Errata

Title & Document Type: 8110A 150 MHz Pulse Generator Service Guide

Manual Part Number: 08110-91021

Revision Date: 1993-12-01

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

About this Manual

We've added this manual to the Agilent website in an effort to help you support your product. This manual provides the best information we could find. It may be incomplete or contain dated information, and the scan quality may not be ideal. If we find a better copy in the future, we will add it to the Agilent website.

Support for Your Product

Agilent no longer sells or supports this product. You will find any other available product information on the Agilent Test & Measurement website:

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Search for the model number of this product, and the resulting product page will guide you to any available information. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available.

Agilent Technologies

AVAH

Service Guide

HP 8110A 150 MHz Pulse Generator

HEWLETT PACKARD

HP Part No. 08110-91021
Printed in Germany December 1993

Edition 2.0
E1293

Notice

Copyright

Warranty

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Complete product warranty information is given in the User Guide.

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.

Notice

Warranty

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

For warranty service or repair, this product must be returned to a service facility designated by Hewlett-Packard. The Buyer shall pay Hewlett-Packard's round-trip travel expenses.

For products returned to Hewlett-Packard for warranty service, the Buyer shall prepay shipping charges to Hewlett-Packard and Hewlett-Packard shall pay shipping charges to return the product to the Buyer. However, the Buyer shall pay all shipping charges, duties and taxes for products returned to Hewlett-Packard from another country.

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

Limitation of Warranty

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

No other warranty is expressed or implied. Hewlett-Packard specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

Exclusive Remedies

The remedies supplied are the Buyer's sole and exclusive remedies. Hewlett-Packard shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort or any other legal theory.

Assistance

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.
For any assistance, contact your nearest Hewlett-Packard Sales Office.

Certification

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

About this edition

HP Part Number
08110-91021

Printed in Germany

Edition 2.0 E1293
December 1993

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.

Contents

Figures

Tables

1

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:

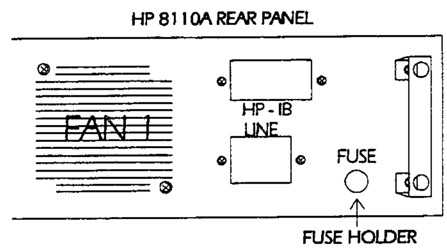


Figure 1-1. Position of fuse-holder

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.

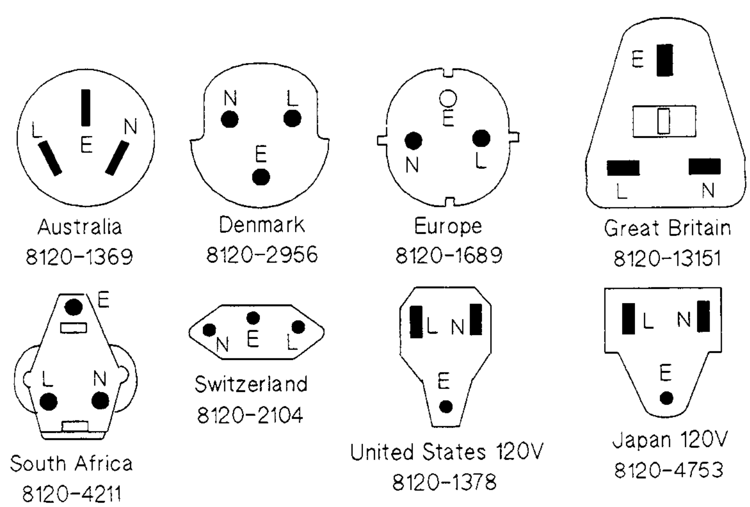


Figure 1-2. Power Cables - Plug Identification

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

Item	HP Part Number
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

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:

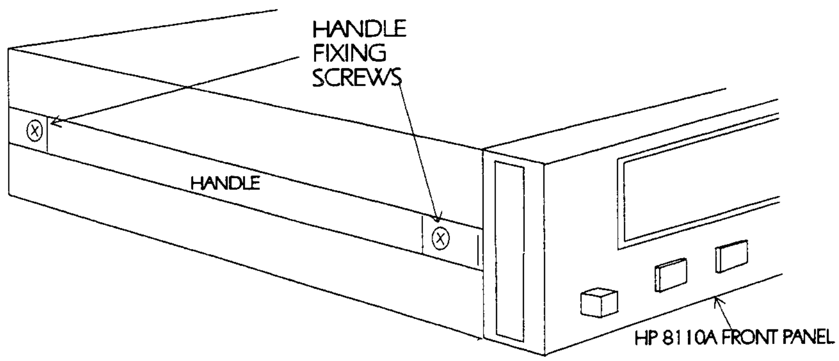


Figure 1-3. Removing the Carrying Handles

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:

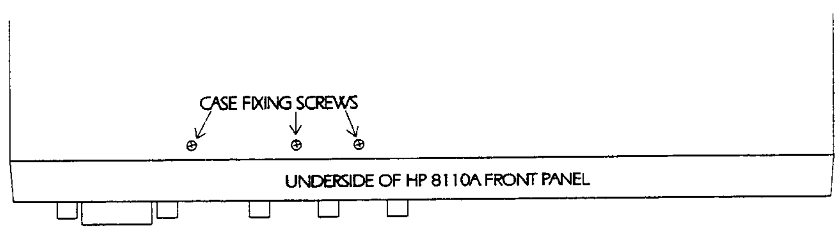


Figure 1-4.
Underside View of Front Panel Showing Case Fixing Screws

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

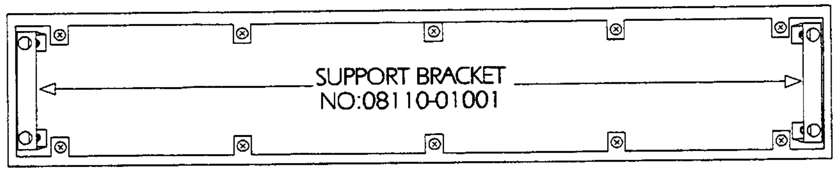


Figure 1-5. Rear Panel Showing Case Fixing Screws

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.

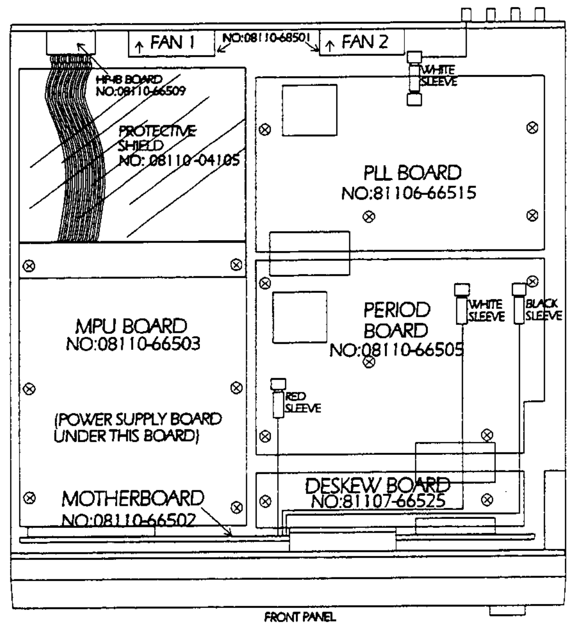


Figure 1-6. Top View of HP 8110A

This is an underside view of the instrument:

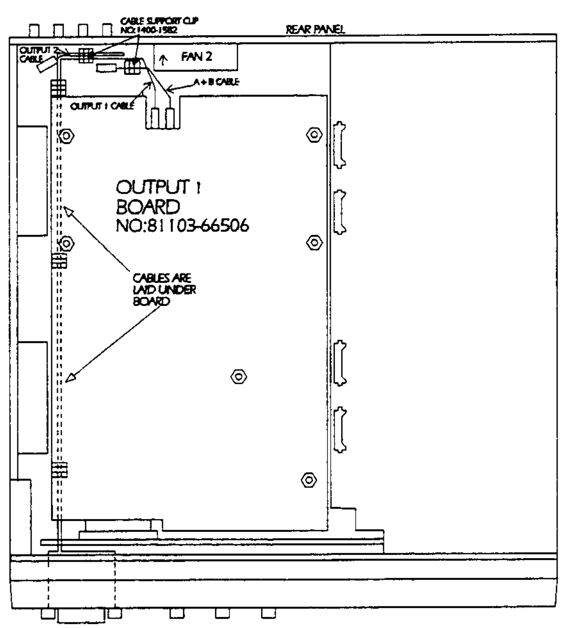


Figure 1-7. Underside View of HP 8110A

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 Eproms; 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 prescence of flammable gases, fumes or powders. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.**

2

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, ±10%, 50-60 Hz;

100-120 Vac, ±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

Recalibration period 1 year recommended

Warranty 3 years standard

Acoustic Noise Emission

Acoustic Noise Emission	Geräuschemissionswerte
For ambient temperature up to 30°C, under normal operation and at the typical operator position:	Bei einer Umgebungstemperatur bis 30°C
LpA = 46 dB	LpA = 46 dB
Measured in accordance with ISO 7779/EN 27779.	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
Range:	6.65 ns to 999 ms
Resolution:	3 digits, 10 ps best case[1]
Accuracy:	±5% ± 100 ps[1]
RMS-jitter:	0.03% + 25 ps[2]
Frequency range:	1.00 Hz to 150 MHz

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

2 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.

Burst count:	2 to 65536
Format:	single or double pulses

Pattern Mode

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

Pattern length:	4096 bits/channel including STROBE OUT
Format:	RZ (return-to-zero)
	NRZ (non-return-to-zero)
	DNRZ (delayed non-return-to- zero)
Random pattern:	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.

Maximum Frequency:	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_{pp} 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

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

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

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

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.

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[1]

1 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[1]
Accuracy:	±5% ± 250 ps
Duty cycle:	0.01% to 99.9%

1 Max. value: Period – 3.3 ns

Delay

Measured between trigger output and main output. Can be entered as absolute delay, phase° or % of period.

Fixed delay from TRIGGER OUT:	34.0 ns typical
Additional variable range:	0.00 ns to 999 ms[1]
Accuracy:	±5% ±1 ns

1 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[1]
Accuracy:	±5% ±250 ps
Min. period:	13.3 ns (75 MHz)

1 Max. value: Period – Width –3.3 ns

Transition Times

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

Range:	2.00 ns to 200 ms
Min. transition:	≤ 2.0 ns for levels within ±5 V window
	< 2.5 ns for all levels
	1.4 ns typical for ECL levels (20% to 80% of amplitude)
Accuracy:	±10% ±200 ps
Linearity:	3% typical for transitions >100 ns

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

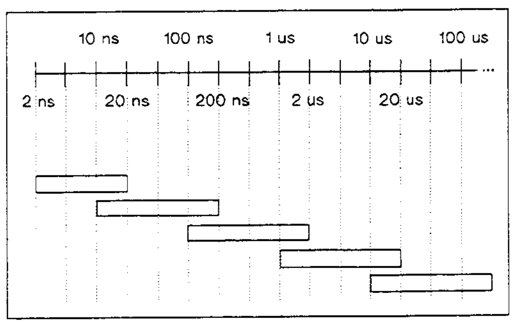


Figure 2-1. Leading/Trailing Edge ranges

Outputs

⚠

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

External Load compensation

For loads ≠ 50Ω, 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)[1]	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

		Seperate Channels		Channels Added at OUTPUT 1			
	Source Impedance	50 Ω	1 kΩ	48 Ω		500 Ω	
	Accuracy	±1% typical	±1% typical	±1% typical		±1% typical	
				OUTPUT 1	OUTPUT 2	OUTPUT 1	OUTPUT 2
Levels	Voltage (50Ω Load)	(Doubles into open)					
	Amplitude	100 mV to 10.0 V	200 mV to 19.0 V	0 V to 19.5 V[1]		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 (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

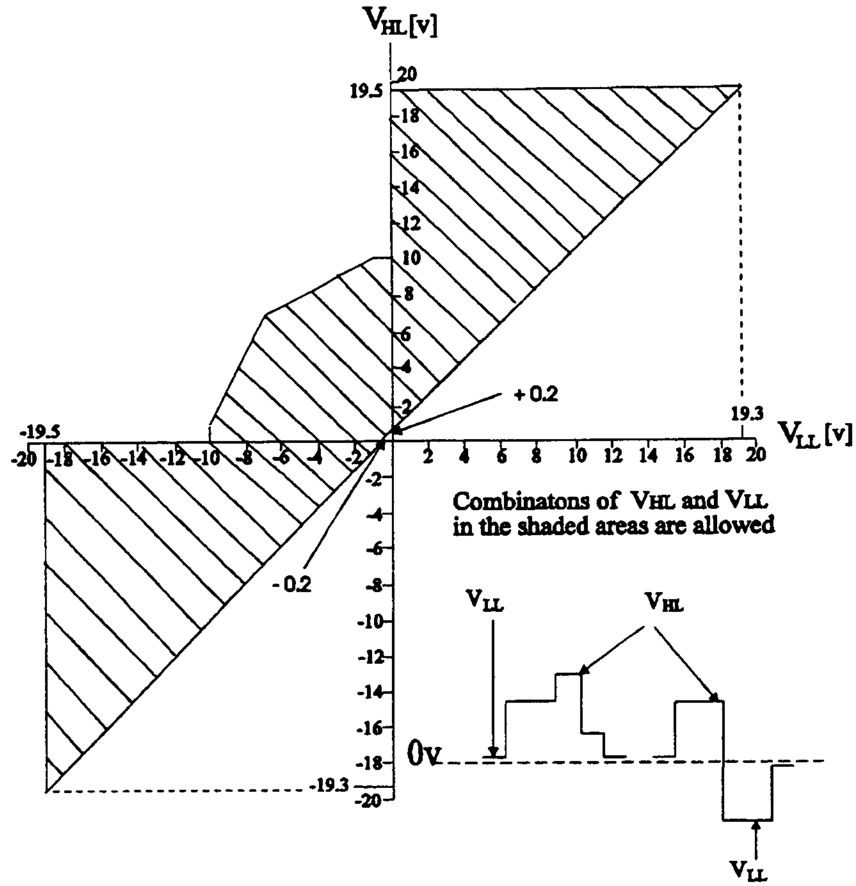


Figure 2-2. Highest and lowest level combinations

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.

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

3

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 Ω 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.

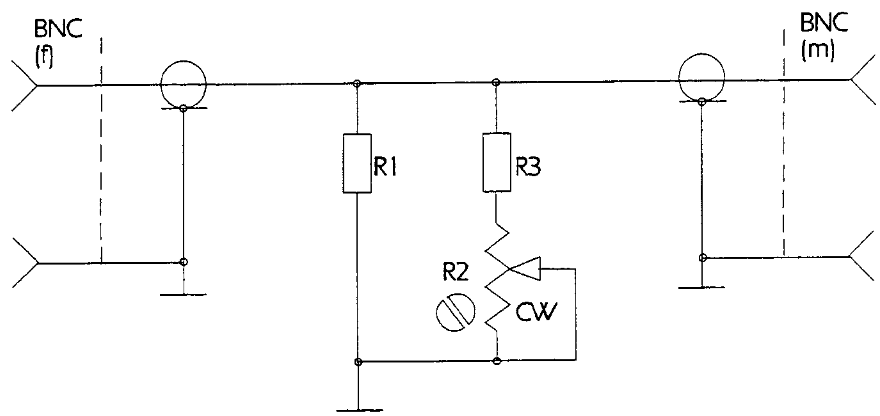


Figure 3-1. 50 Ohm, 0.1%, 10 W Feedthrough Termination

The following parts are required:

1. R1 = 53.6Ω, 1%, 10 W; HP Part Number: 0699-0146.
2. R2 = 200 Ω, 10%, 0.5 W, Variable trimmer; HP Part Number: 2100-3350.
3. R3 = 681 Ω, 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.

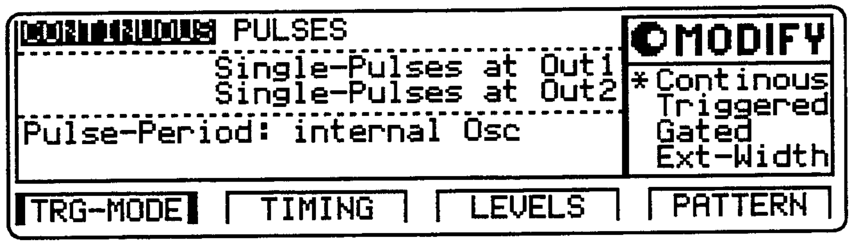


Figure 3-2. The TRG MODE Screen Display in a Fully Fitted HP 8110A

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

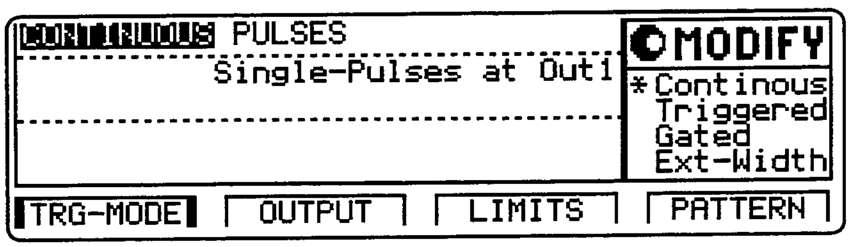


Figure 3-3. The TRG MODE Screen Display in a Standard HP 8110A

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

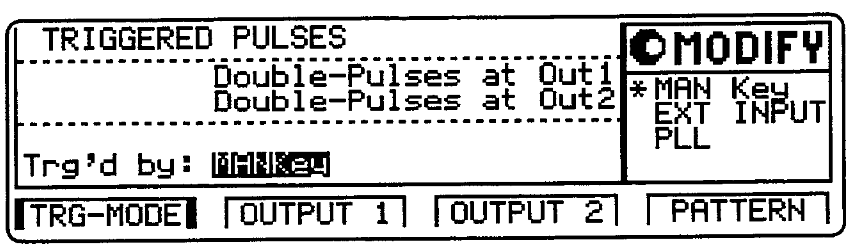


Figure 3-4.
The TRG MODE Screen With Manual Triggering in a Fully-Fitted HP 8110A

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

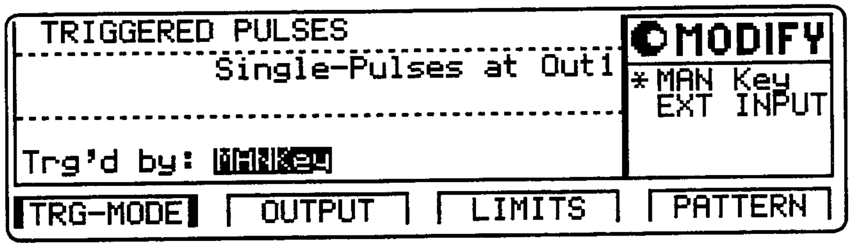


Figure 3-5.
The TRG MODE Screen With Manual Triggering in a Standard HP 8110A

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

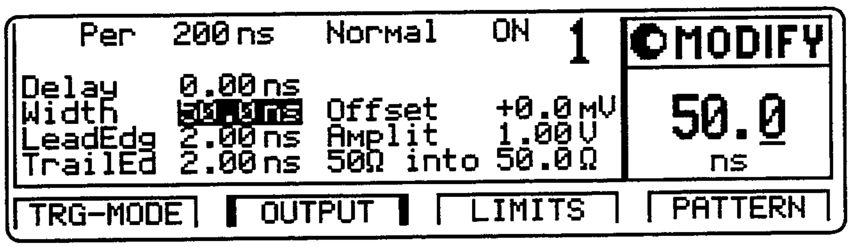


Figure 3-6. The Output Screen in a Standard HP 8110A

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:

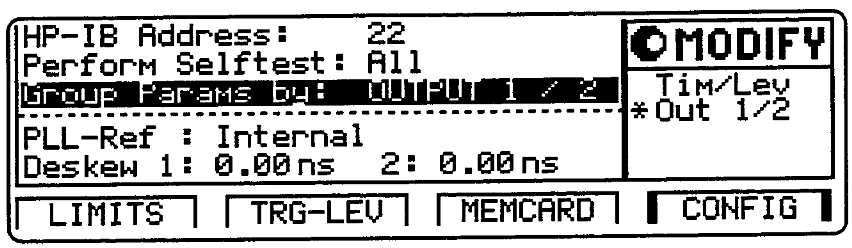


Figure 3-7. `CONFIG` Screen, Parameters grouped by OUTPUT

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

Test Specifications

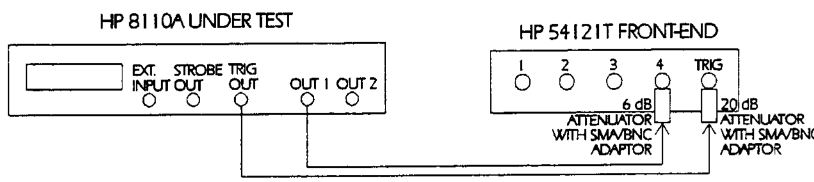
Range	6.65 ns to 999 ms
Resolution	3 digits, best case 10 ps
Accuracy	±5% ±100 ps
RMS-Jitter	0.03% + 25 ps (0.05% + 25 ps in the range 50 ns to 100 ns)

Equipment Needed

Digitizing Oscilloscope with Accessories
Counter
Cable, 50 Ω, coaxial, BNC

Procedure

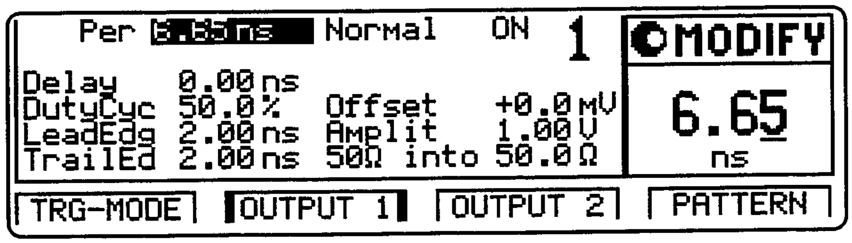
1. Connect the HP 8110A to the digitizing oscilloscope as shown:



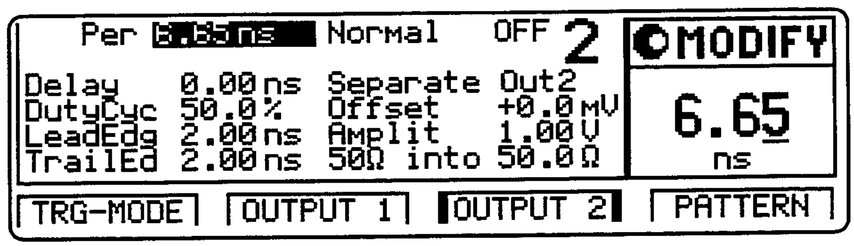
Connecting the HP 8110A to the Scope

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

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



Configuring Output 1



Configuring Output 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.

---

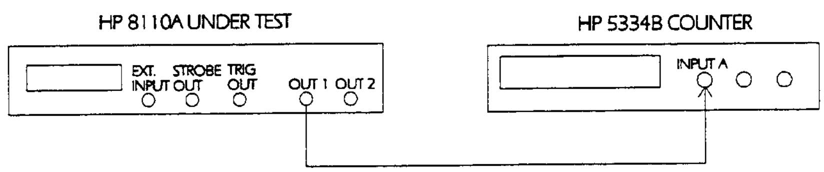
4. Set the Digitizing Oscilloscope HP 54121T:
   - Press (AUTOSCALE)
   - Select the Display menu and set the Number of Averages to 32
   - Press (MORE) key
   - Press (MEASURE) key
   - Press (PERIOD) key

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	4.75μs 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	4.75ms 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	± 0.1%
RMS-Jitter	0.003% + 20 ps

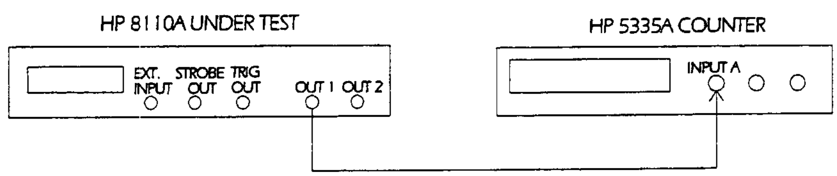
Equipment Needed

Counter HP 5335A
Cable, 50 Ω, 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.

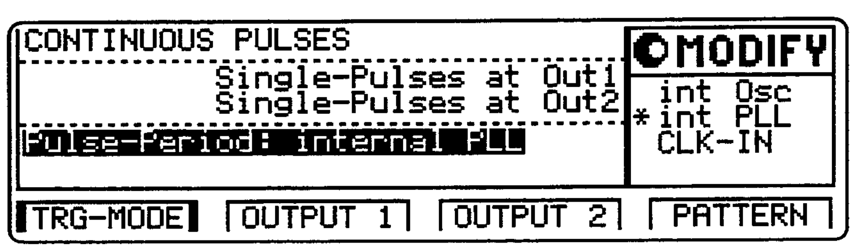
Procedure

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



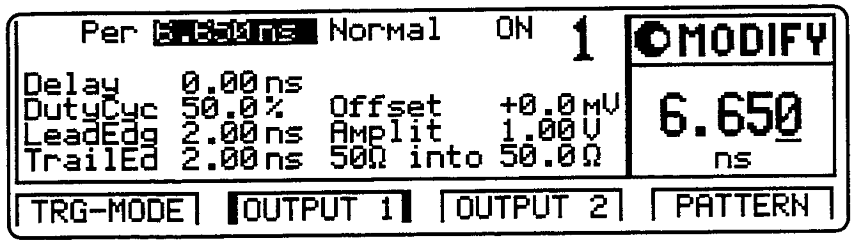
Connecting HP 8110A to the Counter

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:

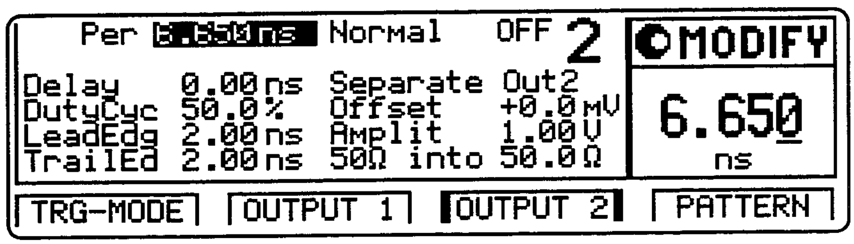


The TRG MODE Screen Setup

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



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 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 μs	1 MHz	999 kHz to 1.001 MHzmu;s	2 - 8
5 μs	200 kHz	199.800 kHz to 200.200 kHz	2 - 9
50 μs	20 kHz	19.980 kHz to 20.020 kHz	2 - 10
500 μs	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

Test Specifications

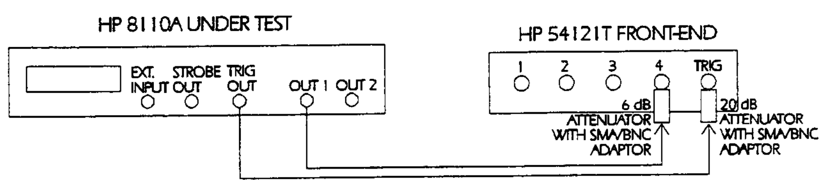
Range	3.30 ns to 999 ms
Resolution	3 digits, best case 10 ps
Accuracy	± 5% ± 250 ps
RMS-Jitter	0.03% + 25 ps (0.05% + 25 ps in the range 50 ns to 100 ns)

Equipment Needed

Digitizing Oscilloscope with Accessories
Counter
Cable, 50 Ω, coaxial, BNC

Procedure

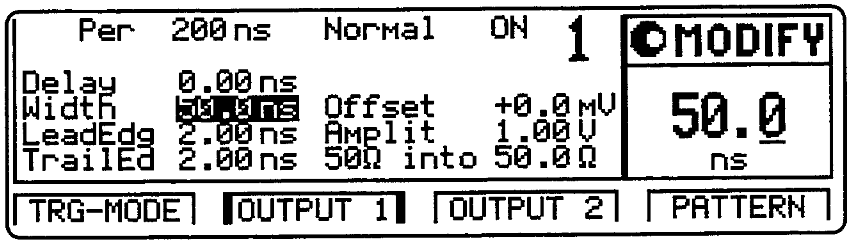
1. Connect HP 8110A to the Scope as shown:



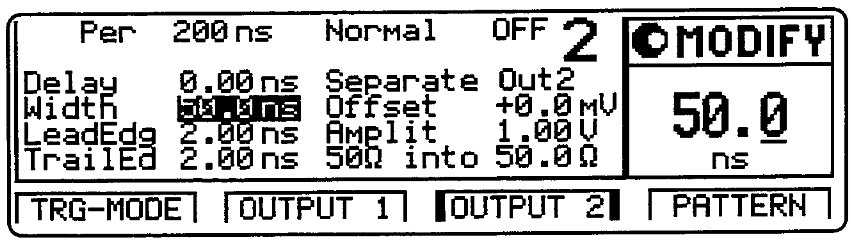
Connecting HP 8110A to the Scope

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:



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.

---

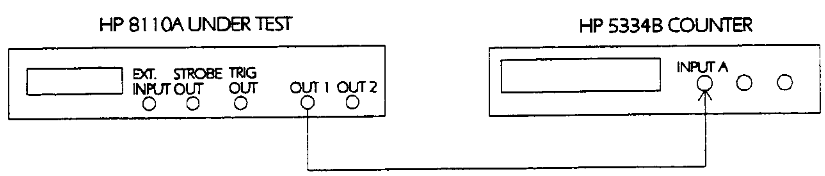
4. Set the Digitizing Oscilloscope HP 54121T:
   - Press (AUTOSCALE)
   - Select the Display menu and set the Number of Averages to 32
   - Select the delta V menu and turn the voltage markers On
   - Set the preset levels to 50% -50% and press (AUTO LEVEL SET)
   - Select the delta t menu and turn the 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 μs	100 ns	94.75 ns to 105.25 ns	3 - 7
100 ns/div	1 μs	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 → B
SENSE	On
INPUT A	50 Ω
COM A	On
INPUT B	50 Ω, 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 μs	1 μs	949.75 ns to 1050.25 μs	3 - 9
100 μs	5 μs	4.75 μs to 5.25 μs	3 - 10
100 μs	50 μs	47.5 μs to 52.5 μs	3 - 11
10 ms	500 μs	475 μs to 525 μs	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

Test Specifications

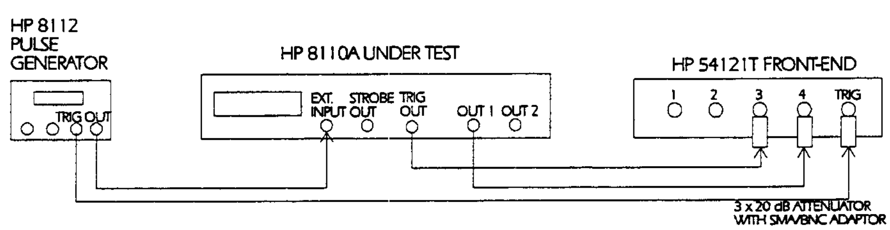
Range: Fixed: typical 34.0 ns
Variable: 0.00 ns to 999 ms
Resolution: 3 digits, best case 10 ps
Accuracy: ± 5% ± 1 ns
RMS-Jitter: 0.03% + 25 ps (0.05% + 25 ps in the range 50 ns to 100 ns)

Equipment Needed

Digitzing Oscilloscope with Accessories
Pulse Generator
Counter
Cable, 50 Ω, coaxial, BNC

Procedure

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



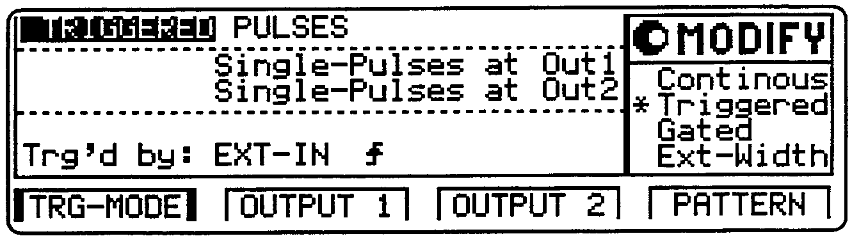
Connecting HP 8110A to the Scope

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

3. Set the Pulse Generator to:

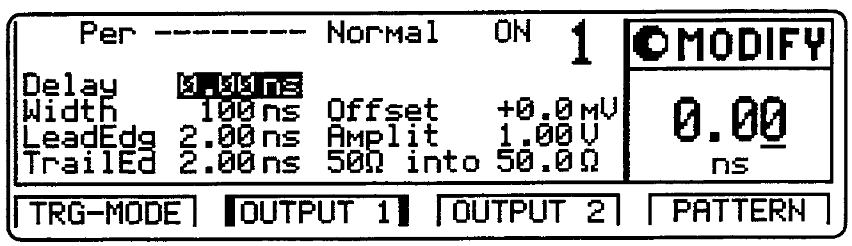
Period	1 μs
Width	100 ns
Amplitude	1 V
Offset	0 V
Output	Enable

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

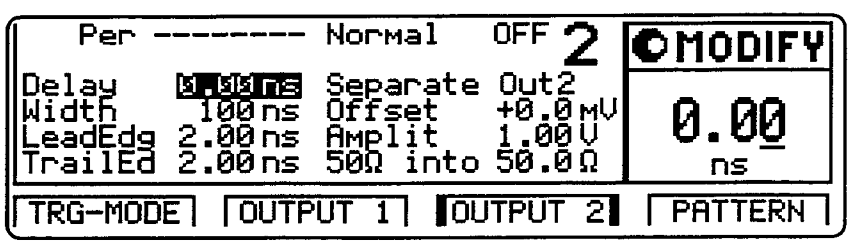


The TRG MODE Screen Setup

5. On the HP 8110A 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.

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:

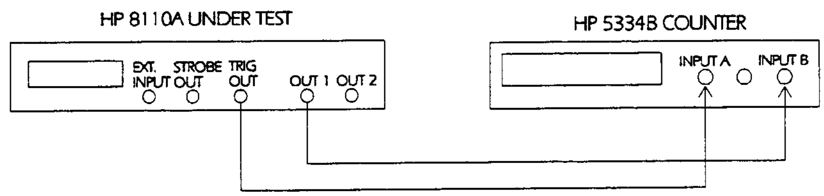
Note

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

Test Specifications

Range	6.65 ns to 999 ms
Resolution	3 digits, best case 10 ps
Accuracy	± 5% ± 250 ps

Equipment Needed

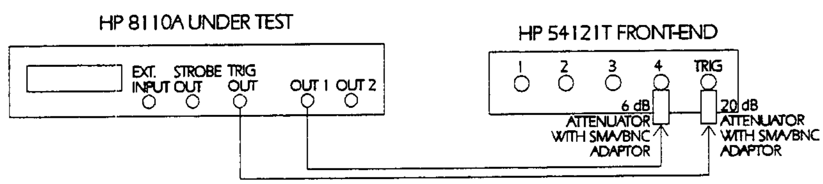
Digitizing Oscilloscope with Accessories

Counter

Cable, 50 Ω, coaxial, BNC

Procedure

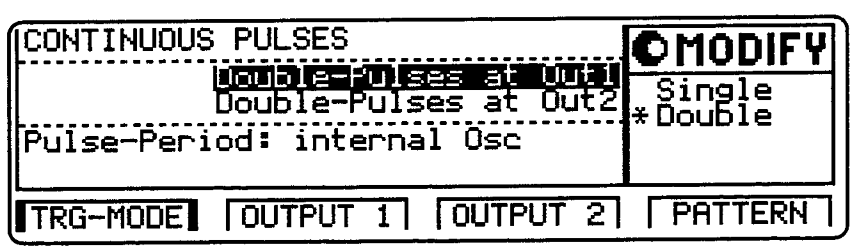
1. Connect HP 8110A to the Scope as shown:



Connecting HP 8110A to the Scope

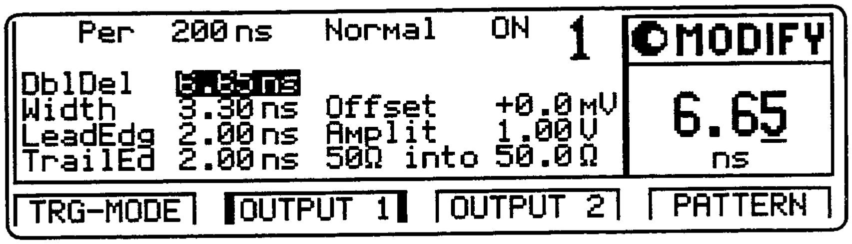
2. Set up the HP 8110A as described in "Initial Setup of the HP 8110A"

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

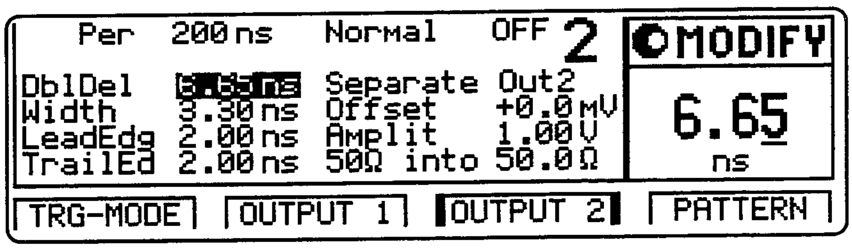


The TRG MODE Screen Setup

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



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.

---

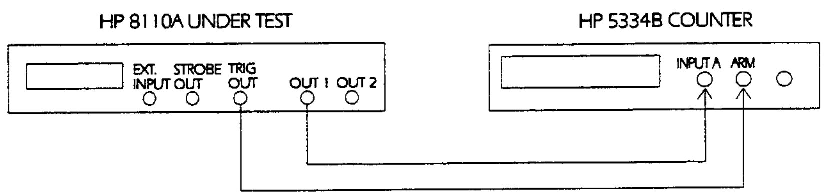
5. Set the Digitizing Oscilloscope HP 54121T:
   - Press (AUTOSCALE)
   - Center the double pulse signal
   - Select the Display menu and set the Number of Averages to 32
   - Select the Delta V menu and turn the Voltage markers On
   - Set Preset Levels = 50% -50% and press (AUTO LEVEL SET)
   - Select 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:



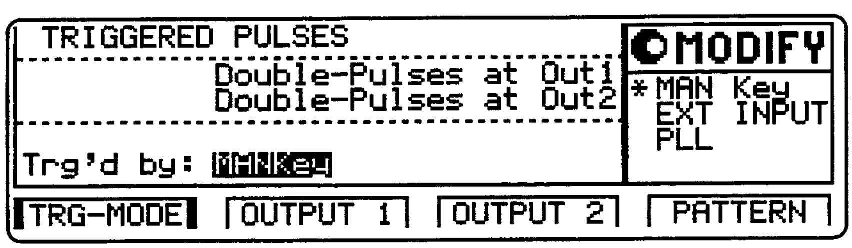
Connecting HP 8110A to the Counter

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

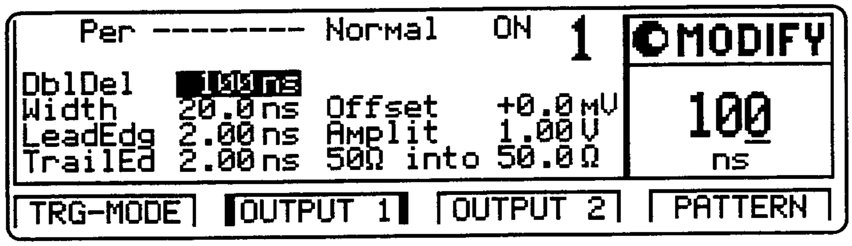
10. Set up the HP 8110A as described in "Initial Setup of the HP 8110A"

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

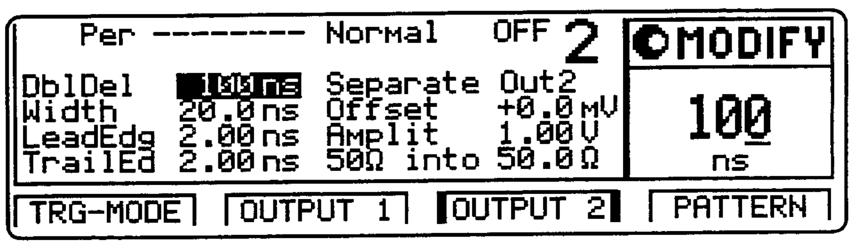


The TRG MODE Screen Setup

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



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.

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 ps (0.05% + 25 ps in the range 50 ns to 100 ns)

Equipment Needed

Digitizing Oscilloscope with Accessories

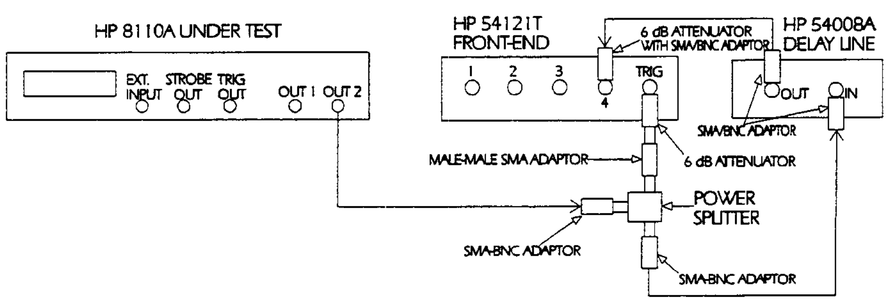
Delay Line (22 ns)

Power Splitter

Cable, 50 Ω, coaxial, BNC

Procedure

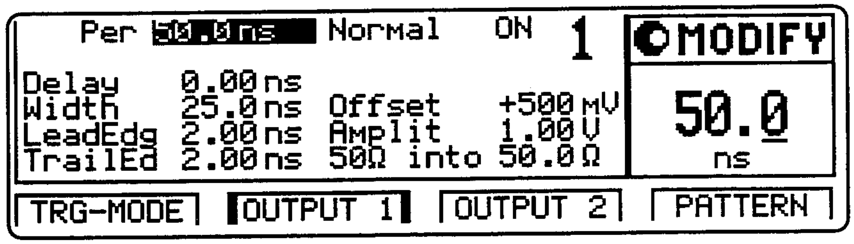
1. Connect HP 8110A to the Scope as shown:



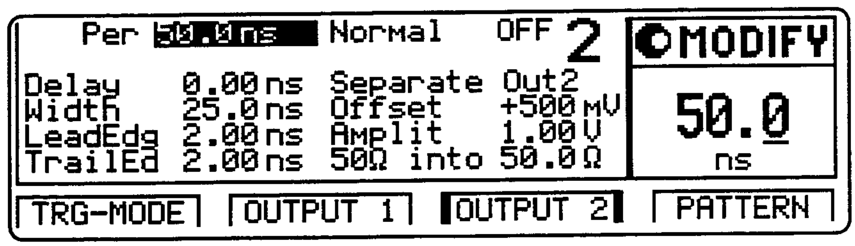
Equipment Set-up for Jitter Test

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

3. On the HP 8110A 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)
   - 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

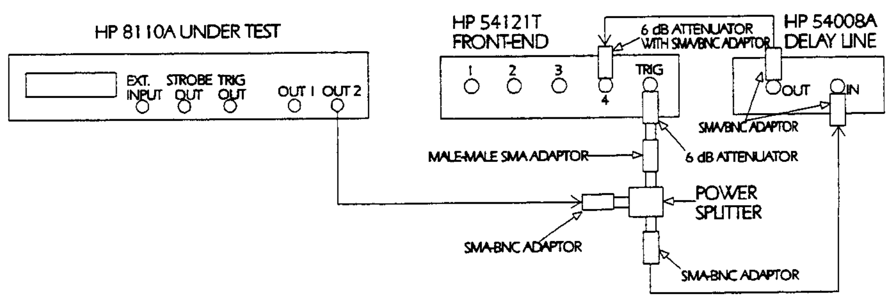
Delay Line (22 ns)

Power Splitter

Cable, 50 Ω, coaxial, BNC

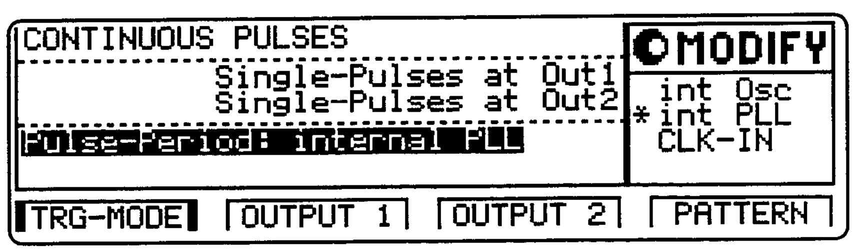
Procedure

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



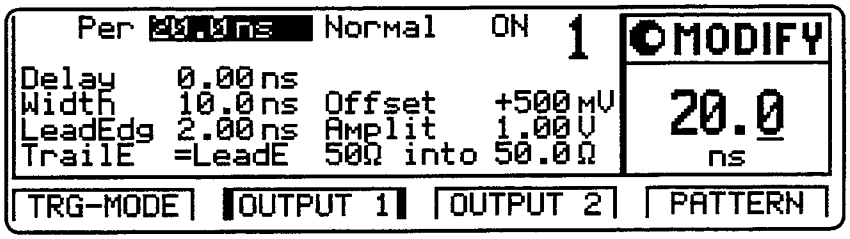
Equipment Set-up for Jitter Test

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:

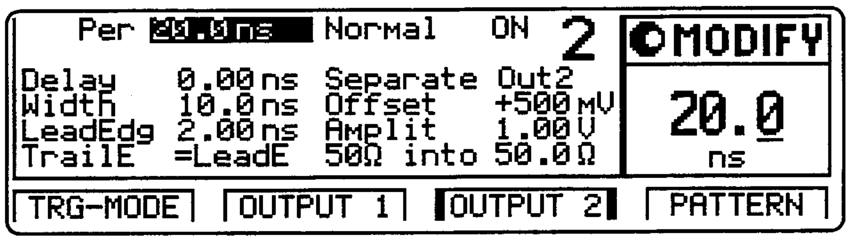


The TRG MODE Screen Setup

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



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.

---

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

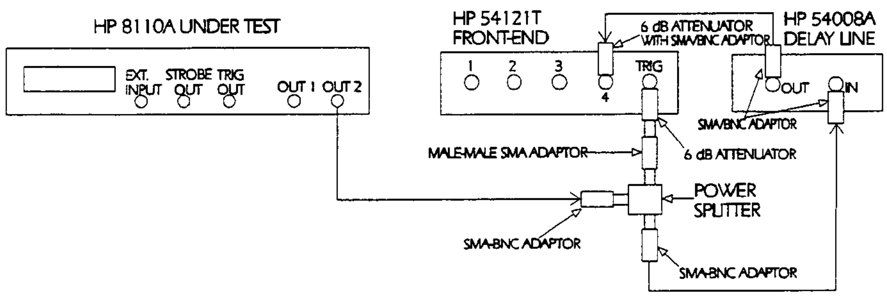
Delay Line (22 ns)

Power Splitter

Cable, 50 Ω, coaxial, BNC

Procedure

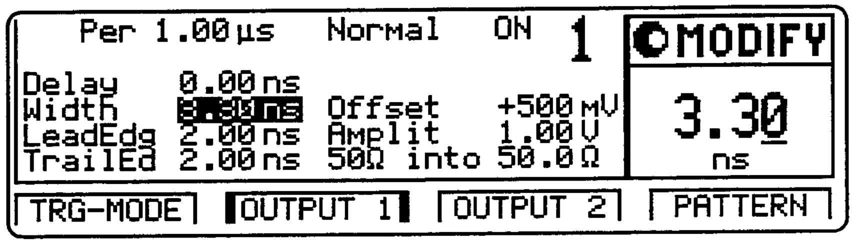
1. Connect HP 8110A to the Scope as shown:



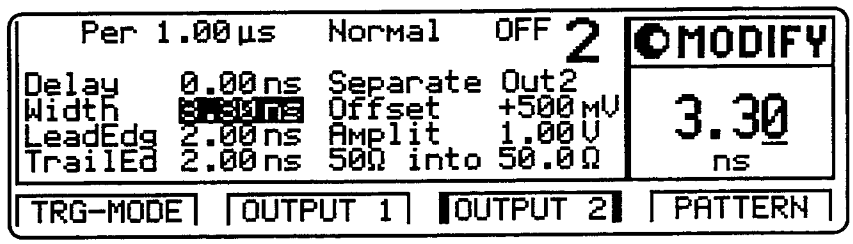
Equipment Set-up for Jitter Test

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

3. On the HP 8110A 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)
   - 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

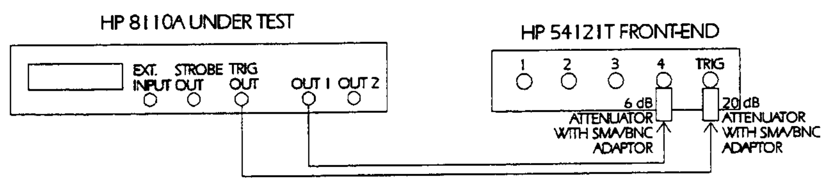
Test 6.3: Delay Jitter

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

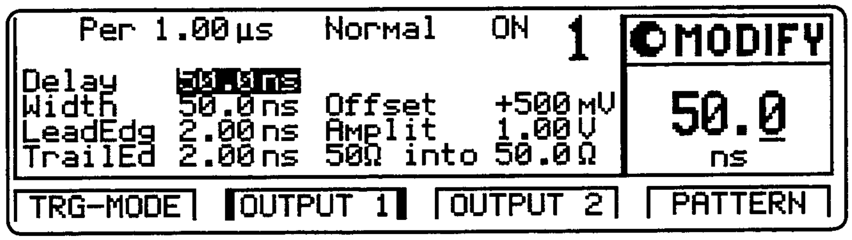
1. Connect HP 8110A to the Scope as shown:



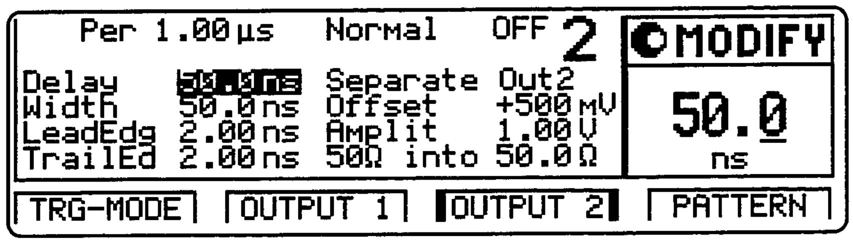
Equipment Set-up for Delay Jitter Test

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:



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.

---

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

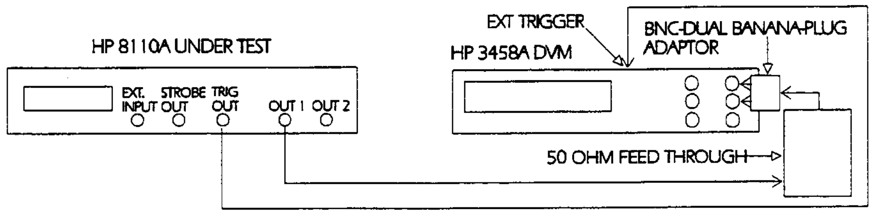
Table 3-12. High and Low Test Specifications

	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

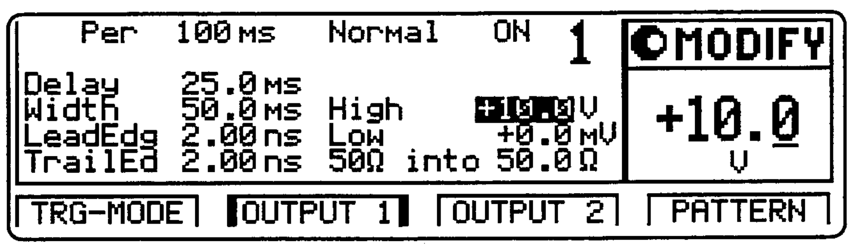
Procedure Connect HP 8110A to the DVM as shown:



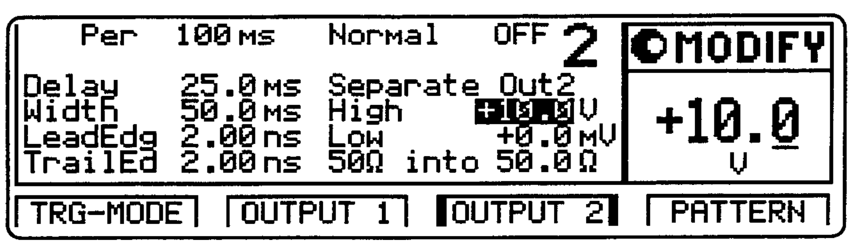
Connecting the DVM for High and Low Levels Tests

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.

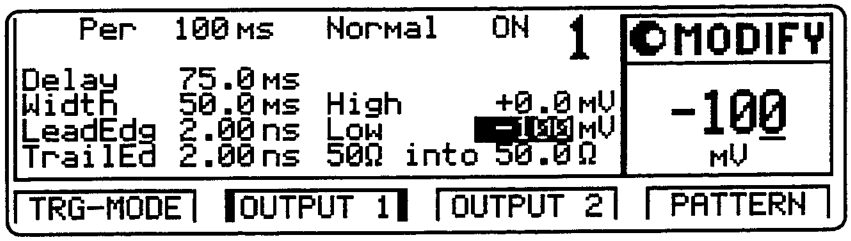
Table 3-13.
High Level Settings (50 ohms - 50 ohms) and TR Reference

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

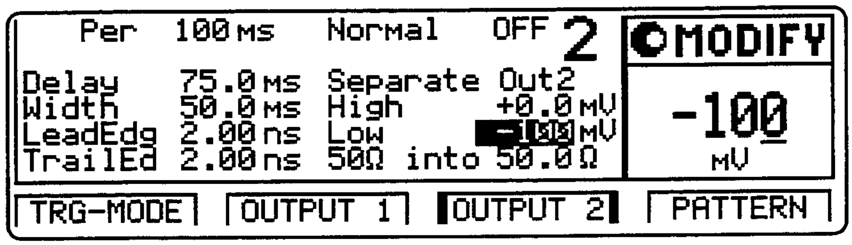
The low level may vary within ±1% of amplitude ±50 mV

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:



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

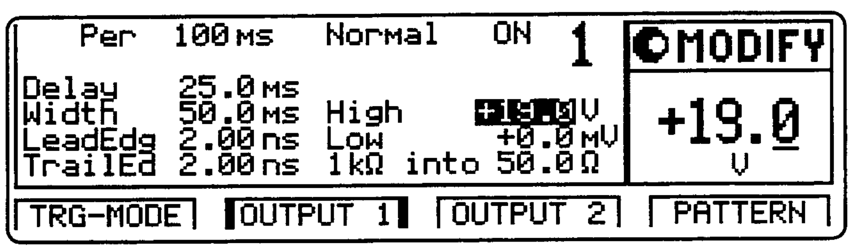
Table 3-14. Low Level Settings (50 ohms - 50 ohms) and TR Reference

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

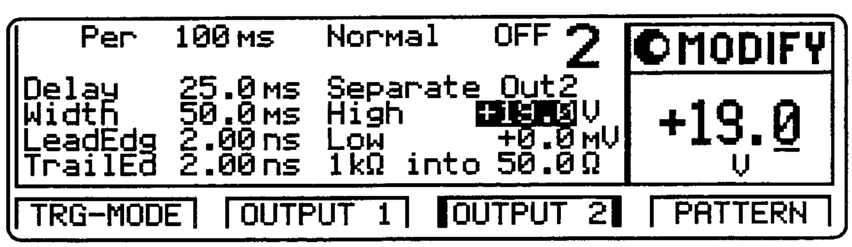
The high level 0.0 V may vary ±1% of amplitude ±50 mV.

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:



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

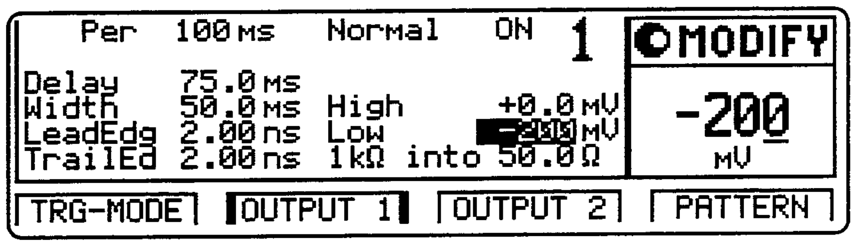
Table 3-15.
High Level Settings (1 Kohms - 50 ohms) and TR Reference

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

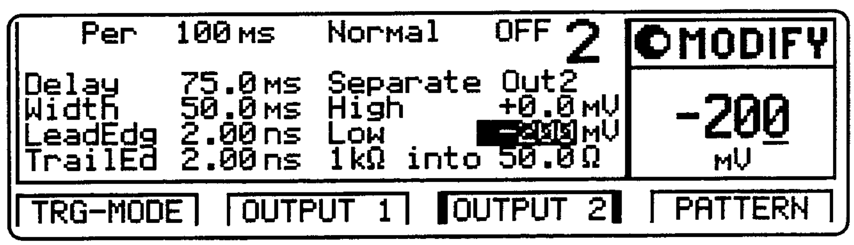
The low level 0.0 V may vary ±1% of amplitude ±100 mV.

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:



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. 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 ± 1% of amplitude ± 100 mV

Note

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

Test 8: Transition Time

The following tests are required:

1. ≤±5V window:
   a. Minimum Leading Edge and Leading Edge range
   b. Minimum Trailing Edge and Trailing Edge range
2. >±5V window:
   a. Minimum Leading Edge
   b. Minimum Trailing Edge

Test Specifications

Range	2.0 ns to 200 ms (measured between 10% and 90% of amplitude)
Minimum Transitions	≤ 2.0 ns for levels within ±5 V window, <2.5 ns for all levels, (typical 1.4 ns for levels within ±5 V window measured between 20% and 80% of amplitude)
Resolution	3 digits, best case 10 ps
Accuracy	± 10% ± 200 ps
Linearity	typical 3% for transitions > 100 ns

Equipment Needed

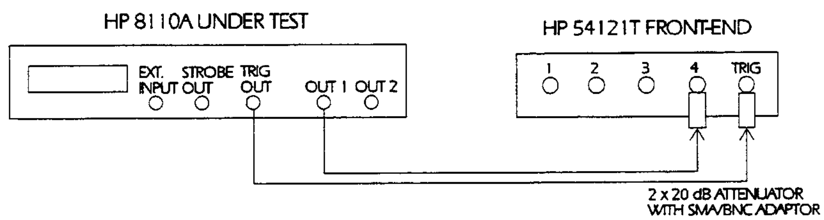
Digitizing Oscilloscope with Accessories

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.

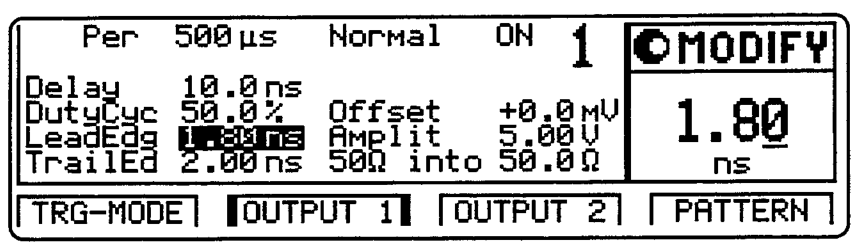
1. Connect HP 8110A to the Scope as shown:



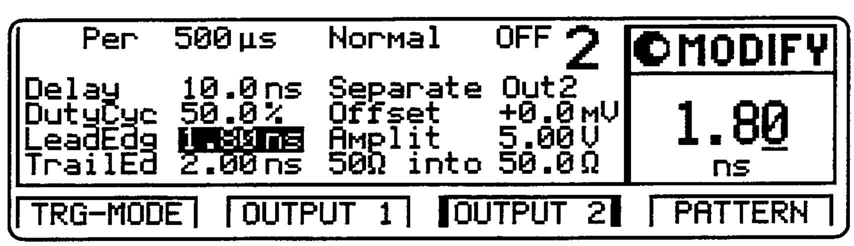
Connecting HP 8110A to the Scope

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 μs/div, DELAY = 365 μs,
   - 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 μs
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

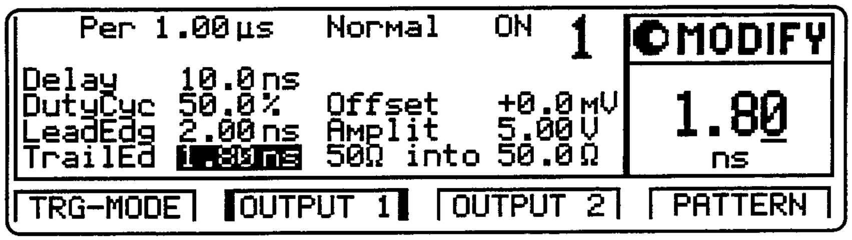
Oscilloscope TIME/DIV	Period	Leading Edge	Trailing Edge	Acceptable Range	TR Entry
2 ns/div	1 μs	1.8 ns *	2 ns	≤2 ns	8.1a - 1
5 ns/div	1 μs	10 ns	5 ns	8.8 ns to 11.2 ns	8.1a - 2
10 ns/div	1 μs	50 ns	50 ns	44.8 ns to 55.2ns	8.1a - 3
100 ns/div	5 μs	500 ns	500 ns	449.8 ns to 550.2 ns	8.1a - 4
1μs/div	50 μs	5 μs	5 μs	4.4998 μs to 5.5002 μs	8.1a - 5
10 μs/div	500 μs	50 μs	50 μs	45 μs to 55 μs	8.1a - 6
100 μs/div	5 ms	500 μs	200 μs	450 μs to 550 μ	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.

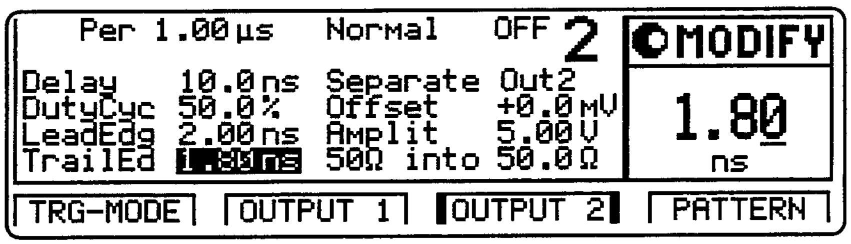
Test 8.1b: Trailing Edge Test

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:



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 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:

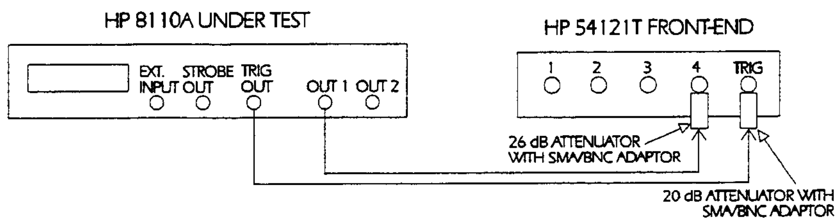
Table 3-18. Trailing Edge Settings and TR Reference

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

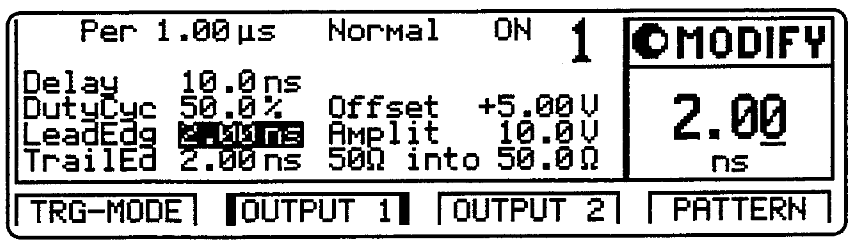
Test 8.2a: Min. Leading edge for Level Window >±5V

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

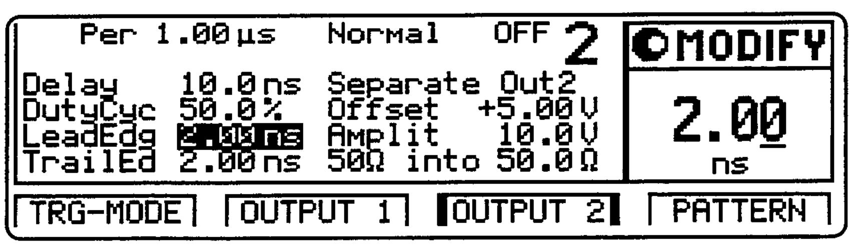


Connecting HP 8110A to the Scope

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:



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)
   - 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 μs/div, DELAY = 365 μs
   - 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 μs
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 >±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

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

Test 9: Pulse Aberration Test

The following tests are required:

Overshoot and Ringing

Preshoot

Test Specifications

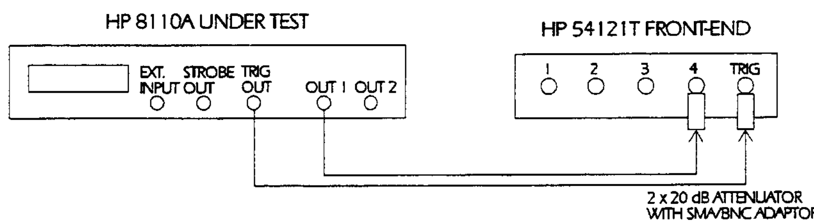
Overshoot/Preshoot/Ringing
±5% of amplitude ±:20 mV

Equipment Needed

Digitizing Oscilloscope with Accessories

Procedure

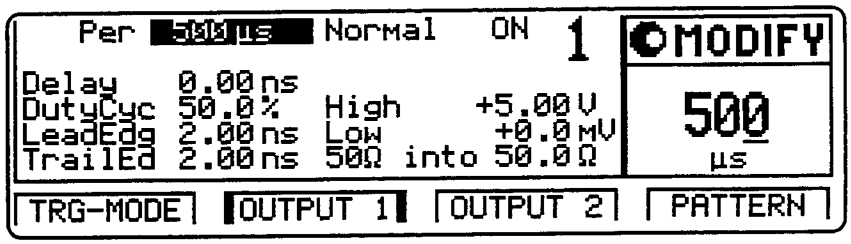
1. Connect HP 8110A to the Scope as shown:



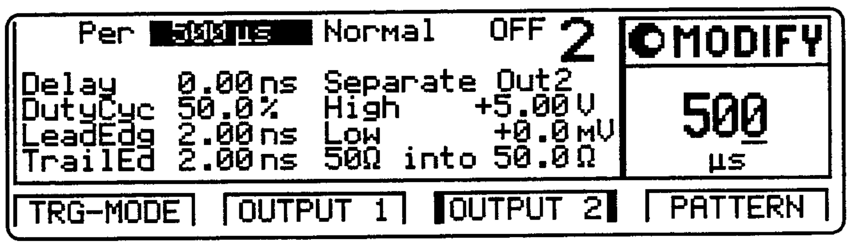
Connecting HP 8110A to the Scope

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:



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.

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 = 50μs/div, DELAY = 365 μs)
   - 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 ±5% of amplitude ±20 mV window
7. Enter the result in the Test Report as TR entry 9 - 1

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

---

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 μs
    - 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 = 50μs/div, DELAY = 365 μs)
    - 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 ±5% of amplitude ±20 mV window.
15. Enter the result in the Test Report as TR entry 9 - 3

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:

____

____

____

Internal Oscillator Period

Scope Uncertainty factor ____________

TR Entry	Test	Limit Minimum	Actual Result	Limit 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 Minimum	Actual Result	Limit 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 μs	949.9 ns	____________	1050.1 ns	____	____

Internal Oscillator Period (continued)

TR Entry	Test	Limit Minimum	Actual Result	Limit Maximum	Pass	Fail
1 - 9	5 μs	4.75μs	________	5.25 μs	___	___
1 - 10	50 μs	47.5 μs	________	52.5 μs	___	___
1 - 11	500 μs	475 μs	________	525 μs	___	___
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 Minimum	Actual Result	Limit 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 Minimum	Actual Result	Limit 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 Minimum	Actual Result	Limit Maximum	Pass	Fail
3 - 9	1 μs	949.75 ns	______________	1050.25 μs	___	___
3 - 10	5 μs	4.75 μs	______________	5.25 μs	___	___
3 - 11	50 μs	47.5 μs	______________	52.5 μs	___	___
3 - 12	500 μs	475 μs	______________	525 μs	___	___
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 Minimum	Actual Result	Limit 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 μs	949 ns	________________	1051 ns	___	___
4 - 9	5 μs	4.749 μs	________________	5.251 μs	___	___
4 - 10	50 μs	47.5 μs	________________	52.5 μs	___	___
4 - 11	500 μs	475 μs	________________	525 μs	___	___
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 Minimum	Actual Result	Limit Maximum	Pass	Fail
6.3 - 1			________________	50 ps	____	____
6.3 - 2			________________	175 ps	____	____

Double Pulse Delay

Scope Uncertainty factor ________________

TR Entry	Test	Limit Minimum	Actual Result	Limit 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 Minimum	Actual Result	Limit 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 μs	949.75 ns	________________	1050.25 μs	____	____
5 - 8	5 μs	4.759 μs	________________	5.25 μs	____	____
5 - 9	50 μs	47.5 μs	________________	52.5 μs	____	____
5 - 10	500 μs	475 μs	________________	525 μs	____	____
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 Minimum	Actual Result	Limit 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 Minimum	Actual Result	Limit 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 Minimum	Actual Result	Limit 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 Minimum	Actual Result	Limit 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 ≤ ± 5V Level Window

Scope Uncertainty factor ____________

TR Entry	Test	Limit Minimum	Actual Result	Limit Maximum	Pass	Fail
8.1a - 1	1.8 ns		____________	≤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 μs	4.4998 μs	____________	5.5002 μs	___	___
8.1a - 6	50 μs	45 μs	____________	55 μs	___	___
8.1a - 7	500 μs	450 μs	____________	550 μ	___	___
8.1a - 8	50 ms	45 ms	____________	55 ms	___	___

Trailing Edge for ≤ ± 5V Level Window

TR Entry	Test	Limit Minimum	Actual Result	Limit Maximum	Pass	Fail
8.1b - 1	1.8 ns		____________	≤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 μs	4.4998 μs	____________	5.5002 μs	___	___
8.1b - 6	50 μs	45 μs	____________	55 μs	___	___
8.1b - 7	500 μs	450 μs	____________	550 μ	___	___
8.1b - 8	50 ms	45 ms	____________	55 ms	___	___

Leading Edge for > ± 5V Level Window

TR Entry	Test	Limit Minimum	Actual Result	Limit Maximum	Pass	Fail
8.2a - 1	2 μs		________________	<2.5 μs	___	___

Trailing Edge for > ± 5V Level Window

TR Entry	Test	Limit Minimum	Actual Result	Limit Maximum	Pass	Fail
8.2b - 1	2 μs		________________	<2.5 μs	___	___

Overshoot and Ringing

Scope Uncertainty factor ________________

TR Entry	Test	Limit Minimum	Actual Result	Limit Maximum	Pass	Fail
9 - 1	5V		________________	±5% of ampl. ±20mV	___	___
9 - 2	500mV		________________	±5% of ampl. ±20mV	___	___

Preshoot

TR Entry	Test	Limit Minimum	Actual Result	Limit Maximum	Pass	Fail
9 - 3	0 V		________________	±5% of ampl. ±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:

____

____

____

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 μs	999 kHz	____________	1.001 MHz	___	___
2 - 9	5 μs	199.800 kHz	____________	200.200 kHz	___	___
2 - 10	50 μs	19.980 kHz	____________	20.020 kHz	___	___
2 - 11	500 μs	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	___	___

4

Troubleshooting

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 messges 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.

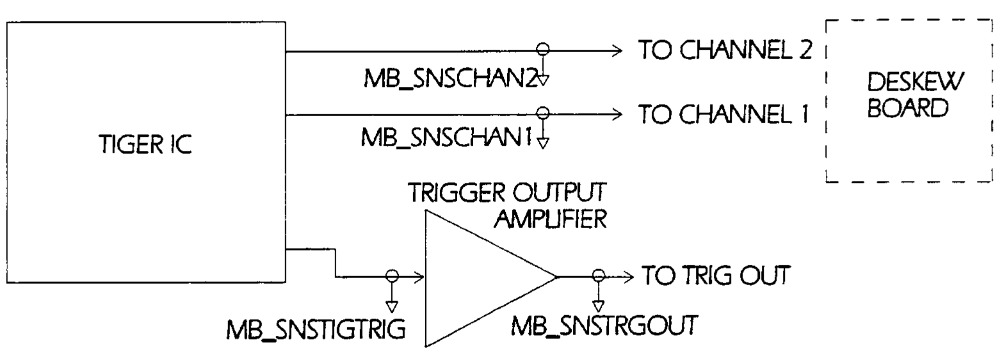


Figure 4-1. Testpoints used in Period Board Selftest

Period Board Selftest Failure Messages

the HP-IB meaasges 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 rigger 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.

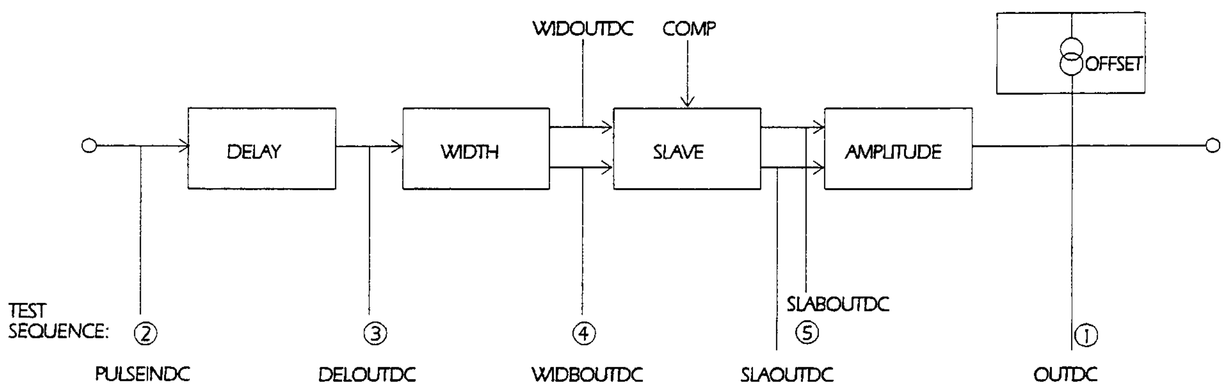


Figure 4-2. Testpoints used in Output Board Selftest

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.

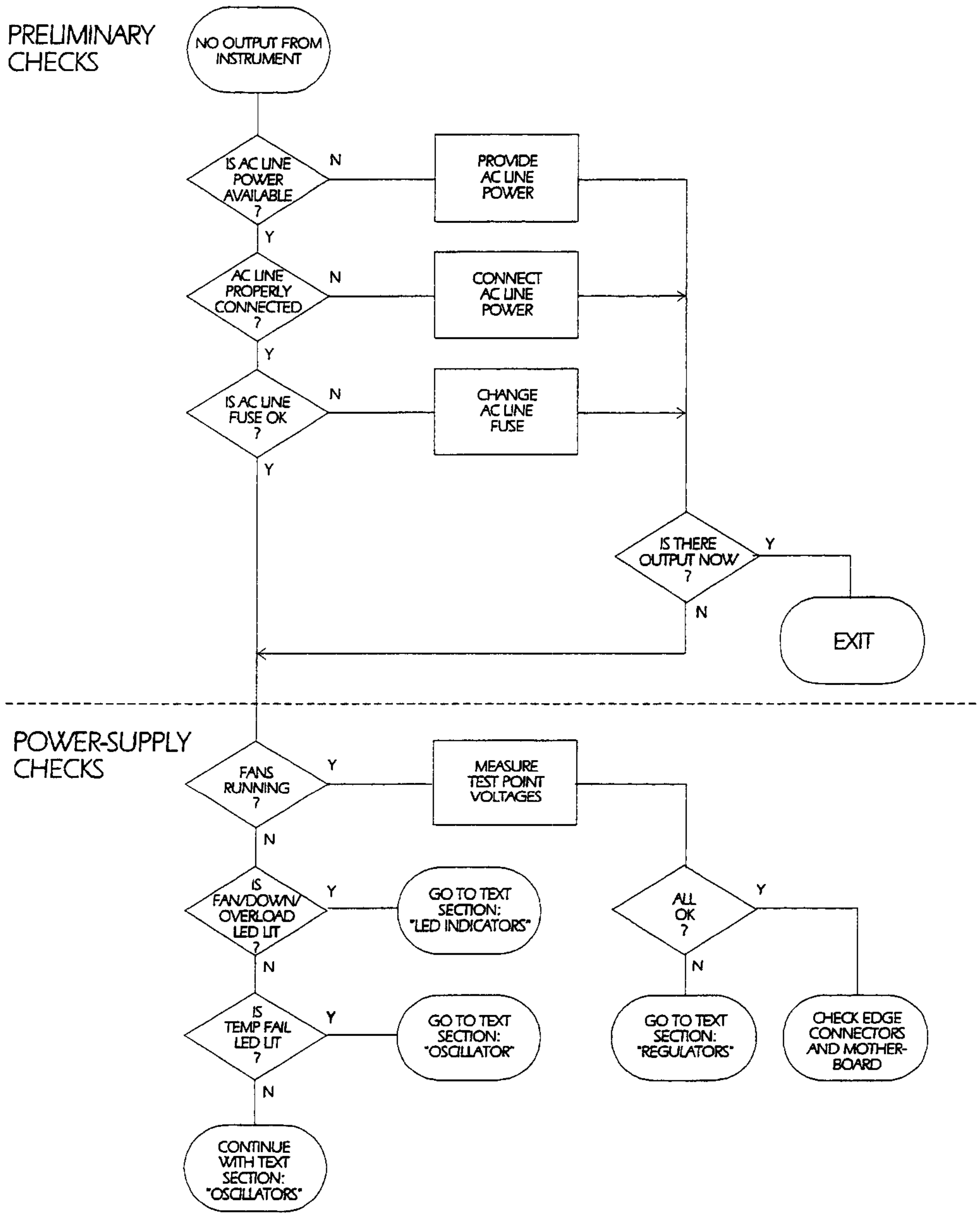


Figure 4-3. getting Started with Troubleshooting the HP 8110A

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 the Primary and Secondary Sections of the Power Supply.

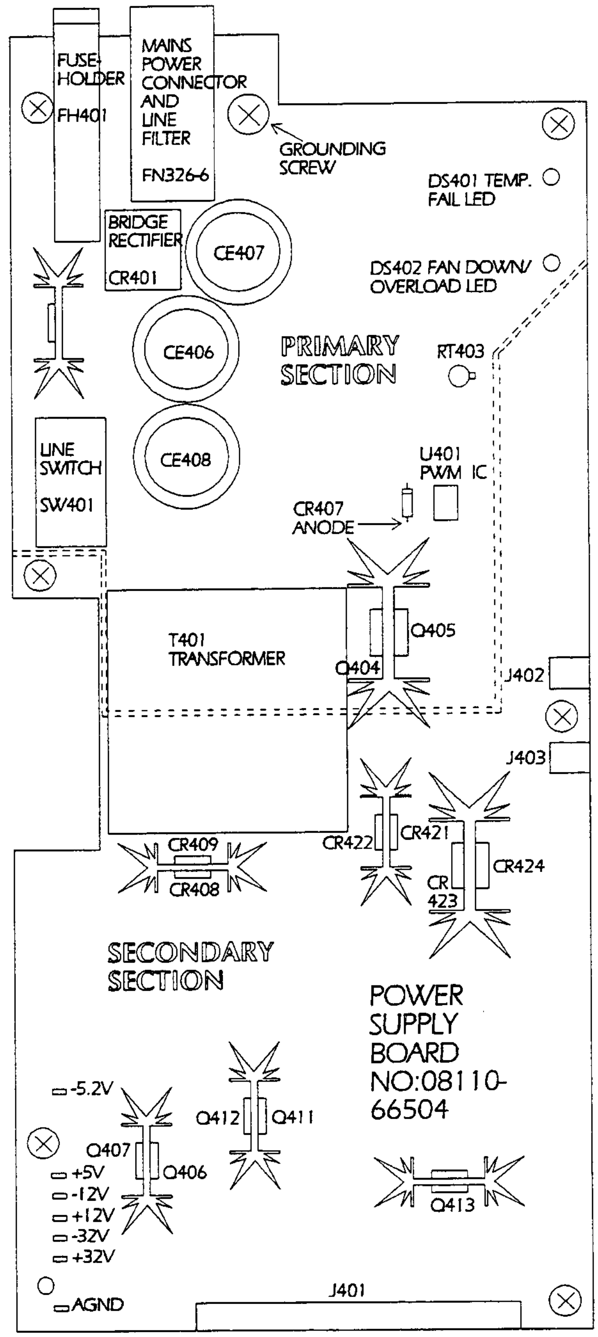


Figure 4-4. The Power Supply Board

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

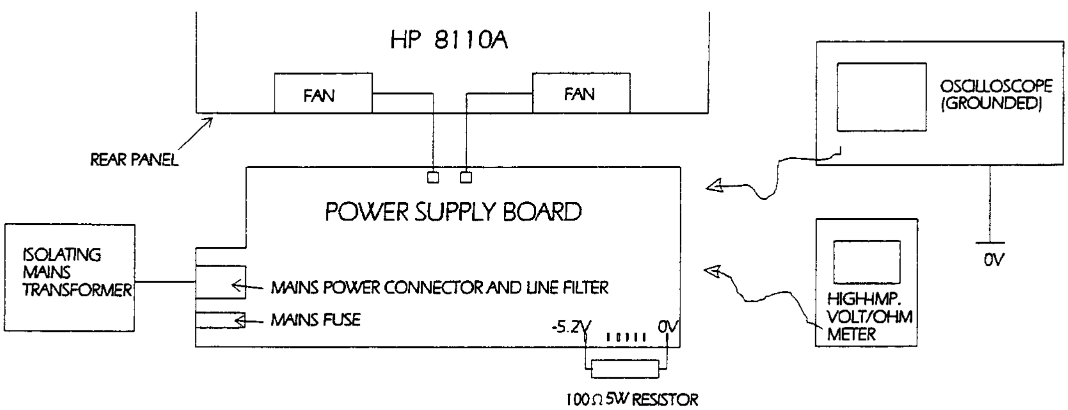


Figure 4-5. Test Setup for the Power Supply Board

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 Ω 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

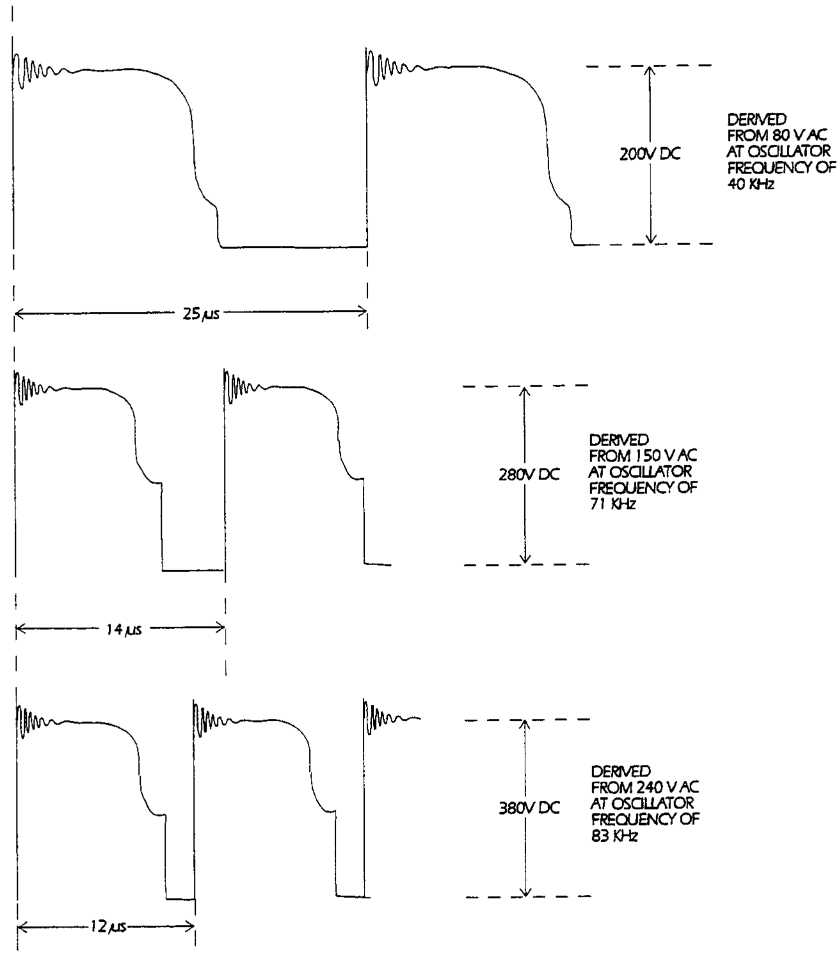


Figure 4-6. Waveforms at CR407 anode

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

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 catkode 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 100Ω 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

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.

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 ±10 V. If not, adjust to ±10 V
2. Check that the signal at the junction of R304 and R305 is approximately ±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 Ω 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 ±10 V. If not, adjust to ±10 V
2. Check that the signal at the junction of R406 and R407 is approximately ±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 Ω 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.

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 Vand 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 ±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
-100	Command header error HP-IB message = "Instrument in LOCAL LOCKOUT mode" Local message = "Instrument in LOCAL LOCKOUT mode" Description: The Local key was pressed on the front panel while the Instrument was set to Local lockout.
-102	Syntax error 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.
-131	Invalid suffix HP-IB message = "Channel out of range" Local message = "Channel out of range" Description: The channel suffix given with a channel sensitive command is out of range.

-148 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

5

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:

Fit To attach a subassembly to the instrument, usually taken to mean a subassembly that was not there before (see *Retrofit*)

Refit To put a subassembly back into the instrument, after removal for any reason

Replace To remove a faulty subassembly, and fit a new (working) one

Remove To take any subassembly (working or not) out of the instrument

Retrofit 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.

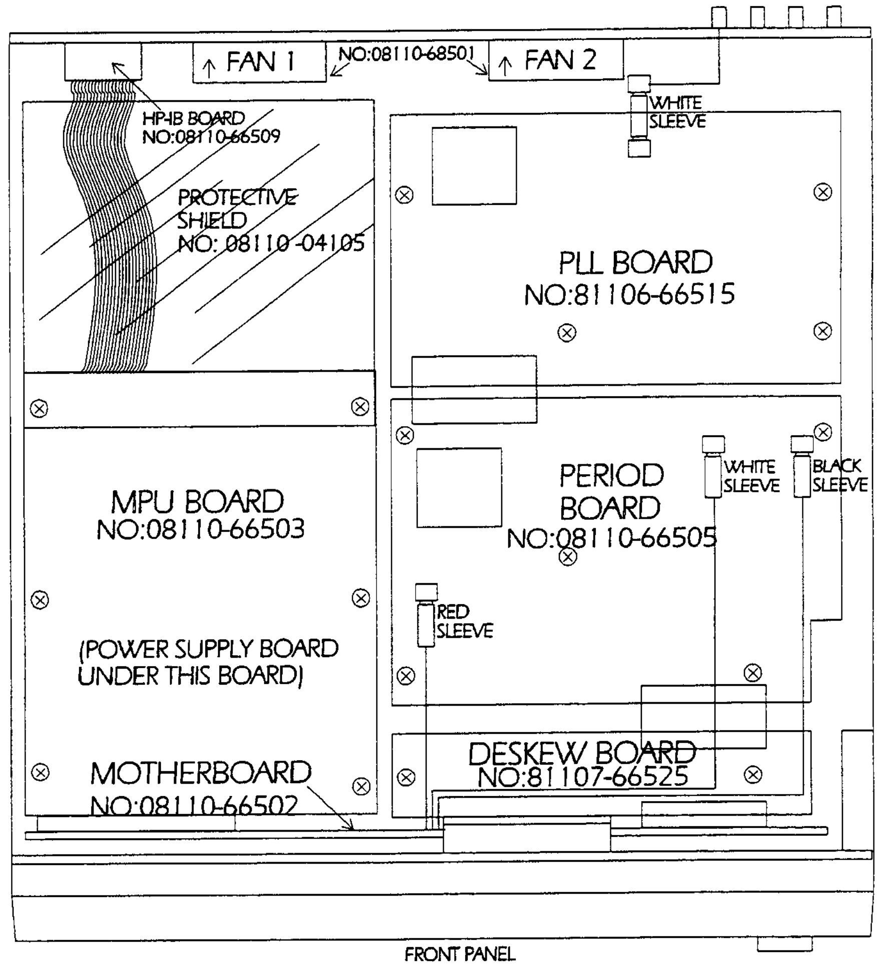


Figure 5-1. Top View of HP 8110A

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:

- 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.

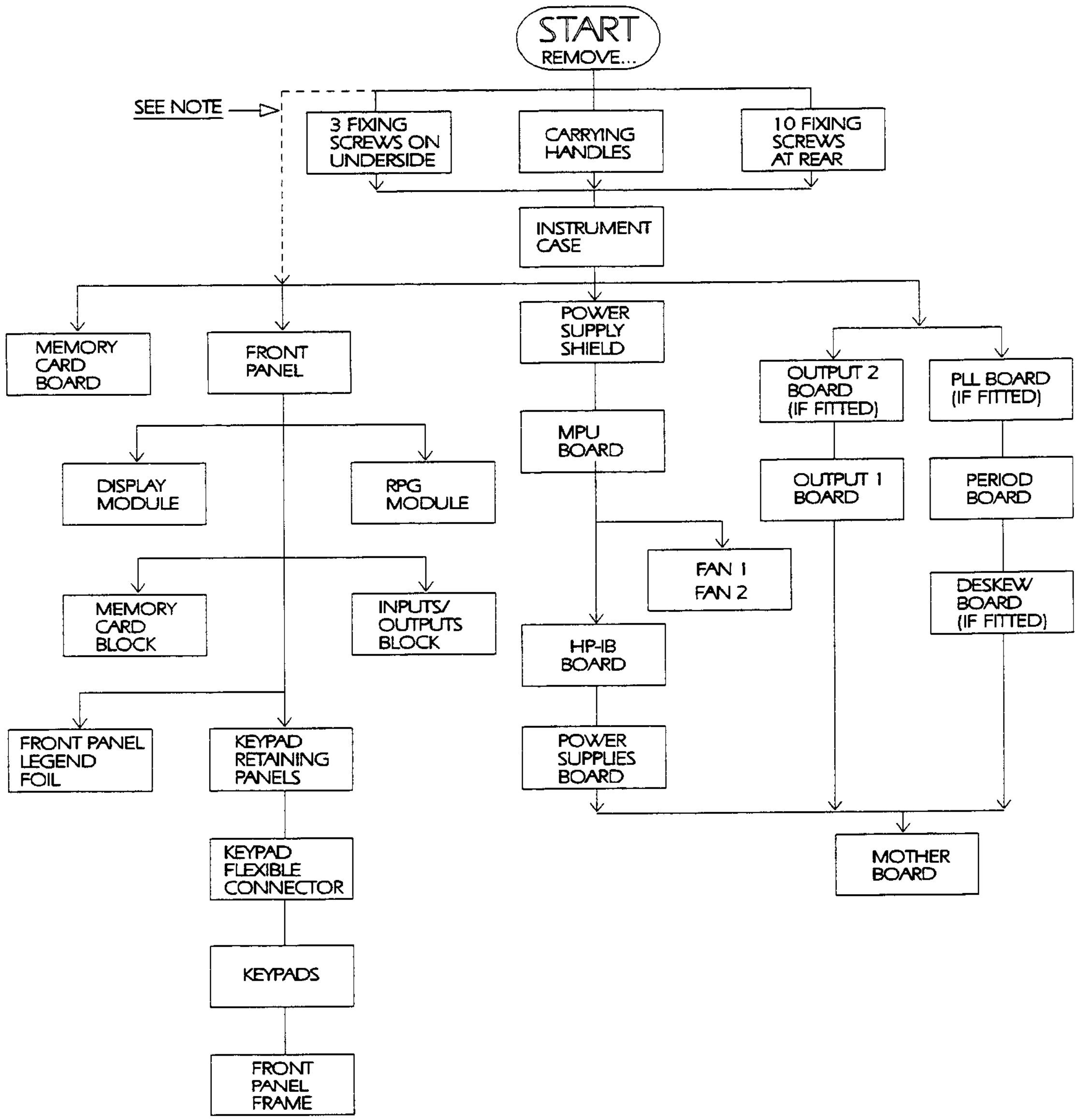


Figure 5-2. Flowchart Showing The Steps Needed for Replacement or Retrofit

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:

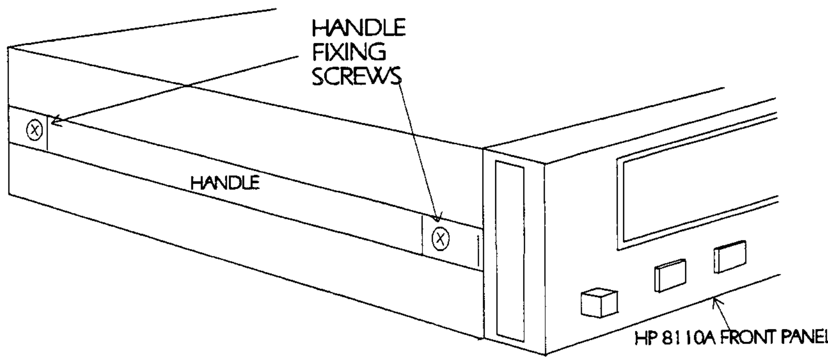


Figure 5-3. Removing the Carrying Handles

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

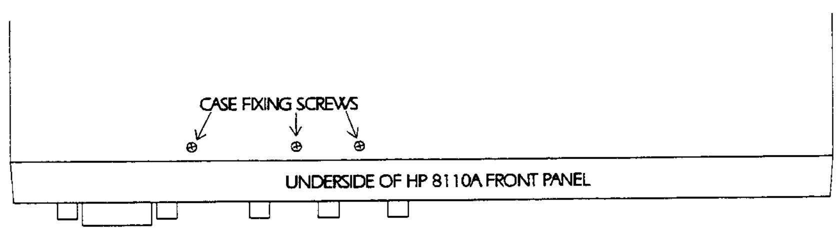


Figure 5-4.
Underside View of Front Panel Showing Case Fixing Screws

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

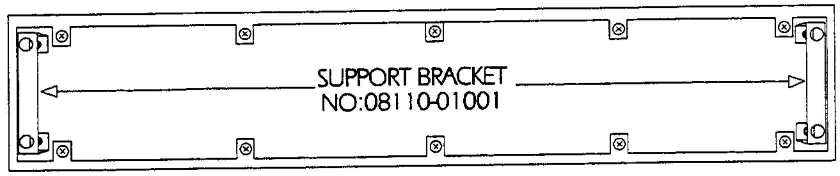


Figure 5-5. Rear Panel Showing Case Fixing Screws

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:

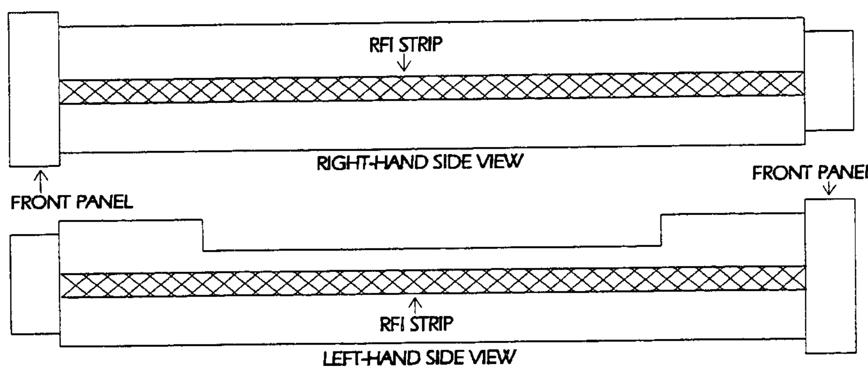


Figure 5-6. RFI Spring-Contacts fitted to the Sides of the Chassis

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.

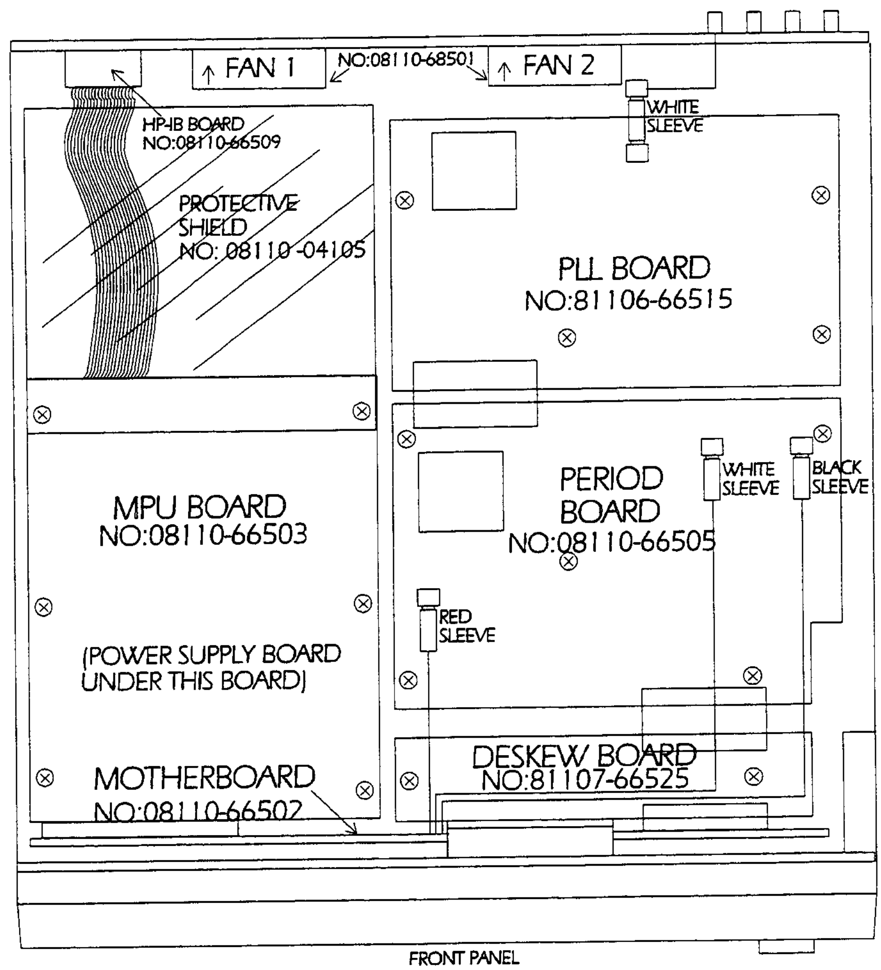


Figure 5-7. Top View of HP 8110A

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:

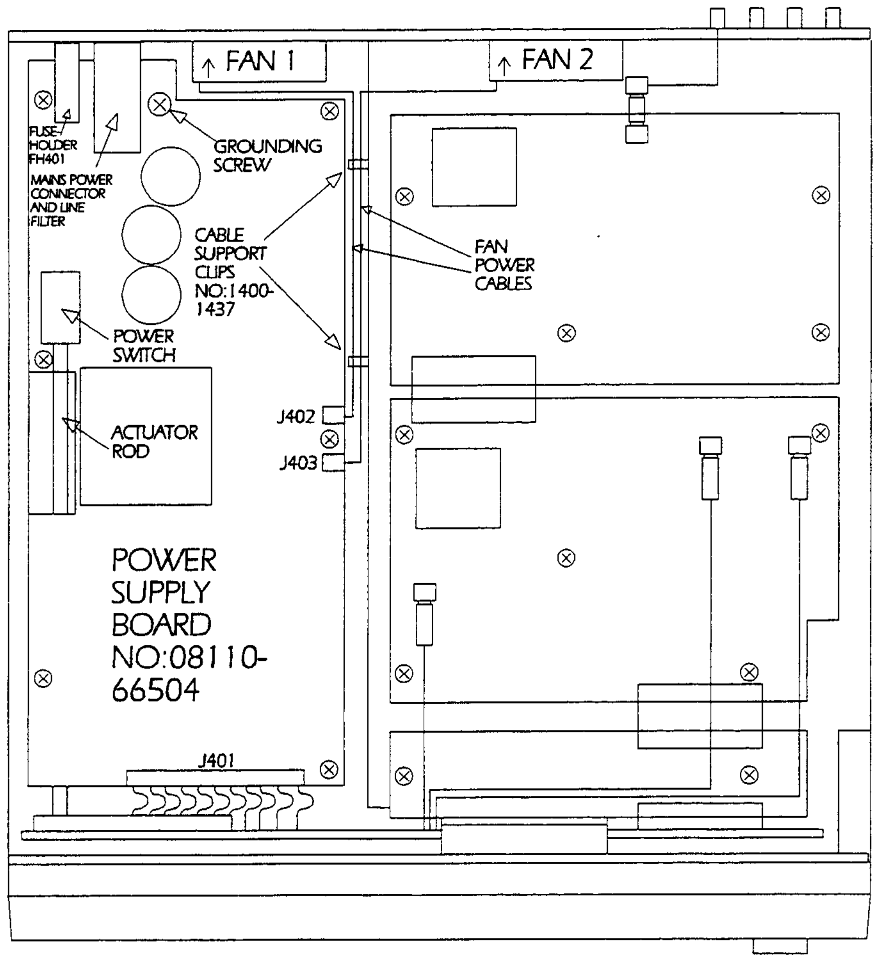


Figure 5-8. Top View of HP 8110A with MPU board Removed

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.

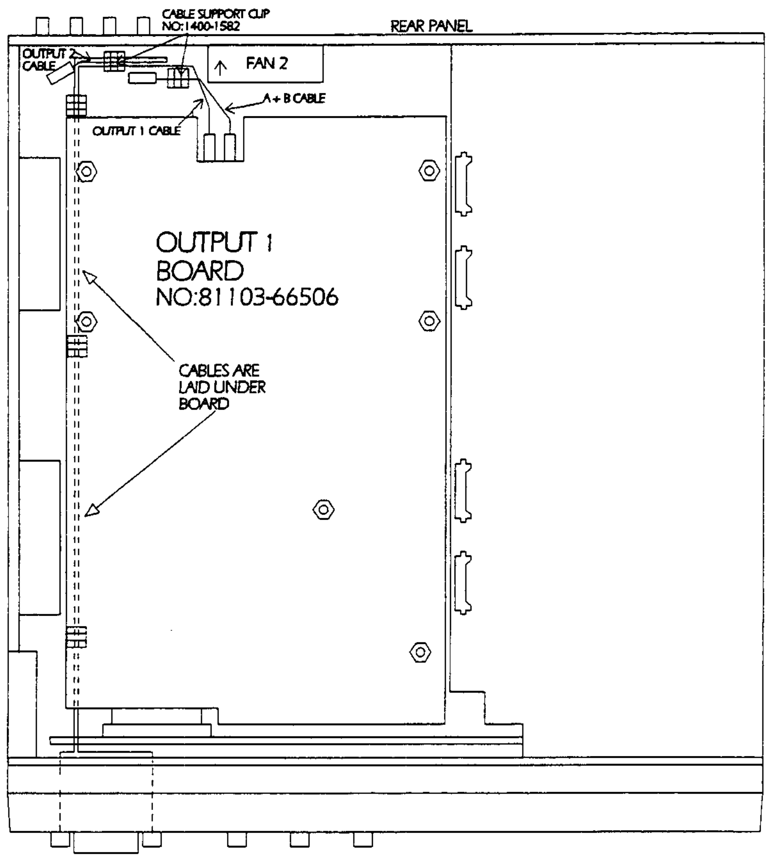


Figure 5-9. Underside View of HP 8110A showing Output 1 board

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

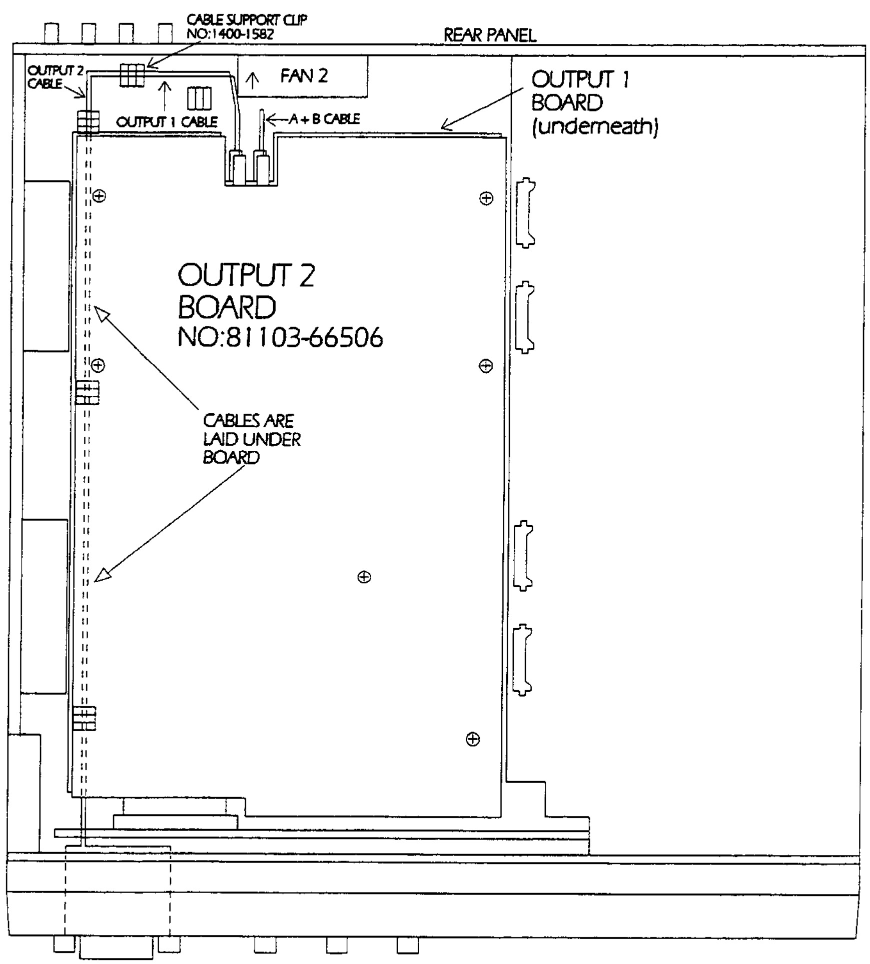


Figure 5-10. Underside View of HP 8110A showing Output 2 board

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

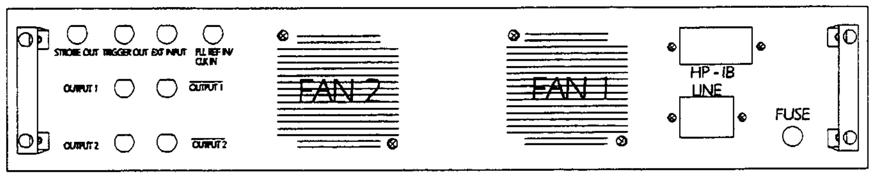


Figure 5-11. View of the Rear Panel Showing the Position of the Fans

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

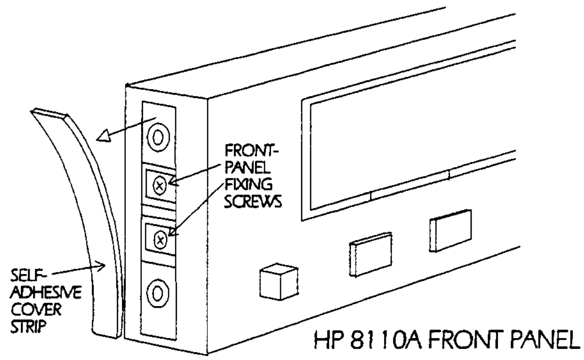


Figure 5-12. Front Panel Fixing Screws

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.

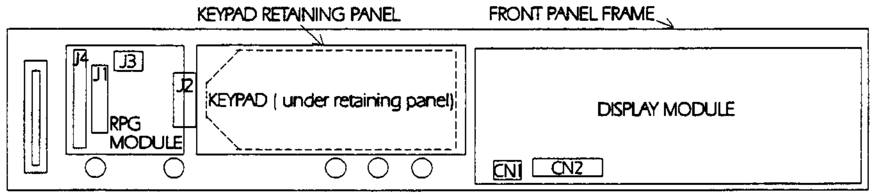


Figure 5-13. Front Panel Subassemblies

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.

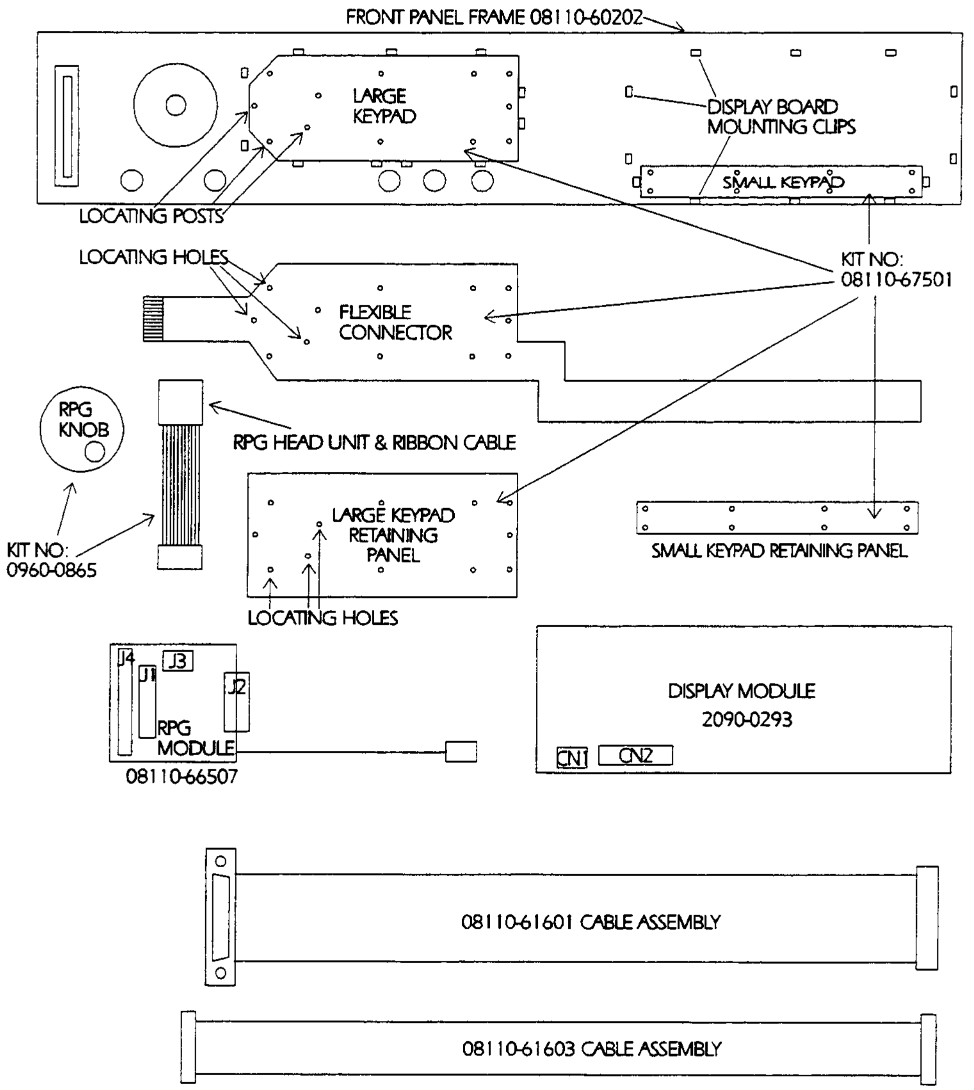


Figure 5-14. Front Panel Subassemblies

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

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

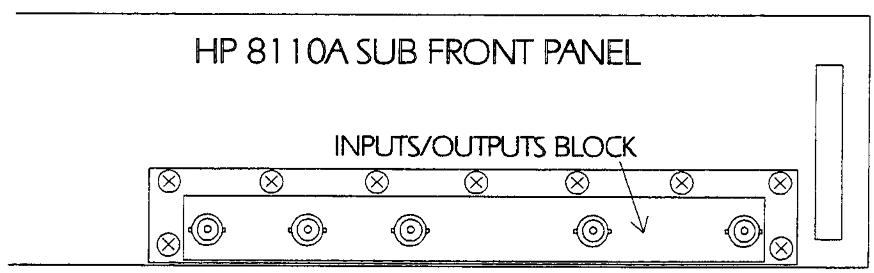


Figure 5-15. Inputs/Outputs Block Showing the Fixing Screws

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:

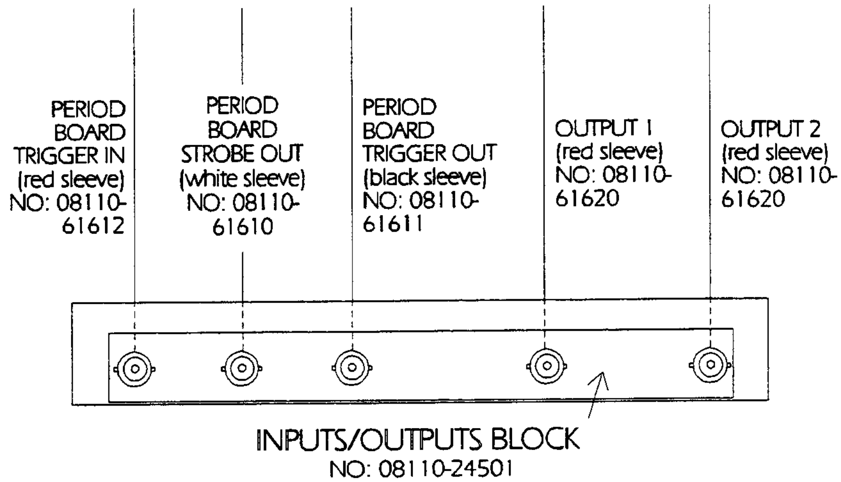


Figure 5-16. Inputs/Outputs Block Showing the Cables

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

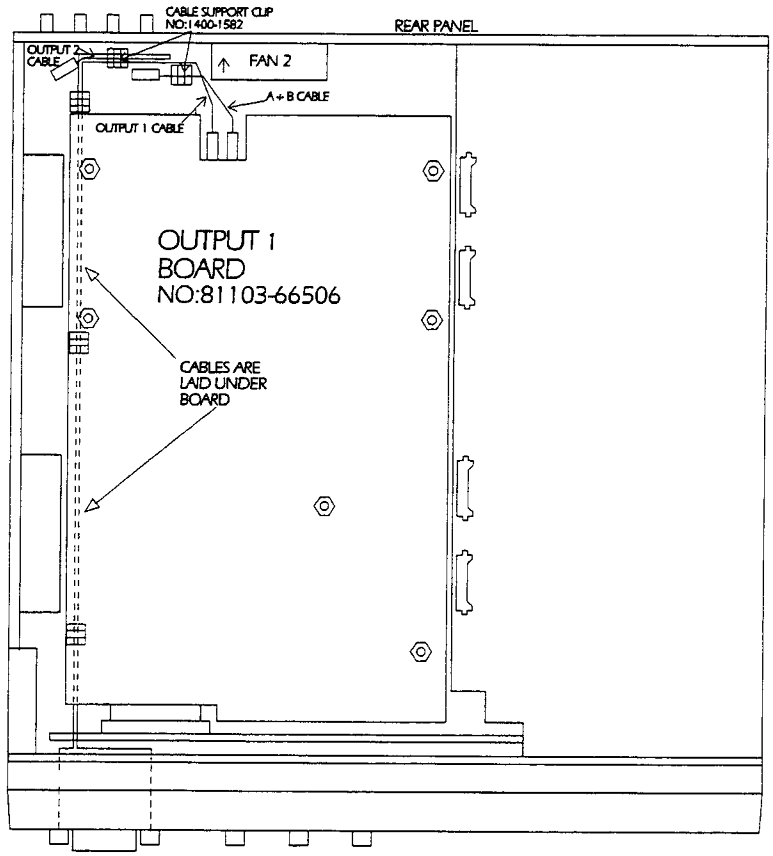


Figure 5-17. Output 1 board Only Fitted

- 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

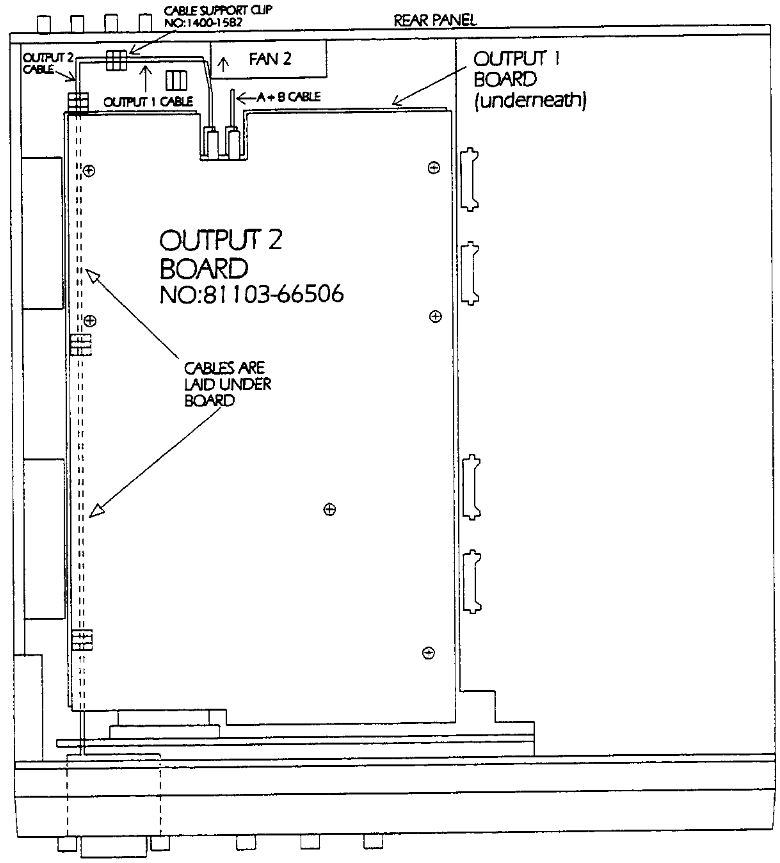


Figure 5-18. Output 1 and Output 2 boards fitted

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:

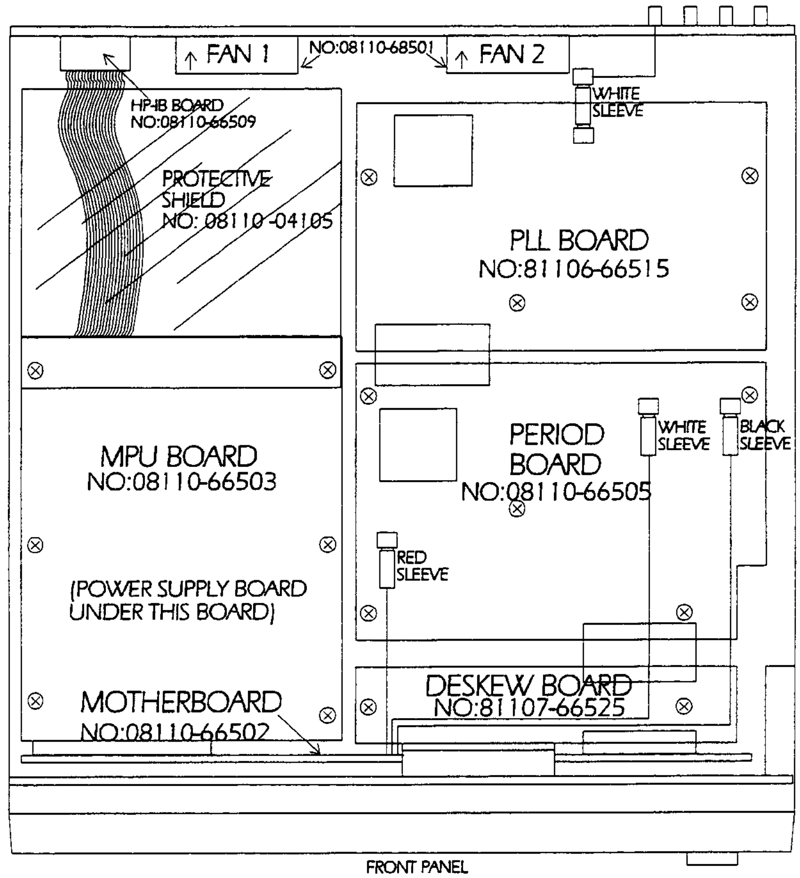


Figure 5-19. Position of Period board Cables

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)

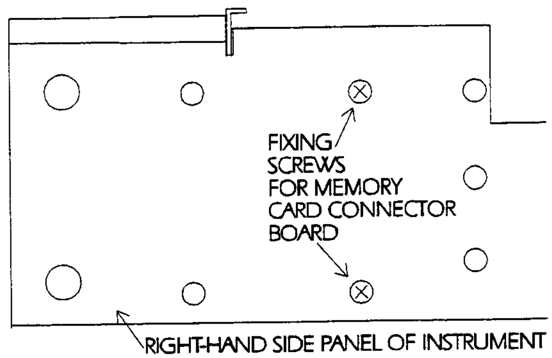


Figure 5-20. Memory Card Connector board Chassis Fixing Screws

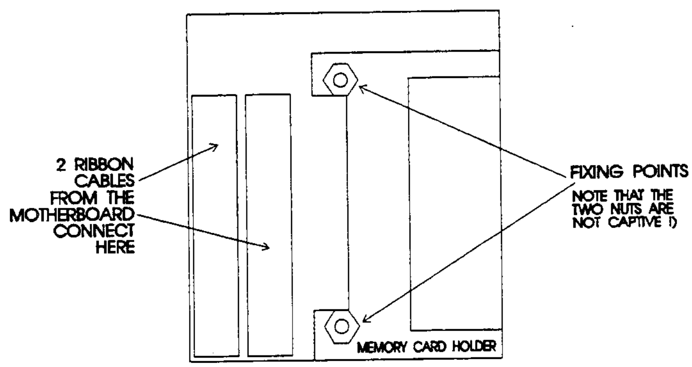


Figure 5-21. Memory Card Connector board Fixings

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

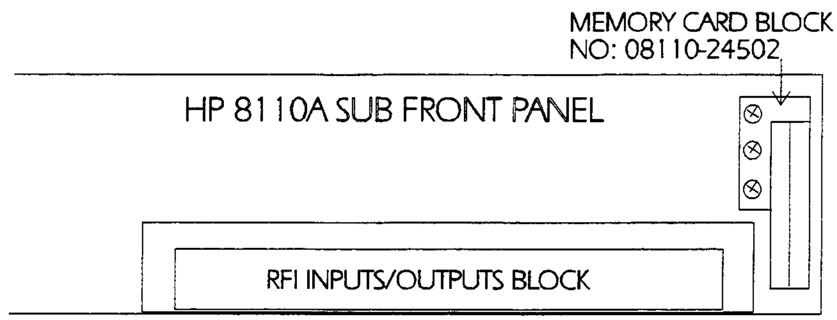


Figure 5-22. Memory Card Connector board Front Fixings

3. Remove 2 screws securing the Memory Card Block to the side of the chassis Figure 5-23 shows the location of these screws

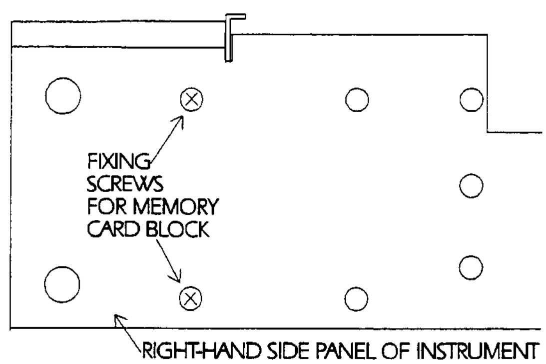


Figure 5-23. Memory Card Connector board Side Fixings

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)

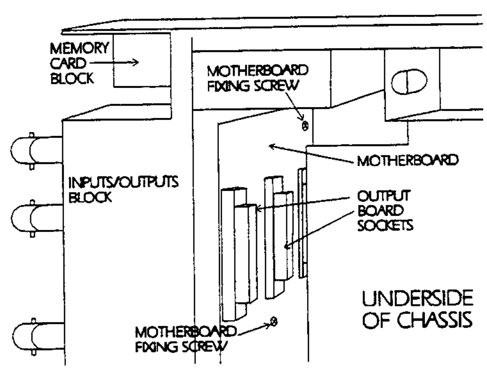


Figure 5-24.
Two of Three Motherboard Fixing Screws on Rear of Sub Front Panel

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)

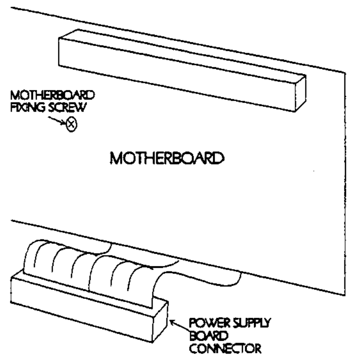


Figure 5-25.
One of Three Motherboard Fixing Screws on Rear of Sub Front Panel

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

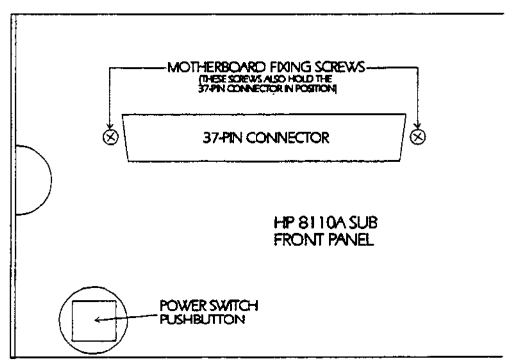


Figure 5-26.
Motherboard Fixing Screws on Front of Sub Front Panel

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.

6

Replaceable Parts

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	

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	ADD MNL OPERATIN	28480	8110A #0B2
MP381	8110A #1BP		0	MIL STD 45662A	28480	8110A #1BP
MP382	8110A #1CM		0	RACK MOUNT KIT	28480	8110A #1CM
MP383	8110A #1CN		0	HANDLE KIT	28480	8110A #1CN
MP384	8110A #1CP		0	RACK MOUNT & HAN	28480	8110A #1CP
MP385	8110A #1CR		0	RACK SLIDE KIT	28480	8110A #1CR
MP386	8110A #UEJ		0	CUSTOMER UPGRADE	28480	8110A #UEJ
MP387	8110A #UN2		0	Rearpanel-Option	28480	8110A #UN2
MP388	8110A #W32		0	3 YEAR CUST RET	28480	8110A #W32
MP389	8110A #W50		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	

7

Functional Description

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.

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.

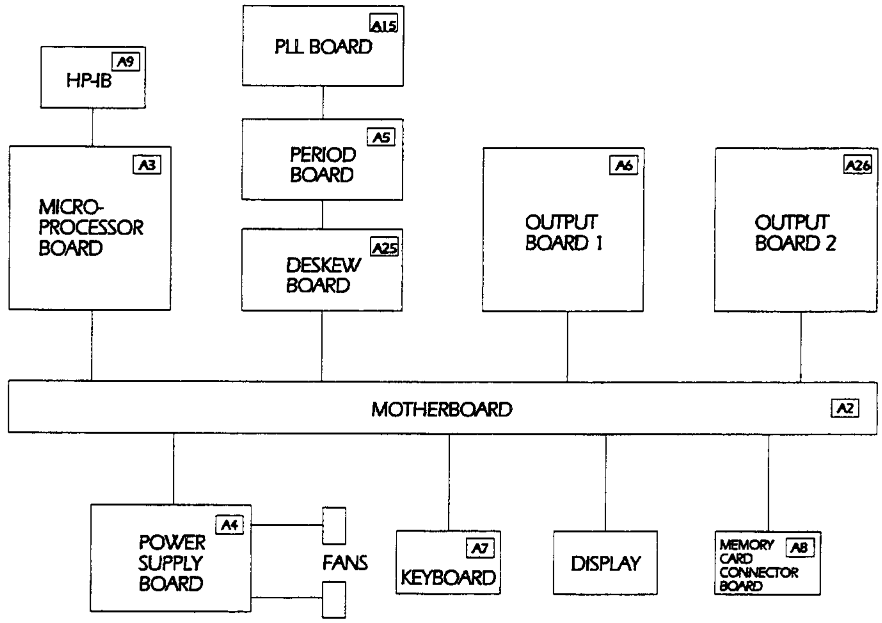


Figure 7-1. The HP 8110A Functional Units

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).

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.

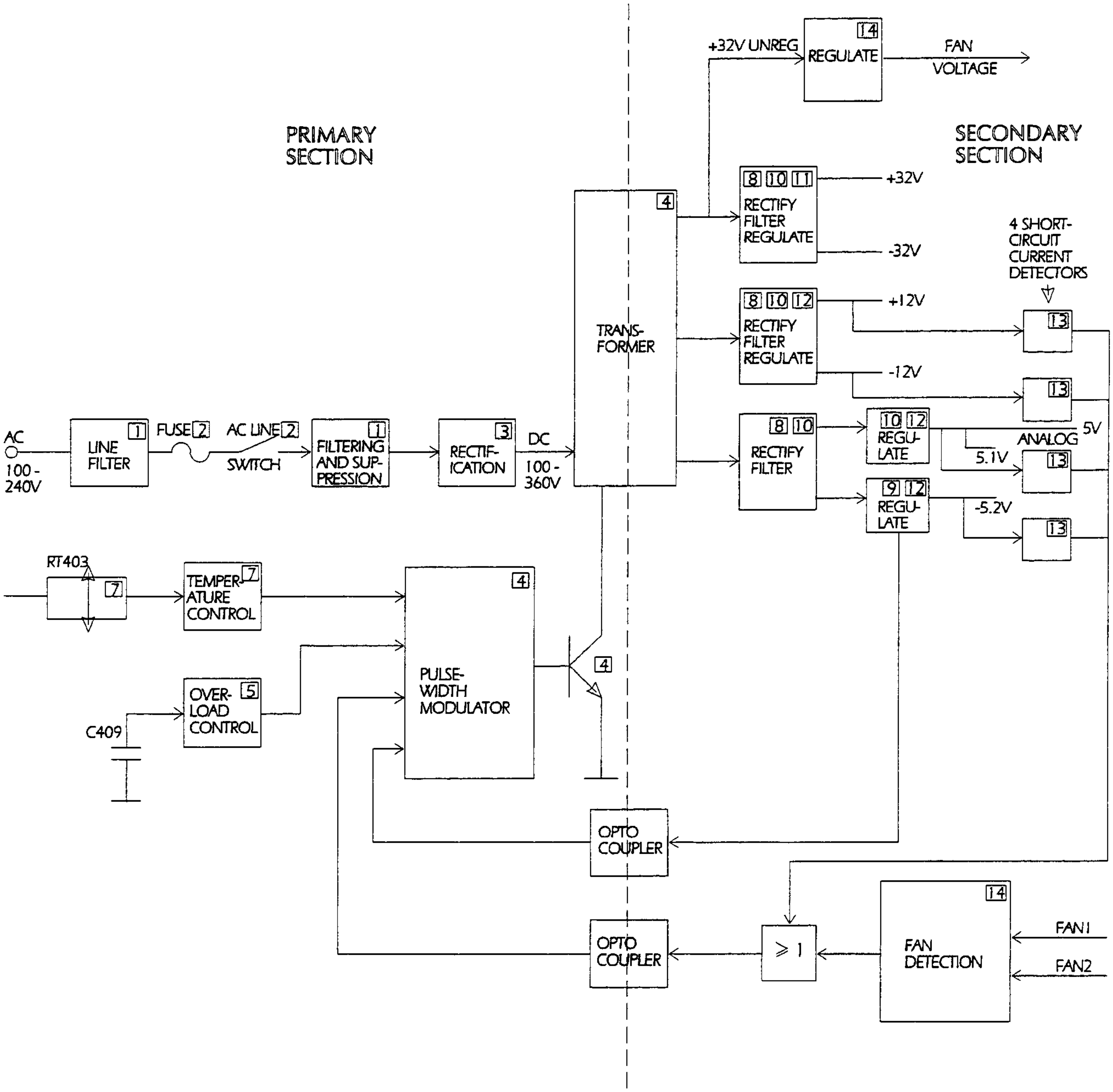


Figure 7-2. The Power Supply Functional Units

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- ±32V, ±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 **Np**, and one or more secondary windings **Nsek**. 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-biassed during 'off-time', resulting in half-wave rectification in the secondary section. The unregulated voltage is smoothed by electrolytic capacitors and filterd 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.

±32 V, ±12 V, +5.1 V Supplies: Linear Power Controlled

This section is on schematics 4A and 4B

The ±32 V, ±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 ±12 V supplies.

Table 7-1.
Power Supply and Components Cross-References

	DC Supply					
	+32V	-32V	+12V	-12V	+5.1V	-5.2V
Components:						
Rectifier	CR408	CR409	CR421	CR422	CR423	CR424
Blocking capacitor	CE433	CE435	CE460	CE464	CE468	CE475
					CE469	CE476
Filter 1	CE434	CE436	CE461	CE465	CE470	CE477
	L403	L405	L411	L413	CE471	
					L415	L417
	L404	L406	L412	L414	L416	L418
Series-pass element	Q406	Q407	Q411	Q412	Q413	n/a
Regulator	VR401	VR402	VR403	VR404	VR405	VR406
Filter 2	CE438	CE440	CE463	CE467	CE473	CE479
	C437	C439	C462	C468	C457	C458
	C441	C442	C454	C455	L419,L420	
	L407	L409	L423	L425	CE474	L421
	L408	L410	L424	L426	C456	L422
Overvoltage protect	n/a	n/a	XS403	XS404	XS405	XS406

Short-Circuit Current Protection

This section is on schematic 4B

±32 V is protected by primary overload protection.

Short-circuit current protection is provided for the +5.1 V, -5.2V and ±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 ≥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 transfered via the opto-coupler OP401 to the thyrister 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 transfered via the opto-coupler OP401 to the thyrister 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

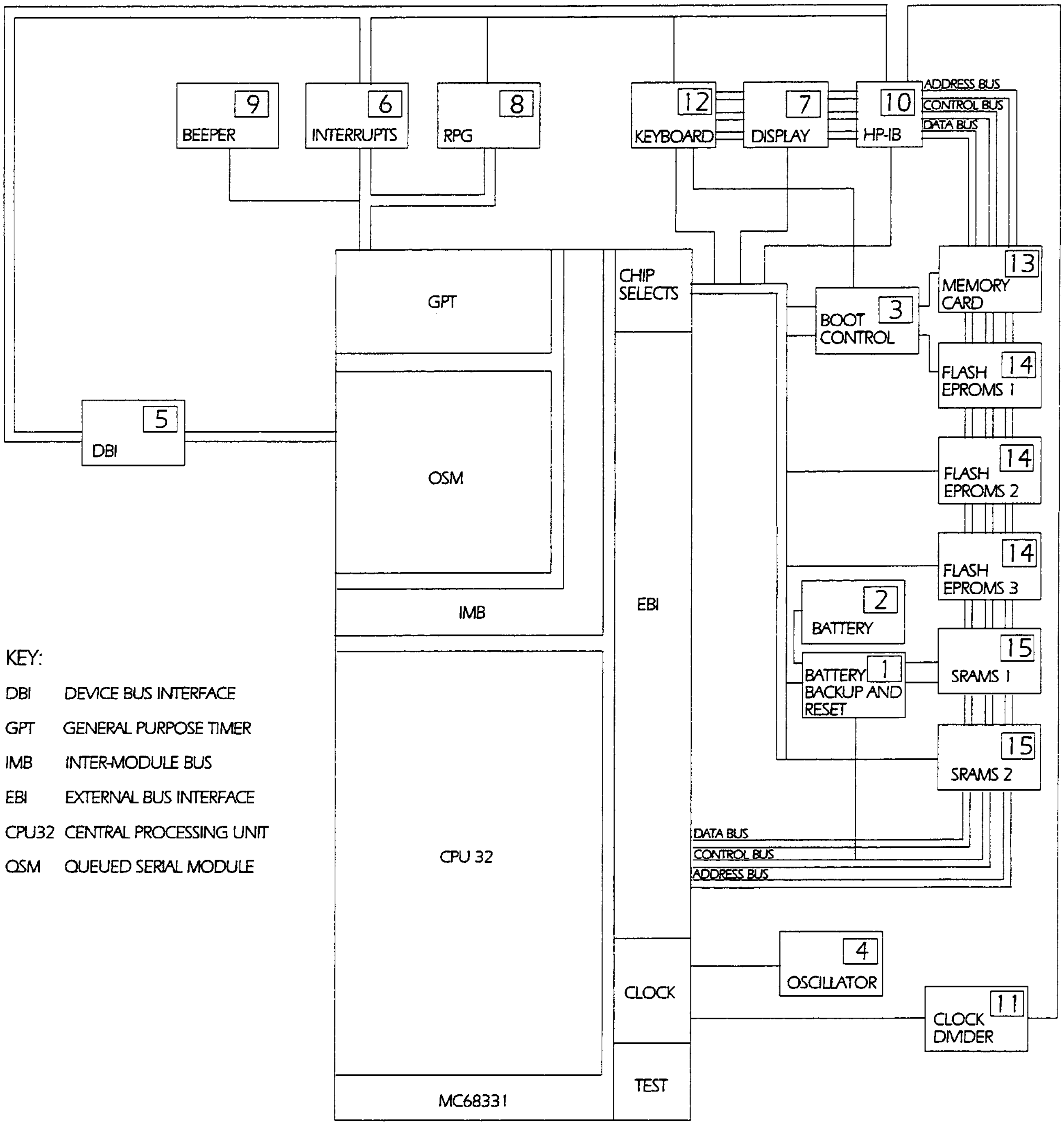


Figure 7-3. The Microprocessor Board Functional Units

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 2μs 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 invertor 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.

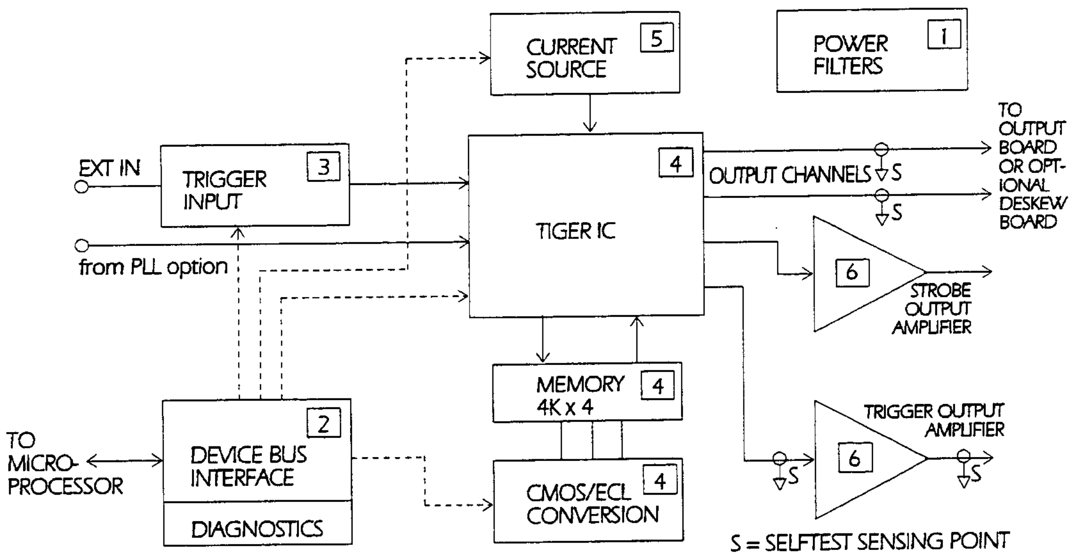


Figure 7-4. The Period Board Functional Units

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 50Ω or a high impedance in the region of 10kΩ, 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.

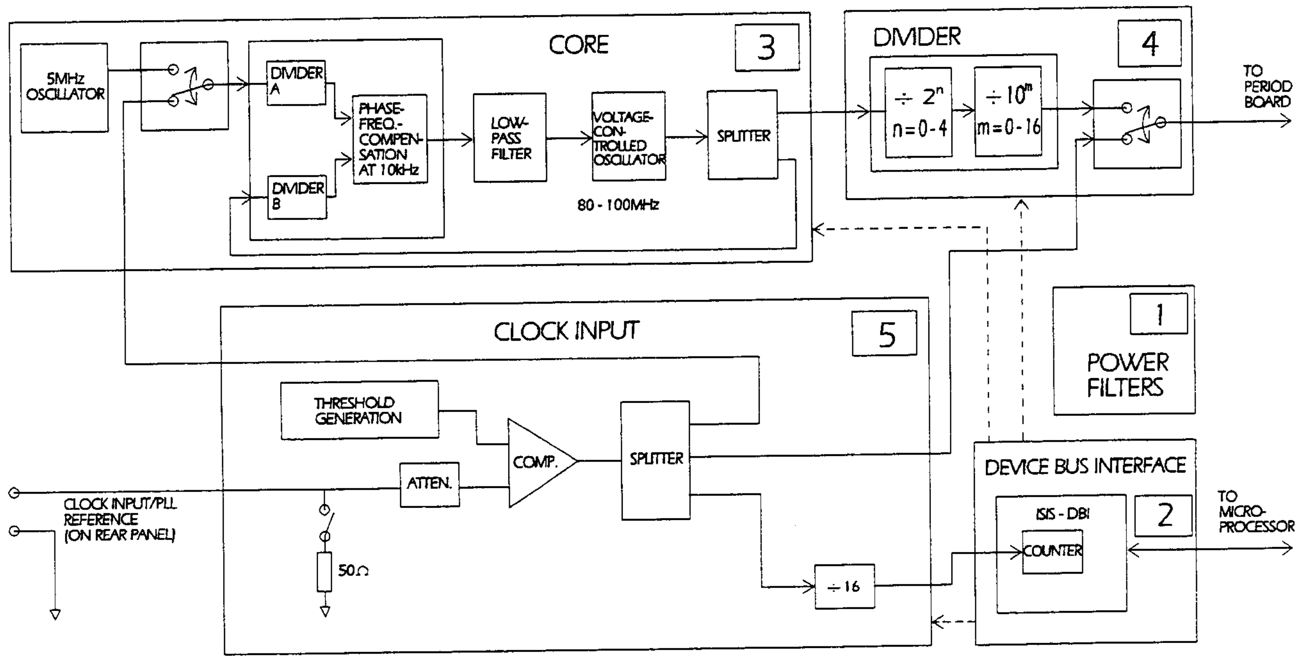


Figure 7-5. The PLL Board Functional Units

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 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.

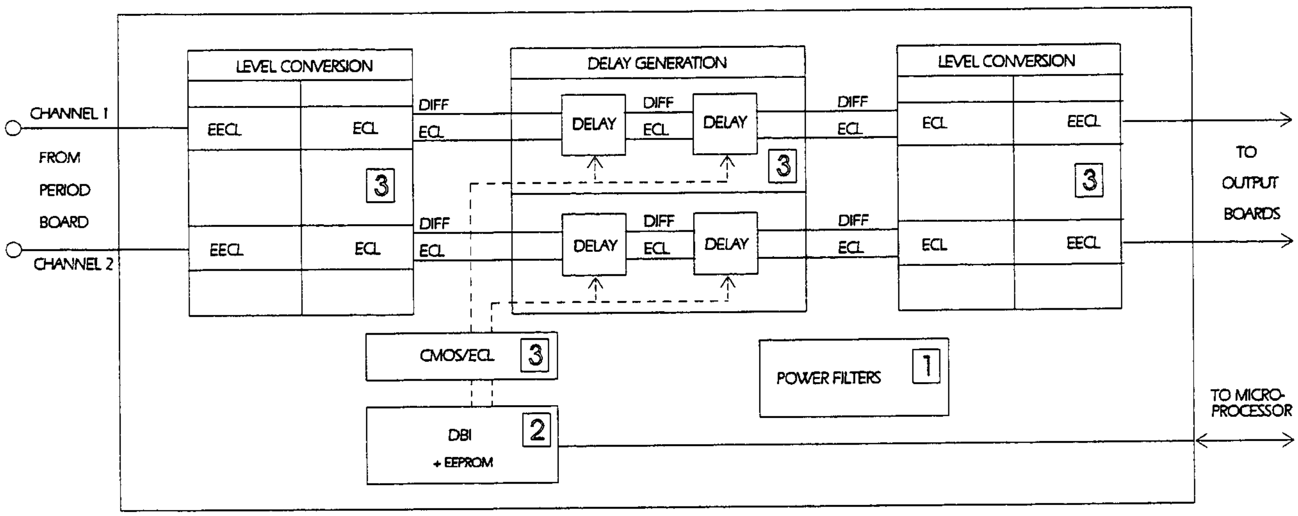


Figure 7-6. The Deskew Board Functional Units

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.

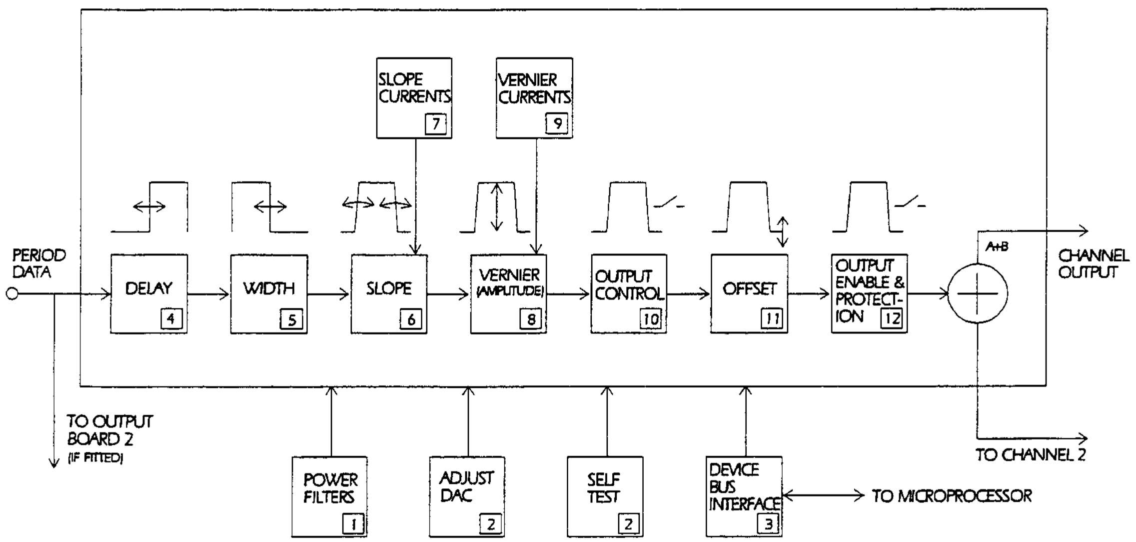


Figure 7-7. The Output Board Functional Units

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 50Ω 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

A

Component Level Information Package

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 seperately by ordering HP Part Number 08110-91031.

HEWLETT PACKARD

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 Serial Number	Manual Changes
ERRATA	
3233G00791	1
3501G01066	2
3501G01261	3
3501G02476	4
3501G02303	5

ERRATA

page 5-9, Disassemply 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.

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 cucle 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.

! 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

INDEX OF MANUAL CHANGE

MANUAL CHANGE	FRAME
ERRATA	
1	MP2,24,25, MP26,27
2	A2, MP1,6, MP60,61,7, MP214,4,215 MP30,31,356 MP357,13,40 MP41,42,400 MP401,402, MP403,404, MP405, W5
3	MP402,403, MP404,405
4	MP80
5	MP14,W1

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

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

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

MANUAL CHANGE 3

On Repl. Parts, Page 6-6 delete:

MP402,403	0363-0125	RFI STRP-FIN
MP404,405	8160-0694	RFI GASKET

MANUAL CHANGE 4

On Repl.Parts, Page 6-2 add:

MP80	0460-1243	TAPE-INDL .375IN

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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