.

If the maximum output voltage of 21V is exceeded, output enable relay K403 operates, switching the output to an internal 50Ω load, R412, representing the external load.

K402 connects the second channel (when fitted) for A+B operation.

Diodes CR400 and CR401 provide peak detection.

**Offset Generator**

This section is on schematic 6J.

DAC U500, buffered by U501B, switches on upper or lower current sources, providing positive or negative offset for the output waveform. The two current sources are similar in design, each having two sources in parallel, delivering equal current. Two sources are required because of power dissipation.

Transistors Q552 - Q555 form a cascode stage.

## Output Enable and Protection

This section is on schematic 6K.

U600C detects the upper output peak voltage level and U601B detects the lower output peak voltage level from the signals provided by CR400 and CR401 (6I).

The Microprocessor sends the Adjust DAC (6C) power limits relative to the upper and lower output levels. These 4 signals are applied to U602A, B, C and D, pulling down R620 if the output waveform exceeds its permissible output voltage range. This switches U605A and FETs U606A and B, operates relay K403, switching the output to an internal 50 $\Omega$  load, R412, representing the external load.

## Memory Sizes

The HP 8110A is fitted with the following sizes of memory:

### EEPROM and RAM Sizes on the PC Boards

The following sizes of EEPROM and RAM are fitted to the PC Boards:

- Microprocessor Board: 256 K Byte RAM; 768 K Byte Flash EEPROM
- PLL Board: 16 K Byte EEPROM
- Period Board: 16 K Byte EEPROM
- Deskew Board: 4 K Byte EEPROM
- Output Board: 16 K Byte EEPROM

Up to 10 different instrument setups can be stored in the RAM locations.

## Restoring Default Settings

There are two ways to restore HP 8110A default settings:

- Using the HP-IB device command
- Overwriting settings

The first method can lead to accidental erasure of wanted settings, as all setups are replaced.

The second method replaces settings in each location individually, so it is possible to restore defaults only where needed.

### Using the HP-IB Device Command

Using the HP-IB device command:

```
:SYSTem:SECurity[:STATe] ON
```

all RAM stored information can be erased, and replaced by the HP 8110A default settings.

Do not switch system security ON unless you are willing to erase all RAM stored information.

RAM is erased when:

- :SYST:SEC[:STAT] OFF is programmed
- The instrument is switched OFF and then switched ON immediately after.

### Overwriting Settings

Recalling **Standard Setting** from memory location **0**, and storing it in locations **1** to **9**, as required, overwrites each setting in turn.

**Firmware Upgrade Cards**

Firmware upgrades are supplied on a 1 M Byte Memory Card.

**Memory Card Sizes**

Memory cards of up to 2 M Byte can be used with the HP 8110A. The following table shows how many setups of a fully-configured HP 8110A can be stored in each size of Memory Card:

**Table 7-3.**

| Memory Card size | No. of setups stored |
|------------------|----------------------|
| 128 K Byte       | 40                   |
| 256 K Byte       | 80                   |
| 512 K Byte       | 160                  |
| 1 M Byte         | 320                  |
| 2 M Byte         | 640                  |



## **Component Level Information Package**

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The complete Component Level Information Package for the HP 8110A and its modules is not part of this Assembly-level Service Guide. It can be obtained separately by ordering HP Part Number 08110-91031.





## MANUAL CHANGES

May, 1997

|                         |               |
|-------------------------|---------------|
| Manual for Model Number | 8110A         |
| Manual printed on       | REV.2.0,E1293 |
| Manual Part Number      | 08110-91021   |

Make all ERRATA corrections.

Check the following table for your instrument serial prefix/serial number/EDC and make the listed changes to your manual

### New Item

| Serial Prefix or<br>Serial Number | Manual<br>Changes |
|-----------------------------------|-------------------|
|-----------------------------------|-------------------|

### ERRATA

|            |   |
|------------|---|
| 3233G00791 | 1 |
| 3501G01066 | 2 |
| 3501G01261 | 3 |
| 3501G02476 | 4 |
| 3501G02303 | 5 |



ERRATA

page 5-9, Disassembly and Reassembly

change to read:

NOTE: Both sides of the chassis are fitted with self-adhesive RFI strip contacts. 1 on the right-hand side, and 1 on the left-hand side, as shown in Figure 5-6:

Figure 5-6. RFI strip-contact fitted to the Sides of the chassis.

If any of these strip-contacts become damaged they must be replaced before re-fitting the instrument case. You can order replacement strip-contacts under part-number 08110-47101.

page 5-1, Disassembly and Reassembly

add:

ATTENTION! STATIC SENSITIVE

DEVICES:

You must perform disassembly and reassembly only in STATIC SAFE WORKAREAS.

page 5-12, Disassembly and Reassembly change to read:

5. Remove the 5 screws securing the Period board to the chassis

page 5-15, Disassembly and Reassembly change to read:

The Output boards are fitted to the underside of the instrument, as shown in Figure 5-10. Output 1 board is always fitted and is secured by 3 screws, and 3 hexagonal standoffs in a standard unit, or by 6 hexagonal standoffs in an optional equipped unit. The second Output board in the optional equipped unit is mounted directly above the first by 6 screws fastening into the hexagonal standoffs that secure Output board 1.

page 5-16, Disassembly and Reassembly change to read:

2. Remove the 3 hexagonal standoffs, and the 3 screws securing Output 1 board to the chassis using a 6mm nut driver, and a small cruciform screw driver.

## MODEL 8110A

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### ERRATA (cont)

On Page 2-9, Specifications, Width spec change to read:

Duty cycle: 0.1% to 94%

- 2) Values from 0.1% to 94% can be entered directly For values >94% press Shift and use Modify knob. The reason for this is that accuracy deteriorates above 90%. Hence, for large values, it's better to select complement and enter 100 minus the required duty cycle value.

On page 1-13 and 2-1

add errata:

Altitude up to 2000m

Installation Category II

Pollution Degree 2

Warning: To prevent electrical shock, disconnect the HP model 8110A from mains before cleaning.  
Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.

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### ! CHANGE TO NEW SERIAL NUMBER FORMAT !

|              |                                 |            |
|--------------|---------------------------------|------------|
| Model 81103A | last serial number old format:  | 3420G04360 |
|              | first serial number new format: | DE34504361 |
| Model 81106A | last serial number old format:  | 3233G01475 |
|              | first serial number new format: | DE32801476 |
| Model 81107A | last serial number old format:  | 3233G00465 |
|              | first serial number new format: | DE32800466 |
| Model 8110A  | last serial number old format:  | 3501G02630 |
|              | first serial number new format: | DE35102631 |

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INDEX OF MANUAL CHANGE

| MANUAL CHANGE | FRAME   |
|---------------|---|
| ERRATA        |   |
| 1             | MP2,24,25,<br>MP26,27   |
| 2             | A2, MP1,6,<br>MP60,61,7,<br>MP214,4,215<br>MP30,31,356<br>MP357,13,40<br>MP41,42,400<br>MP401,402,<br>MP403,404,<br>MP405, W5 |
| 3             | MP402,403,<br>MP404,405   |
| 4             | MP80  |
| 5             | MP14,W1   |

# MODEL 8110A

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## MANUAL CHANGE 1

On Repl. Parts, Page 6-2 delete:

|     |             |            |
|-----|-------------|------------|
| MP2 | 08110-67501 | KEYPAD KIT |
|-----|-------------|------------|

On Repl. Parts, Page 6-2 add:

|      |             |               |
|------|-------------|---------------|
| MP24 | 08110-41901 | RUBBER KEYPAD |
| MP25 | 08110-46501 | KEYPAD FOIL   |
| MP26 | 08110-44101 | PLATE         |
| MP27 | 08110-44102 | PLATE         |

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## MANUAL CHANGE 2

On Repl. Parts, Page 6-2 change to read:

|         |             |              |
|---------|-------------|--------------|
| A2      | 08110-66512 | BD AY MOTHER |
| MP1     | 08110-60102 | CHASSIS AY   |
| MP6     | 08110-24503 | CONN.CASE    |
| MP60,61 | 1400-1605   | CLAMP-CABLE  |
| MP7     | 08110-04106 | COVER SAFETY |

On Repl. Parts, Page 6-3 change to read:

|           |             |           |
|-----------|-------------|-----------|
| MP214,215 | 08110-01002 | REAR FOOT |
|-----------|-------------|-----------|

On Repl. Parts, Page 6-7 change to read:

|    |             |                |
|----|-------------|----------------|
| W5 | 08110-61626 | CBL AY SMB-SMB |
|----|-------------|----------------|

On Repl. Parts, Page 6-2 delete:

|         |             |                  |
|---------|-------------|------------------|
| MP30,31 | 0363-0125   | RFI STRP-FINGERS |
| MP4     | 08110-64101 | COVER AY         |

On Repl. Parts, Page 6-6 delete:

|           |           |           |
|-----------|-----------|-----------|
| MP356,357 | 6960-0041 | PLUG-HOLE |
|-----------|-----------|-----------|

NOTE: EDC-LBL: Engineering Date Code  
Label = Board Revision  
+ Date Code

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**MODEL 8110A**

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MANUAL CHANGE 2 (Cont).

On Repl. Parts, Page 6-2 add:

|      |             |                 |
|------|-------------|-----------------|
| MP13 | 0403-0285   | BMPR FT-ADH MTG |
| MP40 | 08110-03105 | BRKT-AIR        |
| MP41 | 08110-03106 | BRKT-AIR        |
| MP42 | 08110-03107 | BRKT-AIR        |

On Repl. Parts, Page 6-6 add:

|           |             |              |
|-----------|-------------|--------------|
| MP400     | 08110-64102 | COVER TOP    |
| MP401     | 08110-64103 | COVER BOTTOM |
| MP402,403 | 0363-0125   | RFI STRP-FIN |
| MP404,405 | 8160-0694   | RFI GASKET   |

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MANUAL CHANGE 3

On Repl. Parts, Page 6-6 delete:

|           |           |              |
|-----------|-----------|--------------|
| MP402,403 | 0363-0125 | RFI STRP-FIN |
| MP404,405 | 8160-0694 | RFI GASKET   |

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MANUAL CHANGE 4

On Repl. Parts, Page 6-2 add:

|      |           |                  |
|------|-----------|------------------|
| MP80 | 0460-1243 | TAPE-INDL .375IN |
|------|-----------|------------------|

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MANUAL CHANGE 5

On Repl. Parts 6-2, add:

|      |             |                  |
|------|-------------|------------------|
| MP14 | 1400-0824   | STRAP-CABLE      |
| W1   | 08110-61608 | CBL AY RPG-LED-K |

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