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Errata

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Revision Date: January 1991

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.

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Agilent Technologies

Operating and Service Manual

HP 54118A Trigger

HEWLETT PACKARD

Serial Numbers:
This manual applies directly to instruments prefixed with serial number:
3051A

With the changes described within, this manual also applies to instruments with serial prefixed:
2808A

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Introducing The HP 54118A 1

Introduction

The Hewlett-Packard 54118A Trigger is an accessory which extends the trigger range of the HP 54120T Digitizing Oscilloscope to 18 GHz.

Key Features

The HP 54118A's key features include:

- True event triggering
- Continuous wave or pulsed RF input signals
- Input frequency range 500 MHz to 18 GHz
- Outputs a trigger pulse from 5 kHz to 20 kHz
- AC input coupling

Physical Description

The HP 54118A receives its power through an SMB cable which connects from the HP 54118A's rear panel to the four channel test set's rear panel.

There are three front panel controls: ARMING LEVEL, TRIGGER LEVEL, and HOLDOFF.

There are two APC 3.5 front panel connectors: INPUT and OUTPUT. There is one SMB rear panel connector, POWER SUPPLY +15 VDC, which supplies power to the HP 54118A.

Recommended Test Equipment

The test equipment recommended for maintaining the HP 54118A is listed in table 1-1. The three sections requiring test equipment are:

- Performance Tests (Chapter 4)
- Adjustments (Chapter 5)
- Service (Chapter 7, troubleshooting section only)

Table 1-1. Recommended Test Equipment

Instrument	Critical Specifications	Recommended Model	Use*
Oscilloscope	No Substitute	HP 54120T	P,A,T
Sweeper	0.5-18 GHz, -22 dBm to +4 dBm (50 mVp-p to 1 Vp-p)	HP 8341B	P
Oscilloscope	100 MHz, 50 Ω input	HP 54201A	P,T
Oscilloscope Probe	10:1, 10 M Ω	HP 10432A	T
Digital Multimeter	3% Accuracy	HP 3478A	A,T
Pulse Source	0 to 0.5 V positive pulse, 5 µs wide at 4 kHz	HP 8116A	T
Power Meter	0.5-18GHz	HP 436A	P
Power Sensor	-22 dBm to +4 dBm (50 mVp-p to 1 Vp-p)	HP 8485A	P
Directional Coupler	0.5 GHz-18GHz, directivity > 10 dB	Krytar Model 1851	P
50 Ω	Termination APC 3.5 connector	HP 909D	P,A
Accessory	**Critical Specifications**	**HP Part Number**	
Adapter	SMA (m) to BNC (f)	1250-1200	P
Adapter	APC 3.5 (m-m)	1250-1864	P
Adapter	APC 3.5 (f-f)	1250-1865	P
Coaxial Short	APC 3.5 (f)	1250-2127	P
Coaxial Cable	SMA connectors, 18 GHz, Qty 3	8120-4948	P
Coaxial Cable	SMA connectors, 18 GHz	54118-61607	P,A
BNC Tee	1 (m) end, 2 (f) ends	1250-0781	T
BNC Cable		10503A	T
Resistors	180 Ω, ± 3%, 0.5 watt, Qty 2	N/A	T
Alligator Clips	Qty 2	N/A	T
Clip Leads	Connect from BNC (f) to wire	N/A	T

P = Performance Tests A = Adjustments T = Troubleshooting

Installation 2

Accessories Supplied

The following accessories are supplied with the HP 54118A. The quantity is one unless otherwise specified.

- Connector Savers HP 5061-5311 Qty 2
- SMA shorts HP 0960-0055 Qty 2
- External input cable HP 54118-61608
- External output cable HP 54118-61607
- External SMB power cable HP 54111-61609
- Operating and Service Manual HP 54118-90902
- Power splitter HP 11667B *
- 6 dB attenuator HP 33340C opt 006 *
- 3 cm semi-rigid L cable HP 54007-61602 *
- 6 cm semi-rigid L cable HP 54007-61601 *

* Item is deleted if option 090 is ordered.

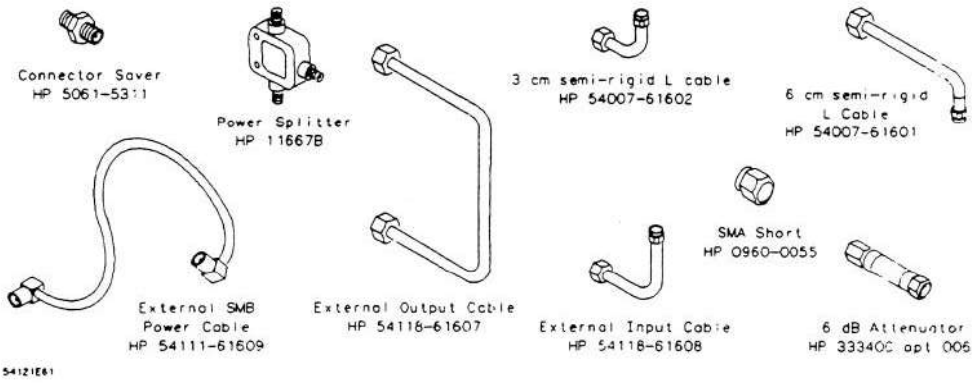


Figure 2-1. Accessories Supplied

Options Available

The following options are available for the HP 54118A. The quantity is one unless otherwise stated.

- Rack mount kit - Option 908
- Additional copy of Operating and Service Manual - Option 910
- Delete the following items - Option 090
  Power splitter HP 11667B
  6 dB attenuator HP 33340C opt 006
  3 cm semi-rigid L cable HP 54007-61602
  6 cm semi-rigid L cable HP 54007-61601

Accessories Available

The following accessories are available for the HP 54118A.

- Antistatic mat and wrist strap HP 9300-1346
- Microwave Amplifier 2-20 GHz HP 8149B
- RF Amplifier 0.1-1.3 GHz HP 8447F
- Step Attenuator HP 8494B opt 002
- Step Attenuator HP 8495B opt 002
- Programmable Attenuator HP 33320H
- Programmable Attenuator HP 33321H
- Series Fixed Attenuators HP 33340C
- High Frequency Probe HP 54006A
- Power Splitter HP 11667B
- Accessory Kit HP 54007A
- 22 ns Delay Line HP 54008A

Antistatic Procedures

The HP 54118A is sensitive to electrostatic damage (ESD). When handling the HP 54118A, use an antistatic mat and wrist strap. These are both supplied with the HP 54120T Digitizing Oscilloscope.

The HP 54118A is connected to earth ground through the rear panel external SMB power cable or the front panel trigger cabling, which connects the HP 54118A to the HP 54121A Four Channel Test Set. To avoid possible ESD damage to the instrument when it is not connected to the HP 54121A, connect the HP 54118A's rear panel ground lug to the antistatic mat. Ensure the antistatic mat is connected to earth ground.

Connector Care

APC 3.5 and SMA connectors are precision connectors and wear out with use. The failure to obtain repeatable measurement results or optimum performance may be caused by worn out or damaged connectors. Mechanically and visually check all connectors on a periodic basis. Use the connector savers, APC 3.5 f-f adapters, on all instrument connectors and on expensive hardware. It is less expensive to throw away a damaged or worn out connector saver than to throw away expensive microwave hardware.

Torque all SMA to SMA, or SMA to APC 3.5 connectors to 8 in/lbs. Torque all APC 3.5 to APC 3.5 connectors to 5 in/lbs.

For a more detailed explanation on connector care refer to the HP 54007A Accessory Kit Operating and Service Manual. The information is also repeated in the HP 54120T Digitizing Oscilloscope Operating Manual appendix B, and Service Manual appendix A.

Connecting the HP 54118A

Use the following steps to connect the HP 54118A to the four channel test set.

CAUTION

Use a properly grounded antistatic wrist strap and mat.

1. Place HP 54118A either on top or underneath the four channel test set.

2. Connect external SMB power cable from the HP 54118A's rear panel connector POWER SUPPLY +15 VDC to the four channel test set's rear panel connector J2 TRIGGER POWER +15 V. Refer to figure 2-1.

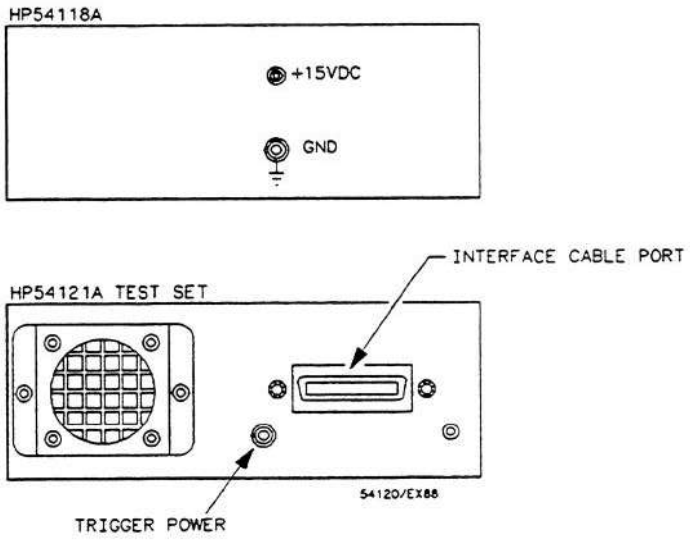


Figure 2-2. External SMB Power Connections

3. Ensure all front panel connectors on the HP 54118A and four channel test set have connector savers installed (APC 3.5 f-f adapters).

4. Connect external output cable from the HP 54118A's OUTPUT connector to the four channel test set's TRIG input. Refer to figure 2-2.

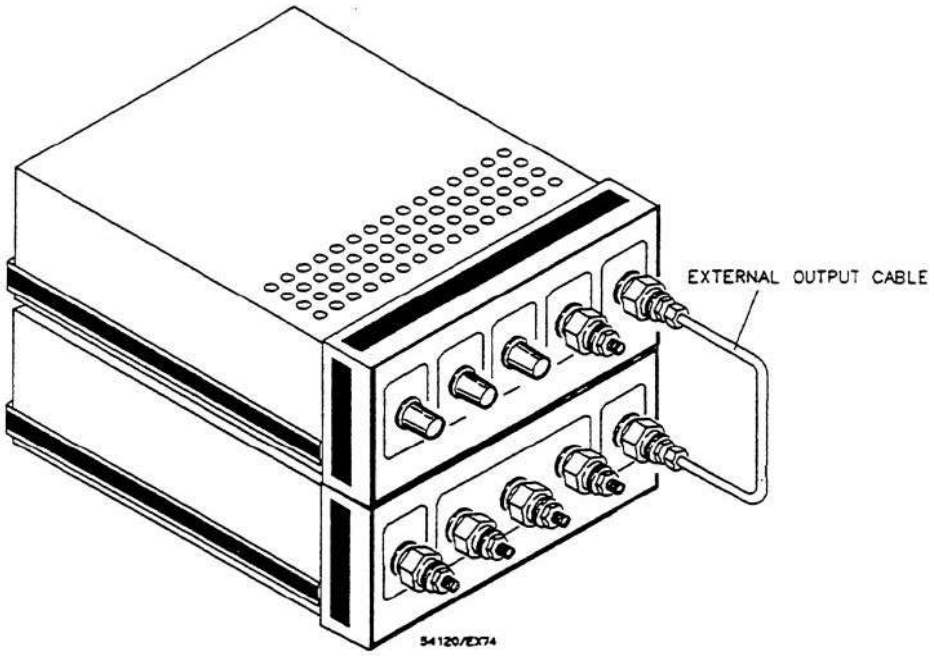


Figure 2-3. Connecting External Output Cable

Rack Mounting

Figure 2-3 illustrates the recommended rack mounting method for connecting the HP 54118A and four channel test set. The HP 54118A may be placed either on top or underneath the four channel test set. The cables needed are supplied accessories with the HP 54118A. Option 908 (HP part number 5061-9672) supples the materials needed for rack mounting the two instruments. The semi-rigid cables supplied with the HP 54118A require that the two instruments are spaced 7/16 inch (1.11 cm) apart. This spacing can be achieved by varying the placement of the instruments in the rack.

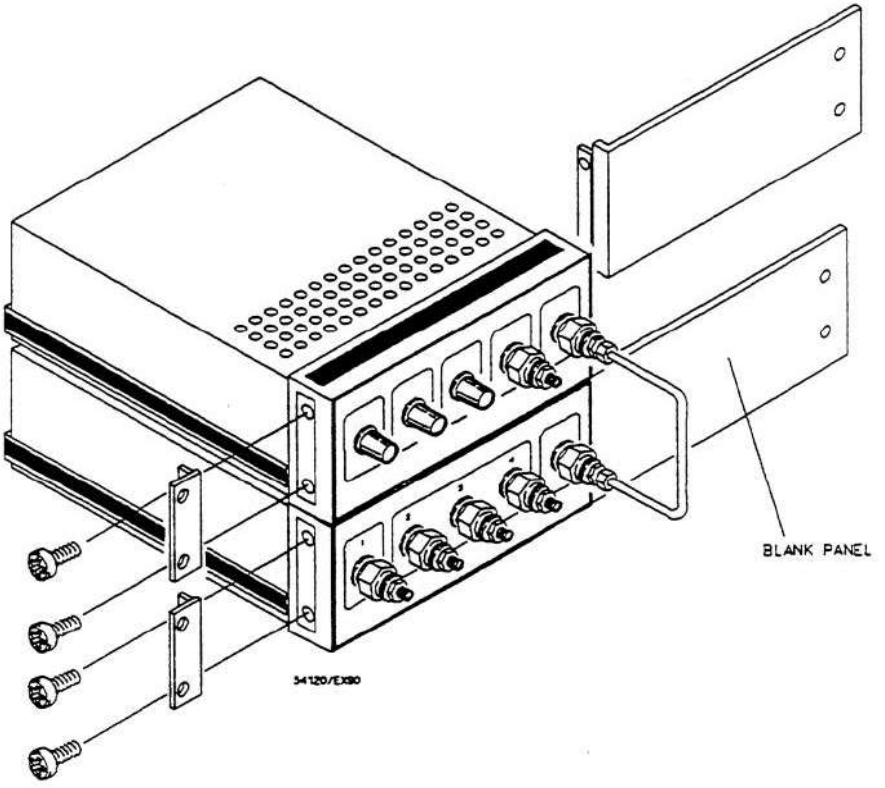


Figure 2-4. Recommended Rack Mount

Figure 2-4 illustrates another rack mount method. The rack mount hardware necessary for this method may be ordered from Hewlett Packard. The semi-rigid cables, which connect the two instruments together, are not supplied.

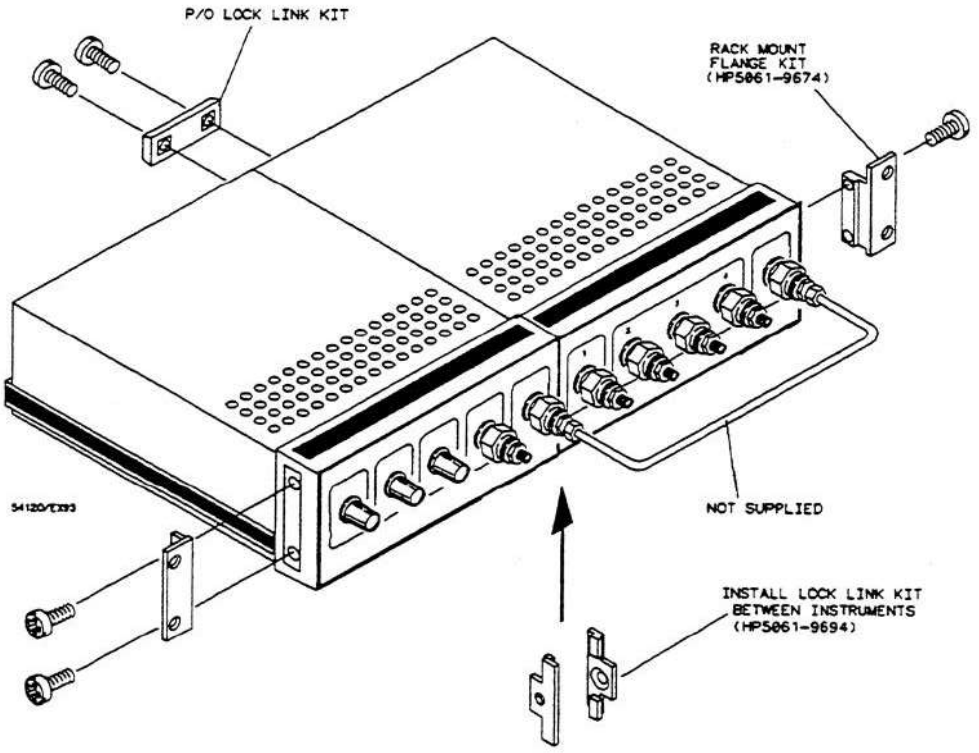


Figure 2-5. Side by Side Rack Mount

Operation 3

Introduction

The HP 54120T 20 GHz Digitizing Oscilloscope triggers on continuous wave signals up to 500 MHz, or higher bandwidth pulses with less than 500 MHz repetition rates. The HP 54118A Trigger extends the HP 54120T's triggering bandwidth by generating low repetition rate pulses which are time correlated to similar positions on the input signal's waveform. Refer to figure 3-1. The HP 54118A's output pulse rate is fairly constant, but it is not an exact subharmonic of the input frequency. This illustrates the HP 54118A Trigger is different from countdown trigger methods.

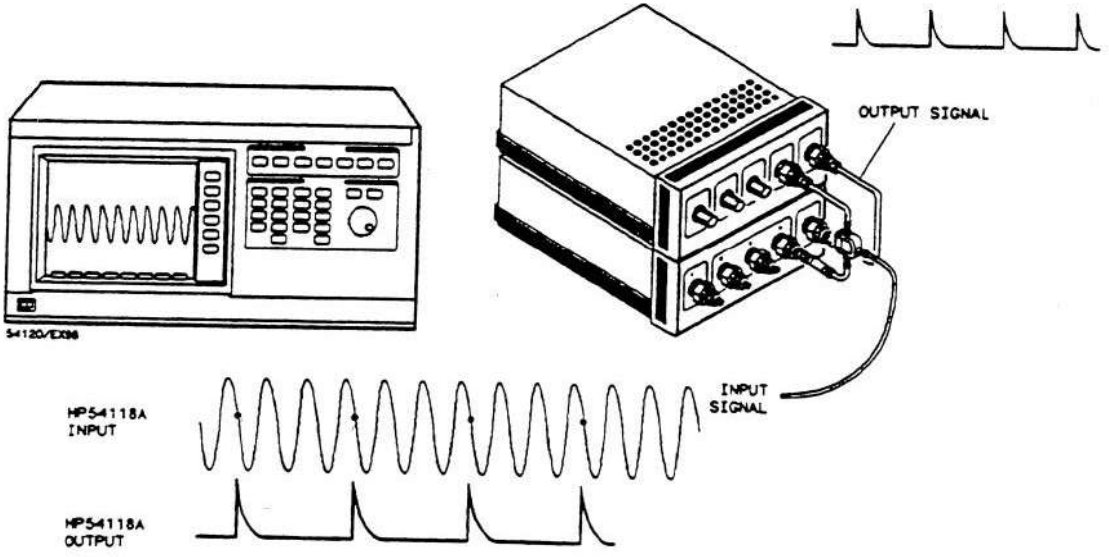


Figure 3-1. How HP 54118A Triggers the HP 54120T

Functional Description

The HP 54118A Trigger input frequency range is 500 MHz to 18 GHz. The trigger output pulses occur at a much slower rate, 5 kHz to 20 kHz. The output pulse rate is determined by the HP 54118A's front panel HOLDOFF setting. The HP 54118A's simplified operation can be described by the following six step sequence. Refer to figure 3-2.

1. The 180° phase splitter continuously supplies a copy (Vin) and a 180° phase shifted copy ($\overline{\text{Vin}}$) of the input signal to the trigger assembly.

2. The bias control assembly arms the trigger assembly.

3. The trigger assembly triggers and outputs a pulse.

4. The bias control assembly senses the trigger event and resets the trigger assembly.

5. The trigger assembly is kept in a reset condition until HOLFOFF ends.

6. Repeat steps 2-5.

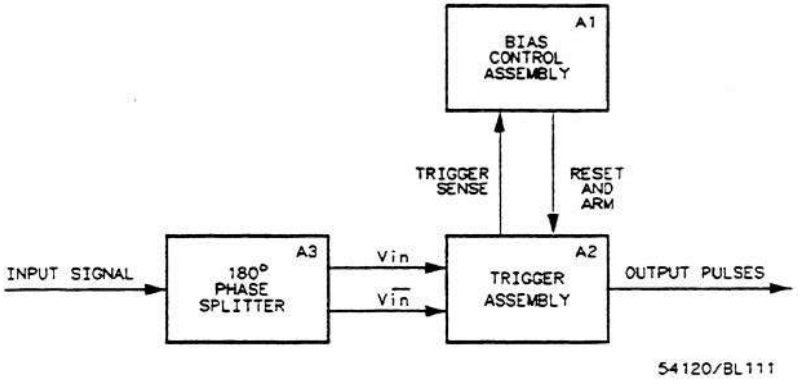


Figure 3-2. Simplified Block Diagram

Detailed Operation

Refer to figure 3-3. The input signal is applied to a 180° phase splitter. The phase splitter's output is a copy (Vin) and a 180° phase shifted copy ($\overline{Vin}$) of the input signal. Vin and $\overline{Vin}$ are each terminated through 50 Ω into a tunnel diode. Vin produces a signal current (Iin) in the arming tunnel diode. $\overline{Vin}$ produces a signal current ($\overline{Iin}$) in the trigger tunnel diode.

The bias control assembly supplies a variable dc trigger bias current to the trigger tunnel diode. After the trigger bias current settles to its final value, the bias control assembly supplies a variable arming bias current to the arming tunnel diode. When the arming bias current is enabled, it increases very slowly with respect to one period of the input trigger signal.

The arming bias current continues to increase until the total current (Iin + arming bias current) reaches the tunnel diode's switching (firing) threshold. When the arming tunnel diode fires, it produces a very fast rising voltage step across the arming tunnel diode.

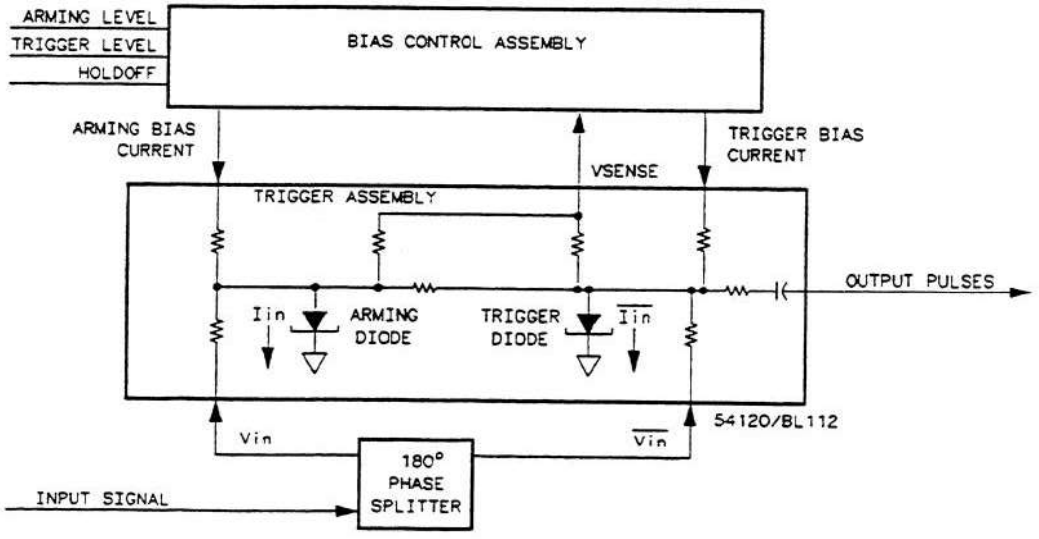


Figure 3-3. HP 5411&A's Internal Functioning

This voltage step produces a current step in the trigger tunnel diode. Recall that the arming bias current was increasing very slowly with respect to one period of the input trigger signal. This ensures that the arming tunnel diode always fires on a positive peak of the signal current Iin, and a negative peak of the signal current $\overline{\text{Iin}}$. Refer to figure 3-4.

The current step produced in the trigger tunnel diode causes the total current ($\overline{\text{Iin}}$ + trigger bias current + current step) to reach the trigger tunnel diode's firing threshold on the next rising edge of $\overline{\text{Iin}}$. The trigger tunnel diode fires producing an output pulse (200 mV, 5 ns wide, with a risetime of approximately 30 ps).

The bias control assembly senses (Vsense) when either of the tunnel diodes fire. The bias control assembly then resets both tunnel diodes by removing the bias currents.

In addition to disabling the bias currents, the bias control assembly also starts a variable holdoff timer. When the holdoff timer times out, the bias control assembly rearms the trigger assembly by enabling the bias currents. The period of the holdoff timer directly affects the HP 54118A's output pulse rate.

Continuous Wave Signal

Continuous wave operation is illustrated in Figure 3-4. Vin is a copy of the input signal and is applied to the arming tunnel diode. $\overline{\text{Vin}}$ is a 180° phase shifted copy of the input signal and is applied to the trigger tunnel diode.

ARMING LEVEL sets the arming tunnel diode's switching threshold (arming level = switching threshold - arming bias current). For continuous wave signals, it is set to the detent CW position. This ensures that without an input signal applied to the HP 54118A, the arming tunnel diode will switch (fire).

TRIGGER LEVEL sets the trigger tunnel diode's switching threshold (trigger level = switching threshold - trigger bias current - current step). Less bias is required for signals with a larger peak-to-peak amplitude. Notice trigger level is brought to a stable operating point before arming level is enabled.

HOLDOFF adjusts the period of the holdoff timer. Adjusting holdoff for continuous wave signals changes the HP 54118A's output pulse rate.

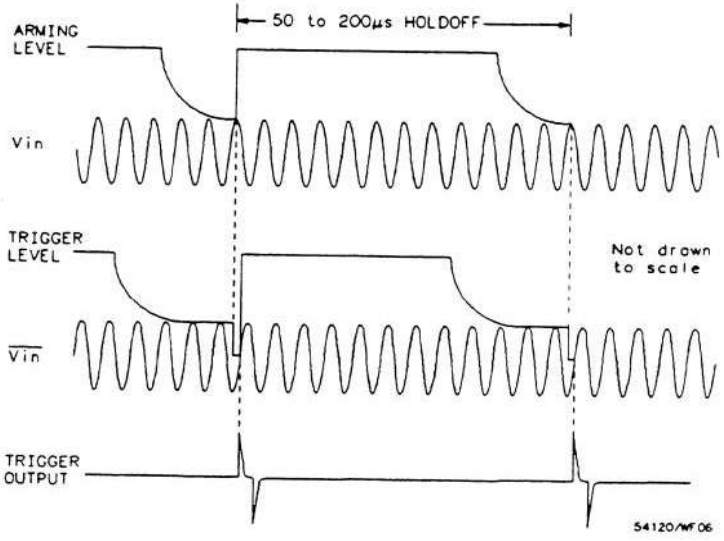


Figure 3-4. Continuous Wave Example

Equipment Setup

The following steps describe how to trigger on continuous wave signals.

CAUTION

Use a properly grounded antistatic wrist strap and mat to avoid electrostatic damage (ESD) to the instruments.

1. Set HP 54118A's TRIGGER LEVEL, ARMING LEVEL and HOLDOFF fully counterclockwise. ARMING LEVEL should be in the detent CW (continuous wave) position.

2. If the trigger signal is also the signal you wish to view, proceed to the next paragraph Viewing the Trigger Signal.
   Otherwise, connect trigger source to the HP 54118A INPUT.
   Example: 10 GHz sine wave, approximately 500 mVp-p (-2 dBm)

3. Connect signal source to HP 54121A channel 4 input.
   Example: 10 GHz sine wave, approximately 250 mVp-p (-8 dBm)

4. Go to Displaying the Signal paragraph.

Viewing the Trigger Signal

To view the trigger signal, connect the equipment as shown in figure 3-5 and follow steps 1-2. If you are using a delay line to view the trigger event, read the "Delaying the Signal paragraph in the Pulsed RF portion of this chapter.

Note

The 6 dB attenuator is used to best match the trigger signal to the sensitivity and dynamic range of the displayed channel. If you do not want to use the 6 dB pad, remove the 3 cm semi-rigid L cable and the 6 dB pad. Replace these parts with a 6 cm semi-rigid L cable.

1. Connect external trigger source to power splitter's input.
   Example signal: 10 GHz sine wave, approximately 1 Vp-p (4 dBm)

2. The power splitter has an attenuation of 6 dB. When using the power splitter and the 6 dB attenuator, set the HP 54120T's channel attenuation to 3.98. If you are using only the power splitter, set the channel attenuation to 2.000.

Note

The trigger signal was connected to the oscilloscope's channel 4 input because the supplied accessories provide the necessary cabling. You may use other cabling techniques to view a signal on any of the other oscilloscope channel inputs.

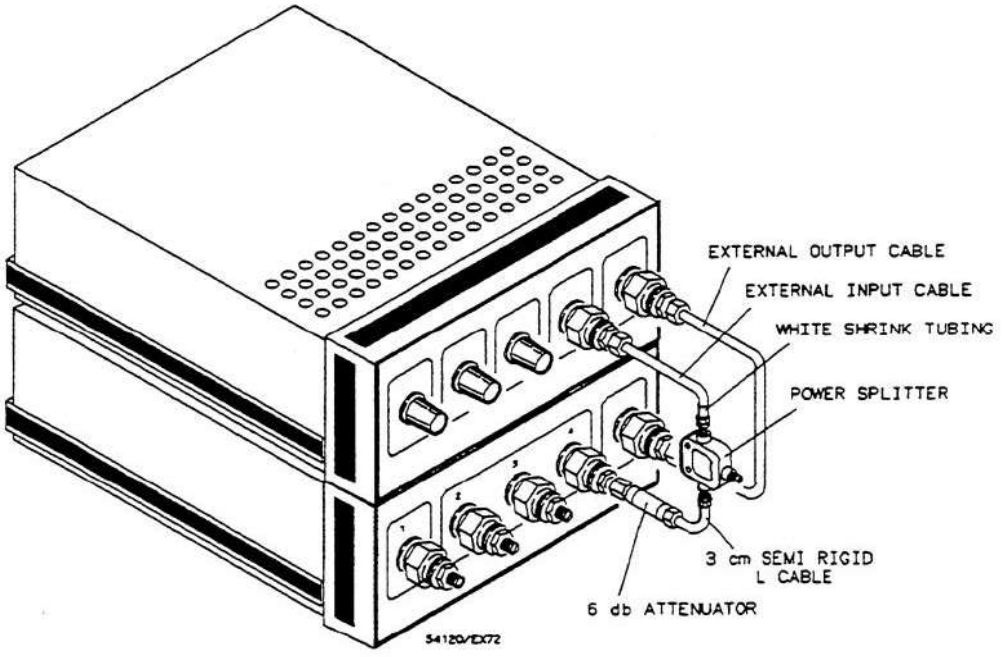


Figure 3-5. Viewing the Trigger Signal

Displaying the Signal

1. Change the HP 54120T to the following settings: trigger level 50 mV, positive slope, HF sense and reject off, display persistence 300 ms, Timebase in triggered sweep mode. Set up the sensitivity, offset, Time/div and delay to properly display the signal on the oscilloscope. If you used the example signal, use the following settings: 200 mV/div, offset 0 V, Timebase 100 ps/div, delay 16 ns.

2. Leave ARMING LEVEL in the detent cw position. This ensures the arming diode will fire reliably on continuous wave signals. ARMING LEVEL is only adjusted for pulsed RF operation.

3. Adjust TRIGGER LEVEL for best triggered oscilloscope display.

Note

How stable the displayed signal appears on the HP 54120T can be affected by the HP 5411&A's HOLDOFF setting. By increasing HOLDOFF the HP 5411&A's output pulse rate is decreased. Whenever the oscilloscope's front panel setup is changed, HOLDOFF should be readjusted for best triggered oscilloscope display.

Pulsed RF Signals

The HP 54118A triggers on the pulsed RF signal's carrier. Pulsed RF operation is illustrated in figure 3-6.

ARMING LEVEL sets the arming tunnel diode's switching threshold (arming level = switching threshold - arming bias current). Arming bias is set low enough to fire the arming tunnel diode near the beginning of the pulse Vin, but high enough so the arming tunnel diode will not fire on noise between pulse bursts.

TRIGGER LEVEL sets the trigger tunnel diode's switching threshold (trigger level = switching threshold - trigger bias current - current step). It is adjusted so the trigger tunnel diode fires on the next rising edge of $\overline{\text{Vin}}$, after the arming tunnel diode has fired.

HOLDOFF is adjusted so the bias control assembly rearms the trigger assembly between pulse bursts rather than during a pulse burst.

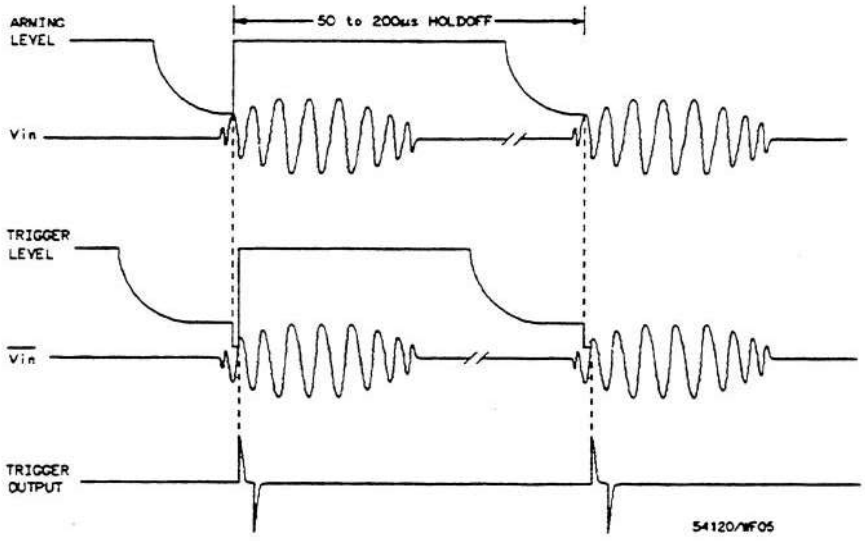


Figure 3-6. Pulsed RF Example

Delaying the Signal

There is approximately 20 ns of delay in the signal's trigger path. For most applications, a 22 ns delay line (HP 54008A) placed between the signal source and the oscilloscope's input will allow you to view the trigger point.

When the tunnel diodes fire, they produce a pulse which appears at the HP 54118A's INPUT and OUTPUT connectors. The pulse which appears at the INPUT connector is called kickout. Refer to figure 3-7. The HP 54120T's minimum delay is approximately 16 ns, by which time the kickout pulse should have decayed.

If you are using a delay line, the kickout pulse may be seen on the oscilloscope's display. Splitting the input signal with a directional coupler can minimize the effects of kickout on the displayed signal.

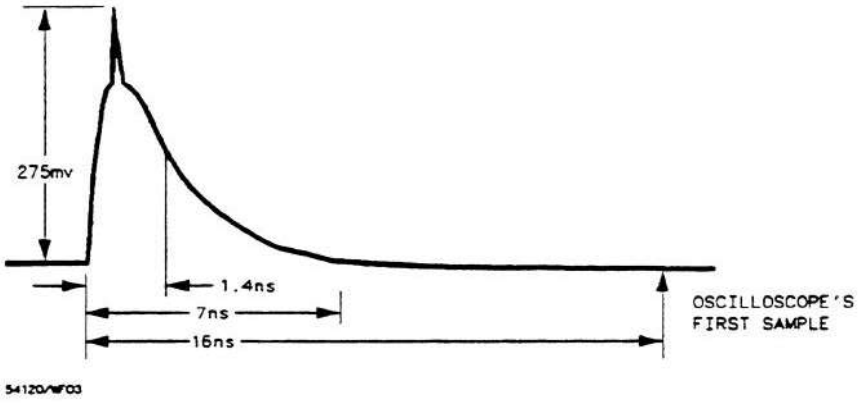


Figure 3-7. Typical Kickout Pulse

Equipment Setup

1. Connect equipment as shown in figure 3-8 (input signal will be connected in a later step). A directional coupler which meets the following specifications is recommended:
   Frequency range - 500 MHz to 18 GHz
   Nominal Coupling - 10 dB ±1 dB
   Directivity - 14 dB from 500 MHz to 12.4 GHz
   12 dB from 12.4 GHz to 18 GHz

2. Set HOLDOFF and ARMING LEVEL fully counterclockwise.

3. Set TRIGGER LEVEL fully clockwise.

4. Set oscilloscope's trigger level to 50 mV, positive slope, HF sense and reject off, display persistence 300 ms.

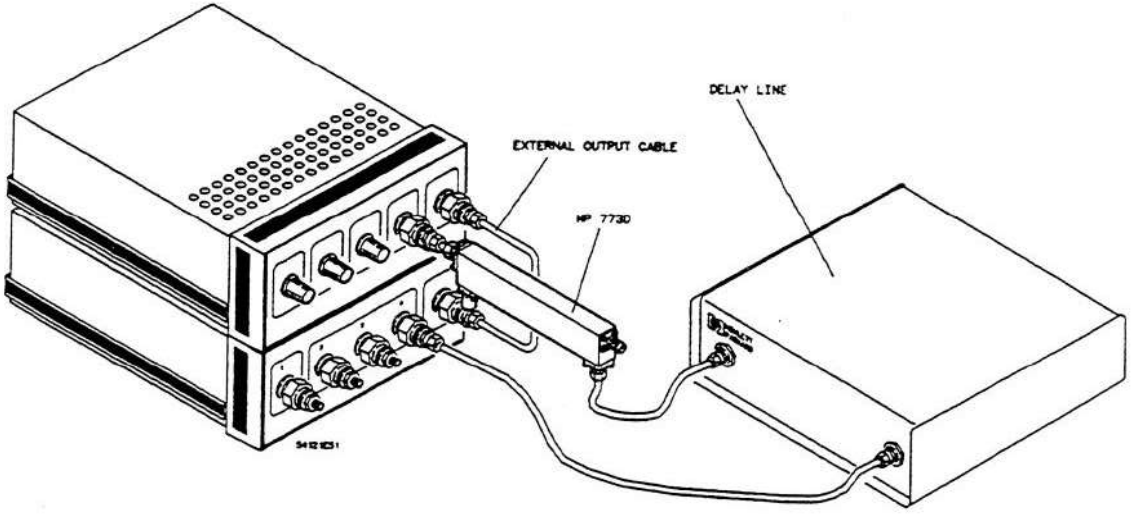


Figure 3-8. Recommended Pulsed RF Connections

5. The oscilloscope should not be triggered. Press the **Clear Display** key. If the trace does not reappear, the oscilloscope is not triggered.

6. Slowly decrease TRIGGER LEVEL (counterclockwise) until HP 54120T begins to trigger. The oscilloscope's display will begin to update when it is triggered.

7. Slowly increase ARMING LEVEL until triggering stops.

Displaying the Signal

1. Connect your available pulsed RF signal to directional coupler
   Example signal: Carrier - 10 GHz sine wave, 500 mVp-p (-2 dBm)
   Modulation - Pulse train, period 10 μs, duty cycle 10%, risetime 10 ns.

2. The oscilloscope's display will begin to update.

3 The oscilloscope's timebase and channel setups will depend on the characteristics of the pulsed RF signal you are using and your preferred view of the signal.

4. Increase TRIGGER LEVEL to obtain display with the least amount of jitter. If the display is a multivalued, increase HOLDOFF to obtain a display with a single valued waveform.

5. Readjust ARMING LEVEL, TRIGGER LEVEL, and HOLDOFF as necessary to obtain the best triggered oscilloscope display.

Performance Tests 4

Introduction

This chapter describes the performance tests which verify the instrument's electrical performance using the specifications in chapter 8. All performance tests can be performed without access to the interior of the instrument. Before doing the performance tests, ensure you have adhered to the adjustment cycle listed in chapter 5 (every twelve months or every 2000 hours of operation).

Recommended Test Equipment

In chapter 1, table 1-1 lists the recommended test equipment. Any equipment which satisfies the critical specifications may be used. At the beginning of each performance test, a list of recommended test equipment for that particular test is given.

Test Record

Performance tests results may be tabulated on the performance test record at the end of this chapter. The test record lists all of the tested specifications and their acceptable limits. The results recorded at incoming inspection can be used for comparison during periodic maintenance, troubleshooting, and after repairs or adjustments.

Performance Test Cycle

This instrument requires periodic verification of performance. The instrument should be checked using the following performance tests at least every twelve months or every 2000 hours of operation. If the instrument is used in high humidity conditions (> 80%), the performance test interval should be reduced to six months. The amount of use, environmental conditions, and the user's experience concerning the need for performance checks will contribute in deciding the performance test cycle.

Test Procedures

Note

Allow the instrument to warm up for at least 15 minutes prior to beginning the performance tests.

Note

This test assumes that the HP 54120T Digitizing Oscilloscope is in calibration. If this is not the case, these tests may not work correctly, or some specifications may not be met. It is also assumed that the operator is familiar with power meter operation.

CAUTION

The HP 5411&A's front panel APC 3.5 connectors are very susceptible to physical damage and the HP 5411&A to electrostatic damage (ESD). Ensure you are familiar with the Antistatic Procedures and Connector Care sections in chapter 2.

Input Sensitivity, Output Jitter

Specifications: Sensitivity and output jitter are system specifications The system includes the HP 54120T and the HP 54118A. Though not a specified characteristic, error rate can be estimated using this procedure.
Sensitivity: 50 mVp-p (-22 dBm) 500 MHz to 2 GHz
500 mVp-p (-2 dBm) 2 GHz to 12.4 GHz
1 Vp-p (+4 dBm) 12.4 GHz to 18 GHz

Jitter: <3% of input signal period (60 ps at 500 MHz)

Instrument	Critical Specifications	Recommended Model
Oscilloscope	No substitute	HP 54120T
Sweeper	0.5-18 GHz, -22 dBm to +4 dBm (50 mVp-p to >1 Vp-p)	HP 8341B
Power Meter	0.5-18 GHz	HP 436A
Power Sensor	-22 dBm to +4 dBm	HP 8485A
Directional Coupler	0.5-18 GHz, directivity >10 dB	Krytar Model 1851
Accessory	**Critical Specifications**	**HP Part Number**
Adapter	APC 3.5 (m-m)	1250-1864
Coaxial cable	SMA connectors, 18 GHz, Qty 3	HP 8120-4948
Coaxial Cable	SMA connectors, 18 GHz	HP 54118-61607

Note

If a directional coupler is not available, a power splitter (such as the HP 11667B 0.5-18 GHz) may be used. However, a signal generator capable of 2 Vp-p at 18 GHz (such as the HP 8340B), must be used.

Procedure

Items shown in parentheses are for the second and third part of this procedure where the steps are repeated, but with different frequencies. i.e. -22 dBm, *(-2 dBm), and **(+4 dBm) would be the power settings for 500 MHz *(12.4 GHz), and **(18 GHz) respectively.

1. Zero power meter.

2. Connect equipment as shown in figure 4-1. When testing 500 MHz, the directional coupler connects directly to HP 54121A through an APC 3.5 (m-m) adapter.

3. Set sweeper output as follows.

RF output	enabled
CW frequency	500 MHz, *(12.4 GHz), **(18 GHz)
Power approx.	-20 dBm, *(-2 dBm), **(+4 dBm)

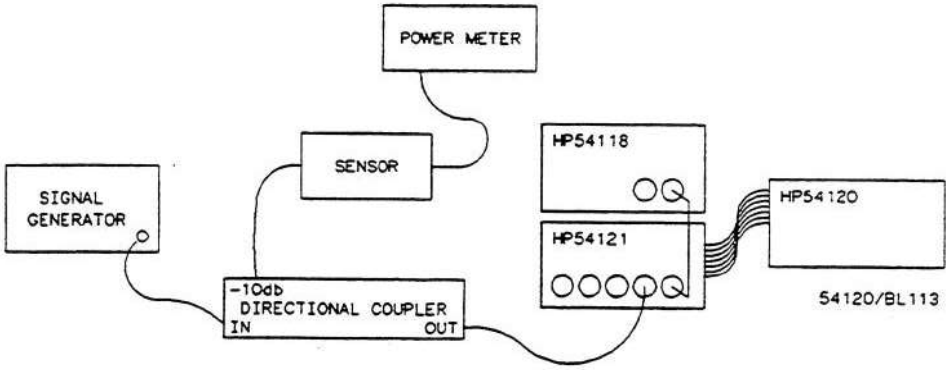


Figure 4-1. Initial Equipment Setup

4. Adjust sweeper power output for -22dBm *(-2 dBm) **(+4 dBm) as indicated on power meter.

5. Disconnect power meter and connect cable to HP 54118A Input.

6. Set up HP 54120T as follows:

Channels:	Chan 1 to 3	OFF
	Chan 4	ON
	Volts/div	(adjust for 6 to 7 divisions of vertical deflection)
	Offset	0.00 V
	Atten	1.0

Display:	Mode	Persistence
	Time	300 ms
	Screen	Single
	Graticule	Grid
	Bandwidth	12.4 GHz
Timebase:	Time/div	200 ps, *(10 ps), **(10 ps)
	Delay	24 nsec
	Delay Ref at	Left
	Sweep	Trig'd
Trigger:	Level	50 mV
	Slope	Pos
	Atten	1.000

7. Set HP 54118A as follows:

ARMING LEVEL	fully counterclockwise to detent CW position
HOLDOFF	fully clockwise
TRIGGER LEVEL	adjust to obtain most stable display. Check entire range of TRIGGER LEVEL, stable triggering should be possible.

8. Re-adjust HP 54120T Timebase Delay to center waveform valley to center graticule. Refer to figure 4-2.

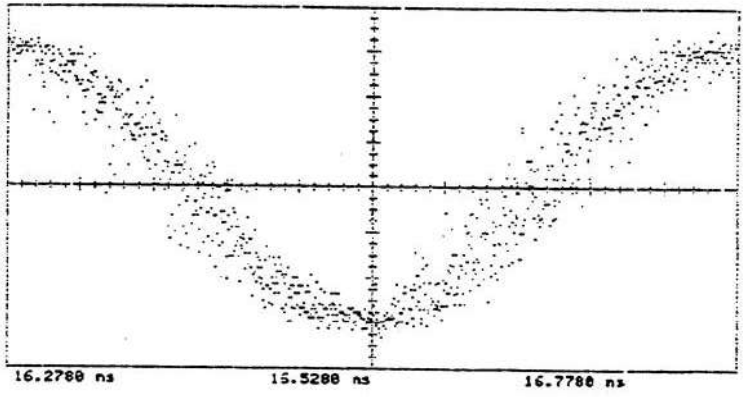


Figure 4-2. Timebase and Delay Settings

9. Change HP 54120A to
   Delta V: V markers ON
   Preset Levels 0 to 100%

10. Press **Auto Level Set** and note Delta V reading _____

11. On HP 54120T, press **MORE** , then **HISTOGRAM** . Set
    Window/Acquire/Results Window
    Source is Chan 4
    Time/Voltage/Histogram Time

12. Use data entry keys to set window marker 1 to + 0.5% of step 10's reading and window marker 2 to - 0.5% of step 10's reading

13. On HP 54120T set
    Window/Acquire/Results Acquire
    number of samples 4000, *(4000), **(8000)

14. Press **Stop** and **Clear Display** on HP 54120T system control keys, then **Start Acquiring** histogram key. Wait for Number of Samples to be 100%.

15. Change HP 54120T to
    Window/Acquire/Results Results
    Upper distr limit set upper distribution limit with RPG knob to the right side of the distribution on the POS slope of signal as shown in figure 4-3.

16. Press **Lower Distr Limit.**

17. Adjust lower distribution marker to right edge of the left distribution as shown in figure 4-3.

18. Press **0-100%** Set at Limit.

19. Press **Upper Distr Limit.**

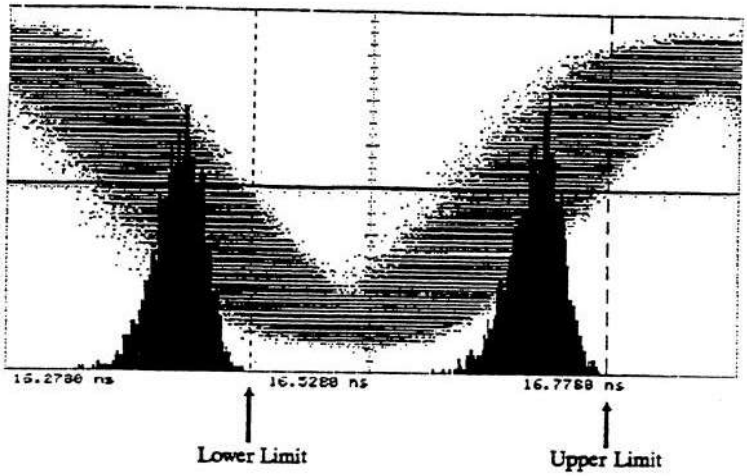


Figure 4-3. Upper and Lower Distribution Limits

20. Observe the Upper % = 100.0% of reading in the lower left corner of display, while turning the RPG knob counterclockwise. Turn counterclockwise until Upper % changes from 100%, then turn slowly clockwise until it just returns back to 100%.

21. Note Upper Marker Value (time). Start = _____.

22. Note Lower Marker Value (time). Stop = _____.

23. Press **Lower distr limit**. Adjust Lower % distribution limit as close to 50% as possible, using either RPG or ENTRY arrows.

24. Note Lower Marker Value (time) Stop = _____. (Median) This value will be used later and referred to as the "median".

25. Note Delta t reading _____.

26. Now move lower distribution marker back until Delta t reading equals TWICE the value noted in step 25.

27. Press **0–100%** Set at Limits.

28. Press **Sigma**. Sigma value displayed in lower right portion of display is estimated jitter. Note value. _____

29. Reset Lower **Distribution Limit Marker** to Stop value noted in step 22 using data entry keys.

30. Press **Upper Distr Limit** and set to Start value noted in step 21 using data entry keys.

31. Press **0-100%** Set at Limits.

32. Press **Lower Distr Limit** and set lower limit marker, using data entry keys, to median value from step 24, minus 4 times the estimated jitter noted in step 28.

Median _____
minus
4 times step 28's value _____
Result _____

33. Note Lower % value as estimated % of error. This is not a specified value, but has been included for information purposes.

34. Press **0-100%** Set at Limits.

35. Press Sigma. The value of Sigma is jitter. Specifications are: <60 ps at 500 MHz, <2.5 ps at 12.4 GHz, and < 1.7 ps at 18 GHz.

36. Reverse the directional coupler's outputs. Connect the -10 dB output to the HP 54121A channel 4 input, and connect the straight-thru output to the HP 54118A input.

37. Repeat procedure at 12.4 GHz using power values shown with *(____).

38. Repeat procedure at 18 GHz using power values shown with **(____).

Input Reflection

Specification: < 5% for 30 ps risetime

Equipment	Critical Specifications	Recommended Model
Oscilloscope	No Substitute	HP 54120T
50 Ω termination	APC 3.5 (m)	HP 909D opt 011
Accessory	**Critical Specifications**	**HP Part Number**
Adapter	APC 3.5 (f-f)	1250-1865
Coaxial Short	APC 3.5 (f)	1250-2127
Coaxial Cable	SMA connectors, 18 GHz	54118-61606

Note

This test is made on the HP 54118A WITHOUT power. Be sure that the rear panel external SMB power cable is disconnected. To ensure the HP 54118A is grounded, connect a cable between the rear panel gound lugs from the HP 54118A to the four channel test set.

Procedure

1. Perform a one-keydown power up. Hold down any key and cycle oscilloscope power off and on. Continue to hold key down until graticules are displayed on screen.

2. Set up HP 54120T as follows:

Channels:	Chan 1	ON
	Chan 2-4	OFF
	Volts/div	5 mV/div
	Offset	200 mV
Display:	Mode	Average
	Averages	16
	Screen	Single

Timebase:	Time/div	350 ps/div
	Delay	19 ns
Network:	Reflect/Trans/CAL	Reflect
	Step & chan 1	On

3. Press **Network** menu, then **Reflect/Trans/CAL** until **CAL** is highlighted.

4. Press **Reflect/Cal** key. Connect semi-rigid cable to HP 54121A TDR Output. Connect a coaxial short connector (APC 3.5 f) to end of cable. Press **Reflect/Cal** key again.

5. Remove coaxial short from cable and connect a 50 Ω termination through an APC 3.5 (f-f) adapter in its place. Press **Reflect/Cal** again.

6. Remove 50 Ω termination. Connect cable to HP 54118A INPUT. Press **Clear Display** key and wait for 16 averages to occur.

7. Press **Network** menu key, then **Reflect/Trans/CAL** key until **Reflect** is highlighted.

8. Set Normalized risetime to 30ps. Press **Normalize to Mem 1** key. Wait for normalization.

9. Press **Stop** key, then **Clear Display** key.

10. Press **Cursor Chan 1** until **Cursor Mem 1** is highlighted.

11. Press **Min & Max Reflect** key.

12. Minimum and Maximum RHO values are displayed in upper left corner of display. They should be $\leq 5\%$.

Holdoff Time

Specification: 50 μsec to 200 μsec

Instrument	Critical Specifications	Recommended Model
Oscilloscope	No Substitute	HP 54120T
Oscilloscope	100 MHz	HP 54201A
50 Ω Termination	APC 3.5 (m)	HP 909D opt 011
Accessory	**Critical Specifications**	**HP Part Number**
Adapter	SMA (m) to BNC (f)	1250-1200
Coaxial Cable	BNC (m-m)	10503A

Procedure

1. Connect external SMB power cable from HP 54118A to the four channel test set

2. Set up HP 54118A as follows:
   Arming Level Fully counterclockwise to detent CW position
   Trigger Level Fully counterclockwise
   Holdoff Fully clockwise

3. Connect oscilloscope to HP 54118A OUTPUT using the SMA to BNC adapter. Connect 50 Ω termination to HP 54118A INPUT.

Note

A monitor digitizing oscilloscope may need to be in the infinite persistence mode to observe the extremely narrow holdoff pulses.

4. Observe output signal. Pulse period should be greater than 200 μsec.

5. Change Holdoff setting to fully counterclockwise.

6. Observe output signal. Pulse period should be less than 50 μsec.

Performance Test Record

Input Sensitivity and Output Jitter

		Yes	No
Triggers at 500 MHz 50 mVp-p (-22 dBm)		____	____
Jitter at 500 MHz 50 mVp-p (-22 dBm)	Limit < 60 ps		____
Triggers at 12.4 GHz 500 mVp-p (-2 dBm)		____	____
Jitter at 12.4 GHz 500 mVp-p (-2 dBm)	Limit < 2.5ps		____
Triggers at 18 GHz 1 Vp-p (+4 dBm)		____	____
Jitter at 18 GHz 1 Vp-p (+4 dBm)	Limit < 1.7 ps		____

Input Reflection

< 5% with 30 ps incident pulse	Limit < 5%	____

Holdoff

Minimum HOLDOFF setting	Limit ≤ 50 µs	____
Maximum HOLDOFF setting	Limit ≥ 200 µs	____

Adjustments 5

Introduction

This chapter describes the adjustments for returning the instrument to optimum operating capabilities after repairs have been made or during routine preventive maintenance.

Adjustment Interval

To maintain proper calibration, these adjustments should be made at approximately one year or after 2000 hours of operation, whichever is less. Amount of use, environmental conditions, and the user's experience concerning the need for adjustment verification will contribute in deciding the adjustment interval.

Recommended Test Equipment

The following list of equipment is recommended for the adjustment procedure. Any equipment which satisfies the critical specifications may be used.

Table 5-1. Recommended Test Equipment

Equipment	Critical Specifications	Recommended Model
Digital Multimeter	3% Accuracy	HP 3478A
Oscilloscope	Trigger on 20 KHz	HP 54120T
50 Ω Termination	APC 3.5 Connectors	HP 909D
Coaxial Cable	SMA connectors, 1 GHz	HP 54118-61607

Equipment Setup

CAUTION

Use a properly grounded antistatic wrist strap and mat.

1. Remove top cover from HP 54118A.

2. Place HP 54118A on top of four channel test set.

3. Connect 50 Ω termination to HP 54118A's INPUT.

4. Disconnect any cables from the four channel test set.

5. Connect external power cable from the HP 54118A's rear panel connector POWER SUPPLY +15 VDC to the four channel test set's rear panel connector J2 TRIGGER POWER +15 V.

6. Ensure connector savers, APC 3.5 (f-f), are installed on the HP 54118A's OUTPUT and on the four channel test set's TRIG input.

7. Connect external output cable from the HP 54118A's OUTPUT to the four channel test set's TRIG input.

8. On the HP 54118A set the front panel TRIGGER LEVEL, ARMING LEVEL, and HOLDOFF controls fully counterclockwise.

9. Setup HP 54120T as follows:

- Display - Persistence mode, 300 ms
- Channels - Channel 1 on, vertical sensitivity 20 mV/div, offset 0 V, channels 2-4 off.
- Timebase - 1 μs/div, delay 16 ns, sweep trg'd
- Trigger - Level 50 mV, positive slope, HF sense and reject off

Adjustments

The following adjustments are performed on the HP 54118A's Bias Control Assembly, (A1).

1. Set R28, MIN. TRIG. LEVEL, and R29, MIN. ARM. LEVEL, full clockwise.

2. There should be a trace on the oscilloscope's display that is coninuously being updated. If you press the **Clear Display** key and the trace reappears on the oscilloscope's display, the trace is being updated.

3. Slowly adjust R28, MIN. TRIG. LEVEL, counterclockwise until the displayed trace is not being updated.

4. Press the **Clear Display** key. The trace will disappear from the oscilloscope's display and not reappear.

5. Slowly increase R28 until oscilloscope just starts to trigger.

6. Connect digital multimeter's positive lead to TP2 and negative lead to TP4, ground.

7. Note the multimeter's reading, _____ V

8. Subtract 200 mV from step 7's measurement[1].
   _____ V - 200 mV = _____ V

9. Slowly adjust R28 clockwise until the multimeter reading equals the result in step 8 ±10 mV.

1: Using 200 mV is the preferred method to ensure proper operation over the instruments complete temperature range and best front panel control adjustment. During the instrument's life, the aging of the trigger assembly may cause the adjustment to not have enough range to achieve 200 mV. It is permissible to use a value as low as 100 mV to avoid purchasing a new trigger assembly at this time..

10. There should be a trace on the oscilloscope's display that is coninuously being updated.

11. Move digital multimeter's positive lead to TP1.

12. Slowly adjust R29, MIN. ARM. LEVEL, counterclockwise until the displayed trace is not being updated.

13. Press the **Clear Display** key. The trace will disappear from the oscilloscope's display and not reappear.

14. Slowly increase R29 until oscilloscope just starts to trigger.

15. Note the multimeter's reading, _____ V.

16. Subtract 200 mV from step 15's measurement.[1]
_____ V - 200 mV = _____ V

17. Slowly adjust R29 clockwise until the multimeter reading equals the result in step 16 ± 10 mV.

18. There should be a trace on the oscilloscope's display that is being updated.

Disassembly 6

Introduction

This chapter contains removal and replacement procedures for the chassis and assembly parts in the HP 54118A Trigger.

Safety Considerations

The following warnings and cautions must be followed for your protection and to avoid damage to the instrument.

WARNING

Remove instrument power before replacing any modules to avoid damaging the instrument.

CAUTION

The HP 5411&A is very sensitive to static discharge. Failure to observe proper antistatic methods may result in damage to the instrument. All maintenance or operation should be performed while using a grounded antistatic mat and wrist strap.

Tools Required

The following tools are used for disassembly of the HP 54118A.

- 3/32 allen wrench (180° phase splitter)
- 0.050 allen wrench (front panel knobs)
- 1/4 inch nut driver (trigger power cable)
- 1/2 inch nut driver (front panel controls)
- 9/16 inch thin wrench HP part number 8710-1770 (APC Connectors)
- 5 in/lb torque driver with TORX #10 (used for most procedures)
- 5 in/lb torque with 5/16 inch wrench (semi-rigid cable)
- 18 in/lb torque driver with TORX #15 (frame hardware)
- Medium posi drive (cover screws)

Rear Panel

Removal

1. Disconnect power cable, and remove top and bottom covers.
2. Remove four screws from top and bottom of rear casting. Refer to figure 6-1.
3. Disconnect external power cable from J1 on the bias control assembly.
4. Pull rear panel away from instrument.

Replacement

1. Reverse removal procedure to install rear panel.

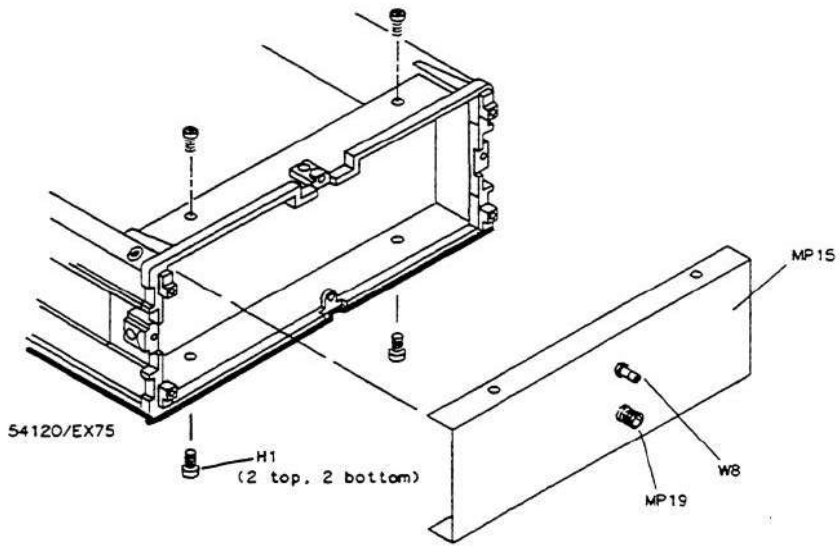


Figure 6-1. Rear Panel Removal

Trigger Power Cable

Removal

1. Disconnect power cable, and remove top and bottom covers.
2. Remove rear panel. Refer to removal procedure for "Rear Panel" in this chapter.
3. Use a 1/4 inch nut driver or wrench to remove hex nut and washer which attach the trigger power cable to the rear panel. Refer to figure 6-2.

Replacement

1. Reverse removal procedure to install trigger power cable.

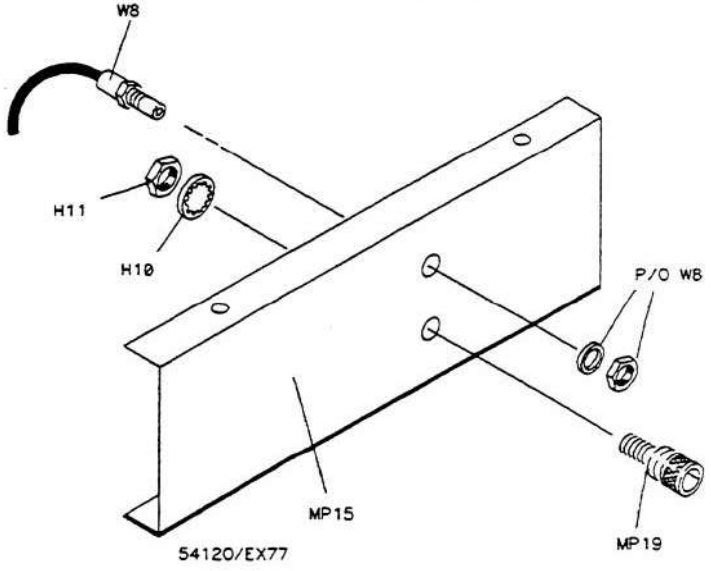


Figure 6-2. Trigger Power Cable Removal

Trigger Assembly

Removal

1. Disconnect power cable, and remove top and bottom covers.

CAUTION

The exposed trigger assembly's pins are very sensitive to electrostatic damage (ESD). Ensure you are wearing a properly grounded antistatic wrist strap before continuing.

2. Disconnect red, black, and blue wires from trigger assembly. Refer to figure 6-3
3. Use a 5/16 inch wrench to disconnect arming, trigger, and output semi-rigid cables from trigger assembly. Avoid bending or stressing the semi-rigid cables.
4. Loosen two screws holding trigger assembly to main deck.

Replacement

1. Attach trigger assembly to main deck with two screws and tighten with a 5 in/lb torque driver.
2. Install semi-rigid cables into trigger assembly. When pushing semi-rigid cables into connectors, a definite slight snap sound will be heard as the cable and connector are seated together. Tighten semi-rigid cable connectors with a 5 in/lb torque wrench
5. Connect red, black, and blue wires to trigger assembly. Refer to figure 6-3.
6. Install top and bottom covers.

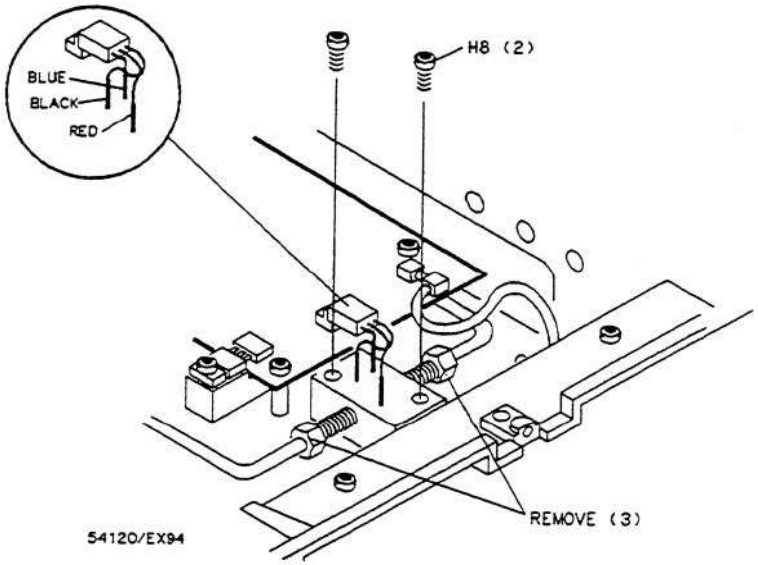


Figure 6-3. Trigger Assembly Removal

Bias Control Assembly

Removal

1. Disconnect power cable, and remove top and bottom covers.
2. Disconnect trigger power cable from J1, trigger control cable from J2, holdoff cable from J3, trigger level cable from J4, and arming level cable from J5.
3. Remove two screws holding Q3 and Q7 to heat sinks on main deck.
4. Remove five screws holding bias control assembly to main deck. Refer to figure 6-4.

Replacement

1. Reverse removal procedure to install bias control assembly. Tighten all seven screws to 5 in/lbs with a torque driver.

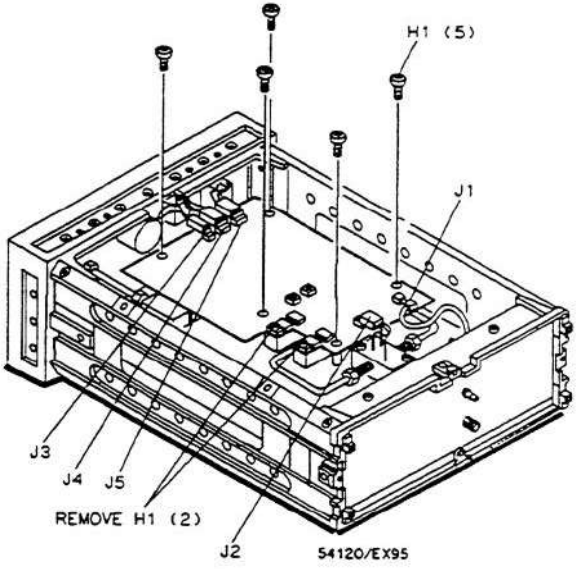


Figure 6-4. Bias Control Assemble Removal

Front Panel Controls

Removal

1. Disconnect power cable, and remove top and bottom covers.
2. Remove main deck. Refer to removal procedure for "Main Deck" in this chapter.
3. Use a 0.050 allen wrench to remove knob from front panel control.
4. Use a 1/2 inch wrench to remove nut from front panel control. Refer to figure 6-5.
5. Disconnect front panel control's wire lead assembly from bias control assembly.

Replacement

1. Reverse removal procedure to install front panel control. H12 is a flat nylon washer used only on the ARMING LEVEL and TRIGGER LEVEL controls.

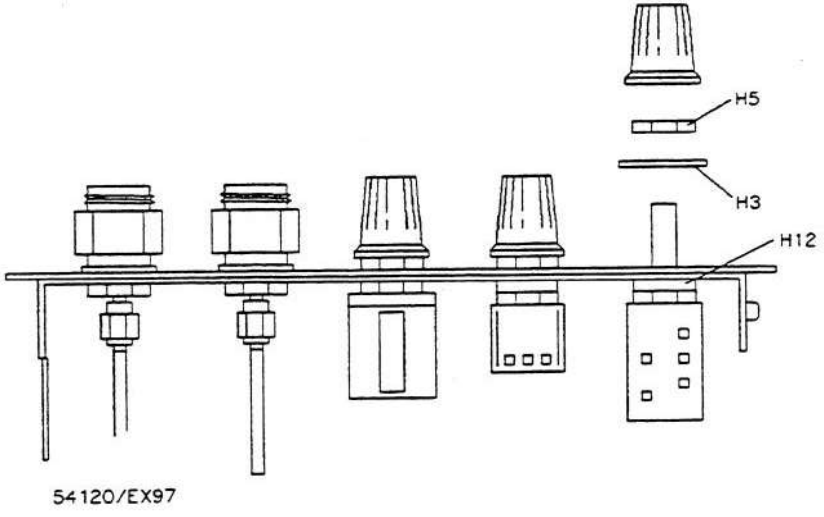


Figure 6-5. Front Panel Controls Removal

180° Phase Splitter

Removal

1. Disconnect power cable, and remove top and bottom covers.
2. Remove bias control assembly. Refer to removal procedure for "Bias Control Assembly" in this chapter.
3. Use a 5/16 inch wrench to disconnect, input, arming, and trigger semi-rigid cables from 180° phase splitter. Avoid bending or stressing the semi-rigid cables.
4. Use a 3/32 inch allen wrench to remove four screws which hold 180° phase splitter to main deck. Refer to figure 6-6.
5. Remove 50 Ω SMA termination from 180° phase splitter.

Replacement

1. Attach 50 Ω SMA termination to 180° phase splitter.
2. Attach 180° phase splitter to main deck with four socket-headed cap screws and tighten with a 3/32 inch allen wrench.
3. Install semi-rigid cables into 180° phase splitter. When pushing semi-rigid cables into connectors, a definite slight snap sound will be heard as the cable and connector are seated together. Tighten semi-rigid cable connectors with a 5 in/lb torque wrench.
4. Install top and bottom covers.

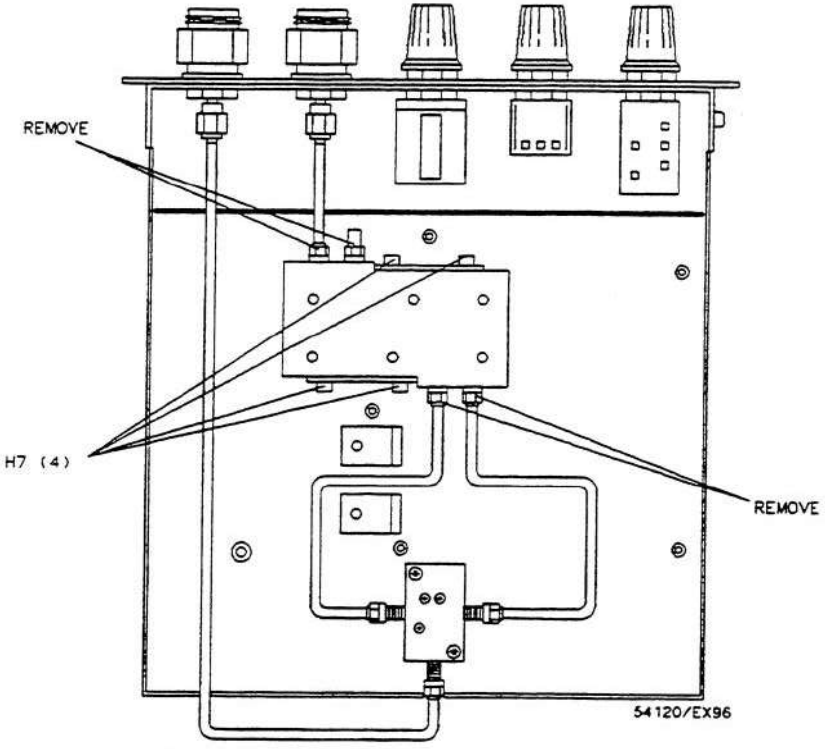


Figure 6-6. 180° Phase Splitter Removal

APC 3.5 Connectors

Removal

1. Disconnect power cable, and remove top and bottom covers.
2. Remove main deck. Refer to removal procedure for "Main Deck" in this chapter.
3. Use a 5/16 inch wrench to disconnect semi-rigid cable from defective APC 3.5 connector.
4. Use a thin 9/16 inch wrench (HP part number 8710-1770) to remove damaged APC 3.5 connector.
   Refer to figure 6-9.

Replacement

1. Reverse removal procedure in install APC 3.5 connector. When pushing semi-rigid cables into connectors, a definite slight snap sound will be heard as the cable and connector are seated together. Tighten semi-rigid cable connector with a 5 in/lb torque wrench.

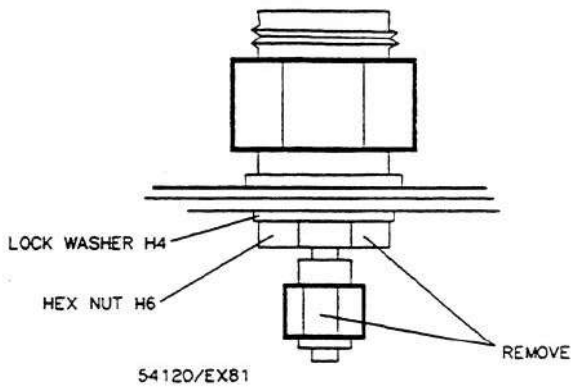


Figure 6-9. APC 3.5 Connector Removal

Front Panel

Removal

1. Remove power cable, and remove top and bottom covers.
2. Remove main deck. Refer to removal procedure for "Main Deck" in this chapter.
3. Remove arming level, trigger level, and holdoff assemblies. Refer to removal procedure for "Front Panel Controls" in this chapter.
4. Remove APC 3.5 connectors. Refer to removal procedure for "APC 3.5 Connectors" in this chapter.
5. Remove two screws from each side of front panel. Refer to figure 6-10.

Replacement

1. Reverse removal procedure to install front panel.

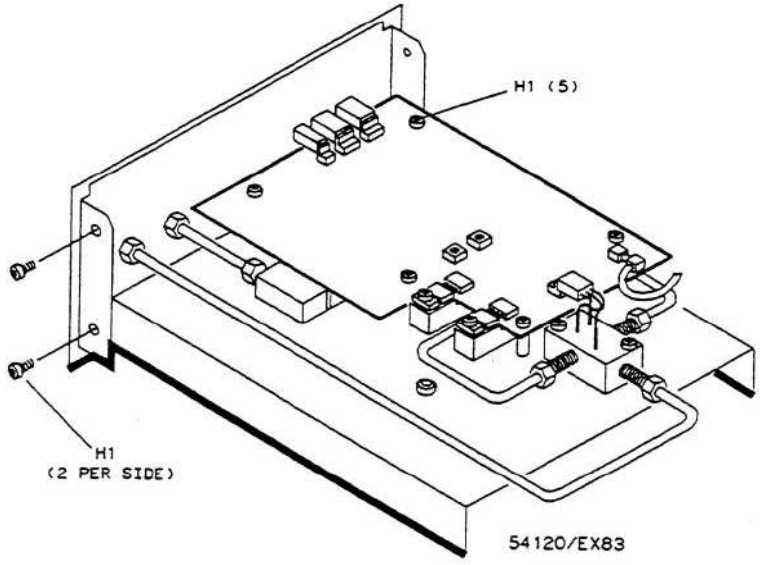


Figure 6-10. Front Panel Removal

Service 7

Simplified Overview

The HP 54118A Trigger input frequency range is 500 MHz to 18 GHz. The trigger output pulses occur at a much slower rate, 5 kHz to 20 kHz. The output pulse rate is determined by the HP 54118A's front panel HOLDOFF setting. The HP 54118A's simplified theory of operation can be described by the following five step sequence. Refer to figure 7-1.

1. The 180° phase splitter continuously supplies a copy (Vin) and a 180° phase shifted copy ($\overline{\text{Vin}}$) of the input signal to the trigger assembly.

2. The bias control assembly arms the trigger assembly.

3. The trigger assembly triggers and outputs a pulse.

4. The bias control assembly senses the trigger event and resets the trigger assembly.

5. Holdoff times out. Go to step 2.

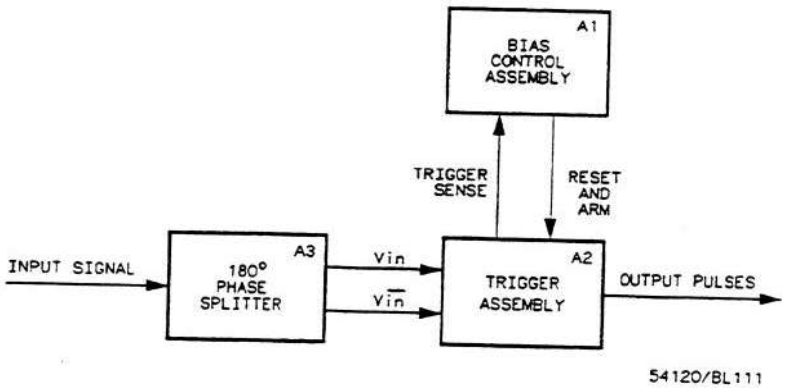


Figure 7-1. Simplified Block Diagram

Detailed Theory

The following theory refers to figure 7-2. A trigger signal is applied to the 180° phase splitter assembly, A3. The phase splitter's output is a copy (Vin) and a 180° phase shifted copy ($\overline{\text{Vin}}$) of the input signal. Vin and $\overline{\text{Vin}}$ are each terminated through 50 Ω into a tunnel diode. Vin produces a signal current (Iin) in the arming diode. $\overline{\text{Vin}}$ produces a signal current ($\overline{\text{Iin}}$) in the trigger diode.

The bias control assembly, A1, supplies a variable dc bias current to the trigger diode. Increasing the front panel TRIGGER LEVEL decreases the trigger bias current.

After a fixed 15 μs delay, produced by U4 and U5, the bias control assembly supplies a variable dc bias current to the arming tunnel diode. Increasing the front panel ARMING LEVEL decreases the arming bias current. When the arming bias current is enabled, it increases very slowly with respect to one period of the input signal current, Iin.

The arming bias current continues to increase until the total current (Iin + arming bias current) reaches the arming tunnel diode's switching (firing) threshold. At the firing threshold, the tunnel diode fires and produces a very fast rising voltage step across the arming tunnel diode. The voltage step generates a current step in the trigger tunnel diode.

Remember that the arming bias current increases very slowly with respect to one period of the input signal current, Iin. This ensures that the arming tunnel diode always fires on a positive peak of its signal current, Iin, and a negative peak of the trigger tunnel diode's signal current, $\overline{\text{Iin}}$. The current step produced by the arming tunnel diode causes the total trigger tunnel diode's current ($\overline{\text{Iin}}$ + trigger bias current + current step) to reach the trigger tunnel diode's firing threshold during the next rising edge of $\overline{\text{Iin}}$. The trigger tunnel diode fires and generates a 200 mV, 5 ns wide pulse at the trigger assembly's output.

The bias control assembly senses when either of the tunnel diodes fire. Within 2 μs both bias currents are disabled by shunting the currents to ground through Q2 and Q6. This removes the bias currents and resets both tunnel diodes.

In addition to disabling the bias currents, the bias control assembly also starts a variable holdoff timer. The front panel HOLDOFF control varies the period of the holdoff timer. When holdoff times out, the bias currents are enabled again and the cycle restarts.

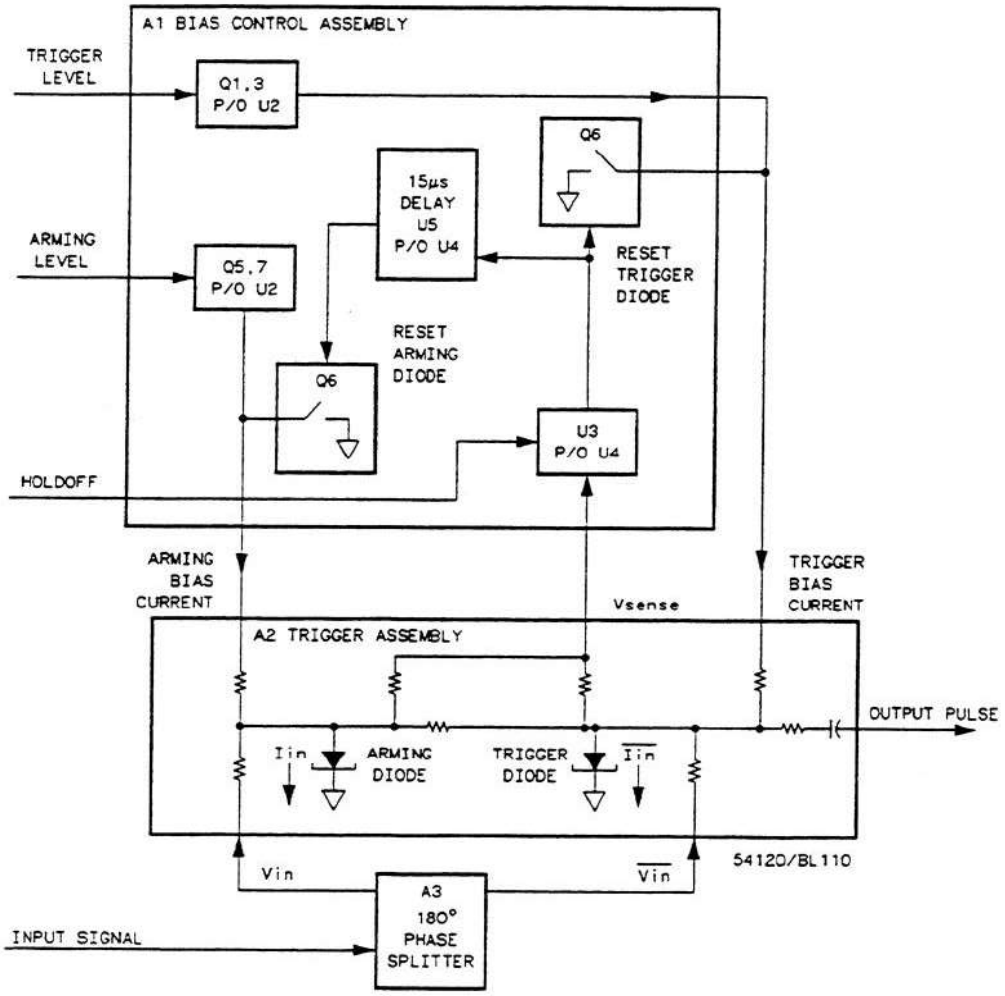


Figure 7-2. Detailed Block Diagram

Troubleshooting

Troubleshooting the HP 54118A consists of making several checks to determine whether the faulty assembly is the bias control assembly, trigger assembly, or cables. Faulty assemblies are a throw away item (there are no exchange assemblies).

Recommended Test Equipment

The following equipment is used for troubleshooting the HP 54118A. Any instrument which satiffies the critical specifications may be used.

Instrument	Critical Specifications	Recommended Model
Oscilloscope	100 MHz, 50 Ω input	HP 54201A
Oscilloscope Probe	10:1, 10 M Ω	HP 10432A
Pulse Source	0 to 0.5 V positive pulse 5 µs wide at 4 kHz	HP 8116A
Accessory	**Critical Specifications**	**HP Part Number**
BNC Tee	1 (m) end, 2 (f) ends	1250-0781
BNC Cable		10503A
Resistors	180 Ω, ±3%, 0.5 watt, Qty 2	N/A
Alligator Clips	Qty 2	N/A
Clip Leads	Connect from BNC (f) to wire	N/A

Incorrect Output or No Output

1. Set ARMING LEVEL fully counterclockwise to detent CW position. Set TRIGGER LEVEL and HOLDOFF fully counterclockwise. On the bias control assembly, set both R28 (MIN TRIG LEVEL) and R29 (MIN ARM LEVEL) fully clockwise.

2. Set monitor oscilloscope to 50 Ω. Connect HP 54118A OUTPUT to monitor oscilloscope. Set up monitor oscilloscope to observe pulses. Pulses should be approximately +225 mV and approximately 5 ns wide. Refer to figure 7-3.

Note

Presence of an output does not verify correct performance since the oscilloscope will not display the actual risetime or jitter. This check is just a troubleshooting aid.

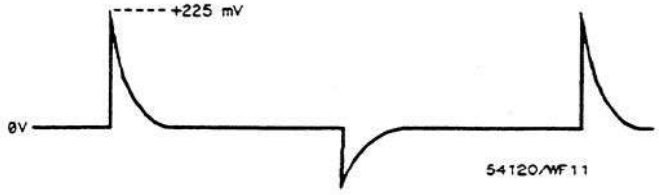


Figure 7-3. HP 54118A Trigger Output Pulses

3. If output is absent or obviously incorrect, first check for obvious problems: damaged connectors, burned components, or loose wires (especially the red, blue, and black wires connecting to the trigger assembly.

4. Check the operating voltage, +15 Vdc at J1 on the bias control assembly. If +15 Vdc is not present at J1, check the HP 54121A rear panel J2 TRIGGER POWER for +15 Vdc. If there is +15 Vdc at the four channel test set, than check W8 trigger power cable and the external SMB power cable for continuity.

5. Disconnect external SMA power cable from HP 54118A's rear panel.

6. Connect a monitor oscilloscope with a 10:1 high impedance probe to U3 pin1.

7. Reconnect power cord. Observe monitor oscilloscope display. Approximately 1/2 second after power-up, the dc level at U3 pin 1 should rise from 0 Vdc to about +5 Vdc. If this does not occur, replace the bias control assembly A1.

8. Disconnect external SMB power cable from HP 54118A's rear panel.

9. Disconnect the three wires connected to top of trigger assembly.

10. Connect a 180 Ω ±3%, 0.5 watt resistor to the black wire, and another to the blue wire. Connect other end of resistors to chassis ground. Refer to figure 7-4.

Note

These resistors are simulating the current load for the trigger assembly. Keeping these resistors within the ±3% of 180 Ω is very critical. The circuitry may not work properly if this is not adhered to. Hewlett-Packard part number 0698-3334, 178 Ω ±1%, 0.5 watt resistors may be used. DO NOT use resistors with less than a 0.5 watt rating.

11. Set up equipment as shown in figure 7-4. Notice the red wire connects to a pulse source through a BNC tee. Set monitor oscilloscope channel B to 50 Ω.

12. Set pulse source for a 0 V to 0.5 Vdc positive pulse, approximately 5 μs wide at 4 kHz.

CAUTION

Ensure the resistor and test leads do not short together.

13. Reconnect power cord.

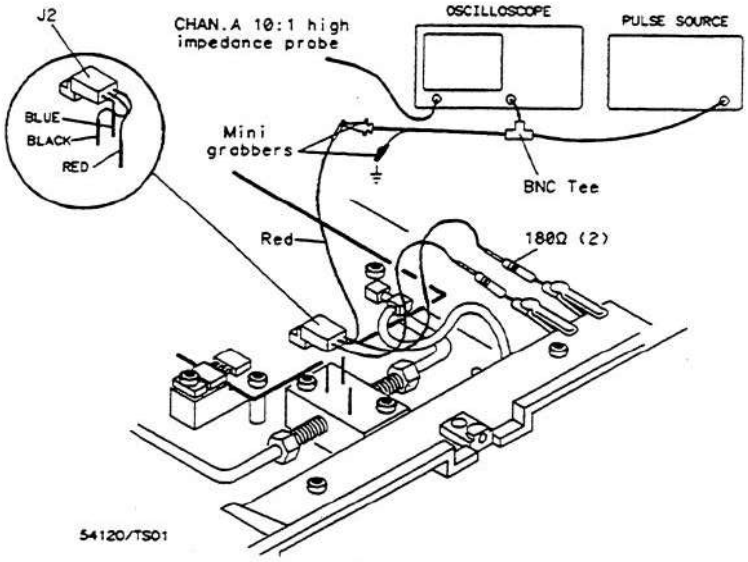


Figure 7-4. Troubleshooting Equipment Setup

14. Using a 10:1 high impedance probe from monitor oscilloscope, check outputs from the blue wire and black wire. Figures 7-5 and 7-6 show the correct waveforms.

Note

These waveforms show voltage levels with the front panel knobs and internal pots in several positions. Make all combinations of checks.

The critical parameter is the current provided to the trigger assembly. A more accurate check is to measure the current through the 180 Ω resistors. Current measurements should be made with the pulse source disconnected. Figures 7-5 and 7-6 contain a listing of the correct currents for each control setting.

15. If signals are correct, replace trigger assembly, A2.

16. If signals are incorrect or absent, replace bias control assembly, A1.

17. Perform adjustment procedure and performance tests to verify correct instrument operation.

Excessive Jitter

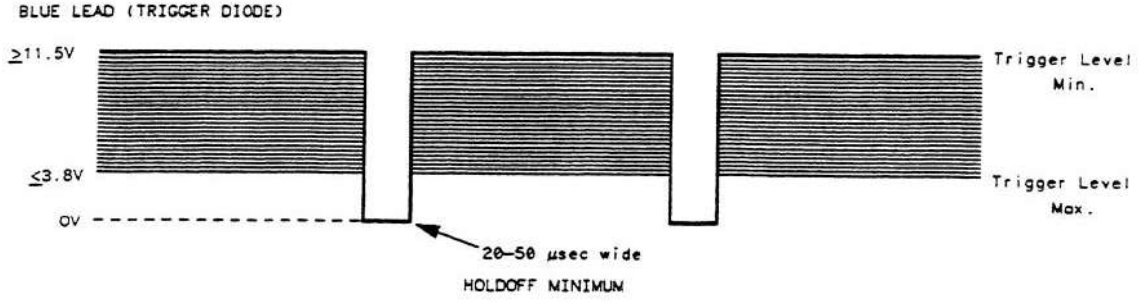
Excessive jitter problems can be caused either by the HP 54120T system or the trigger assembly, A2.

1. Verify jitter and trigger specifications of the HP 54120T system. If adjustments are made to the HP 54120T system, retest the HP 54118A for proper operation.

2. If excessive jitter remains, replace the HP 54118A trigger assembly, A2.

Schematic Diagrams

Figure 7-11 is the component locator for the Bias Control Assembly. Figures 7-12 and 7-13 are the schematic diagrams for the Bias Control Assembly, A1. These three figures are at the end of this chapter and are included as additional information only.

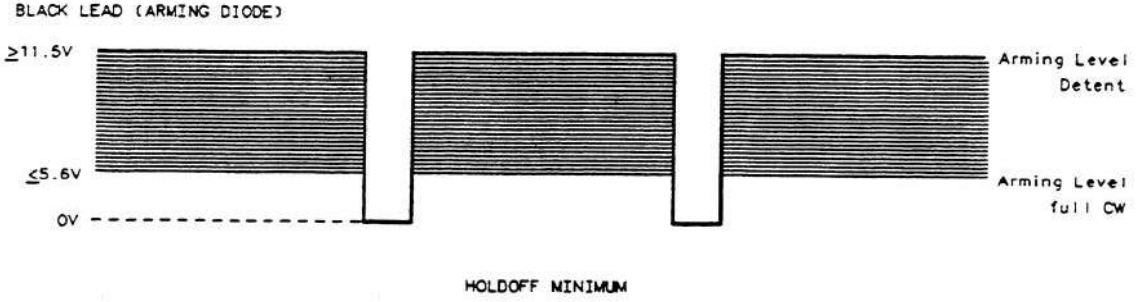


With internal minimum trigger level adjust set to fully CCW, maximum voltage excursions change to ≤7.4V to ≤3.8V.

TRIGGER LEVEL Control	MIN TRIG LEVEL R28	Trigger Diode Current
Fully counter clockwise	Fully clockwise	≥64 mA
Fully counter clockwise	Fully counter clockwise	≤41 mA
Fully clockwise	Fully counter clockwise	≤21 mA

54120/WF09

Figure 7-5. Trigger Diode Waveforms on the Blue Wire



With internal minimum arming level adjust set to fully CCW, voltage excursions change to ≤7.4V to ≤5.6V.

ARMING LEVEL Control	MIN ARM LEVEL R29	Trigger Diode Current
Detent CW position	Fully clockwise	≥64 mA
Detent CW position	Fully counter clockwise	≤41 mA
Fully clockwise	Fully counter clockwise	≤31 mA

54120/WF10

Figure7-6. Arming Diode Waveforms on the Black Wire

Replaceable Parts

The following replaceable parts tables are included in this section.

- Table 7-1 - List of Manufacturers' Codes
- Table 7-2 - Chassis mounted parts
- Table 7-3 - Bias Control Assembly, A1

Tagging for Service

If the instrument is to be shipped to a Hewlett-Packard office for service or repair, attach a tag showing the following:

- Owners name and address
- Entire instrument serial number
- Complete description of service required
- Use original packing material if possible. Otherwise, wrap instrument in heavy paper or plastic, and package in strong shipping container.
- Seal the shipping container securely
- Mark the container FRAGILE

In any correspondence, refer to the instrument by model number and entire serial number.

Direct Mail Order System

Within the USA, Hewlett-Packard can supply parts through a direct mail order system. Advantages of using this system are as follows:

- Direct ordering and shipment form HP Parts Center in Mountain View, California.
- No maximum or minimum on any mail order (there is a minimum order amount for parts ordered through local HP offices when orders require billing and invoicing).
- Prepaid transportation (there is a small handling charge for each order).
- No invoices

To provide these advantages, check or money order must accompany each order. Mail order forms are available through your local HP offices.

Table 7-1. List of Manufacture Codes

Mfr No.	Manufacturer Name	Address		Zip Code
C0633	Rifa Bromm		SE	
S0167	Fujitsu Ltd Tokyo		JP	
00000	Any Satisfactory Supplier			
01121	Allen-Bradley Co	Milwaukee	WI	53204
01281	TRW Inc Semiconductor Div	Lawndale	CA	90260
01295	Texas Instr Inc Semicond Cmpnt Div	Dallas	TX	75222
02111	Spectrol Electronics Corp	City of Ind	CA	91745
02114	Ferroxcube Corp	Saugerties	NY	12477
03888	K D I Pyrofilm Corp	Whippany	NJ	07981
04672	TRW Inc Philadelphia Div	Philadelphia	PA	19108
04713	Mororola Semiconductor Products	Phoenix	AZ	85008
06665	Precision Monolithics Inc	Santa Clara	CA	95050
07263	Fairchild Semiconductor Div	Mountain View	CA	94042
1B546	Varo Semiconductor Inc	Garland	TX	75040
11236	CTS of Berne Inc	Berne	IN	46711
15454	Ametek/Rodan Div	Anaheim	CA	92806
18324	Signetics Corp	Sunnyvale	CA	94086
19701	Mepco/Electra Corp	Mineral Wells	TX	76067
24546	Corning Glass Works (Bradford)	Bradford	PA	16701
25403	N.V. Philips-Elcoma Department	Eindhoven	HL	02876
27014	National Semiconductor Corp	Santa Clara	CA	95050
27167	Corning Glass Works (Wilmington)	Wilmington	NC	28401
28480	Hewlett-Packard Co Corporate Hq	Palo Alto	CA	94304
34335	Advanced Micro Devices Inc	Sunnyvale	CA	94086
34649	Intel Corp	Mountain View	CA	95051
56289	Sprague Electric Co	North Adams	MA	01247
72136	Electro Motive Corp	Florence	SC	06226
75915	Littelfuse Inc	Des Plaines	IL	60016
80031	Mepco/Electra Corp	Morristown	NJ	07960

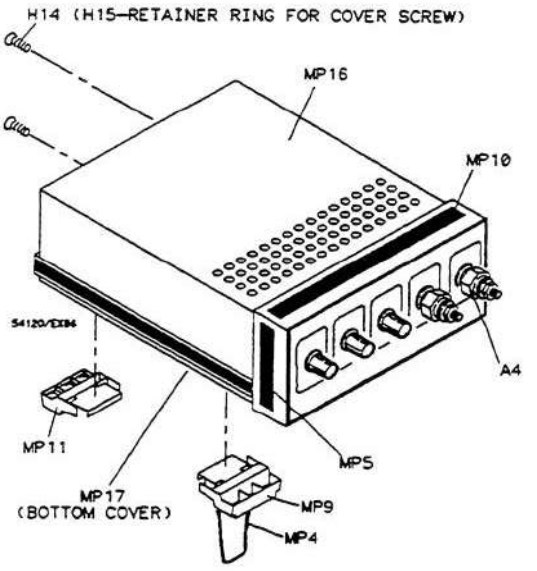


Figure 7-7. View with Covers and Feet Installed

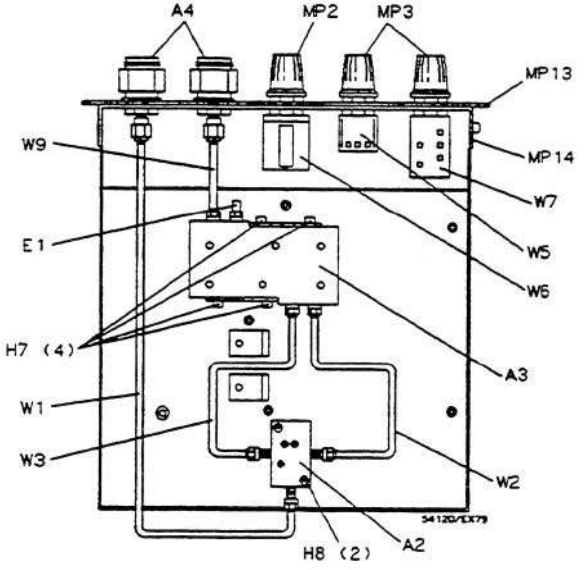


Figure 7-8. View of Semi-rigid Cables and Assemblies

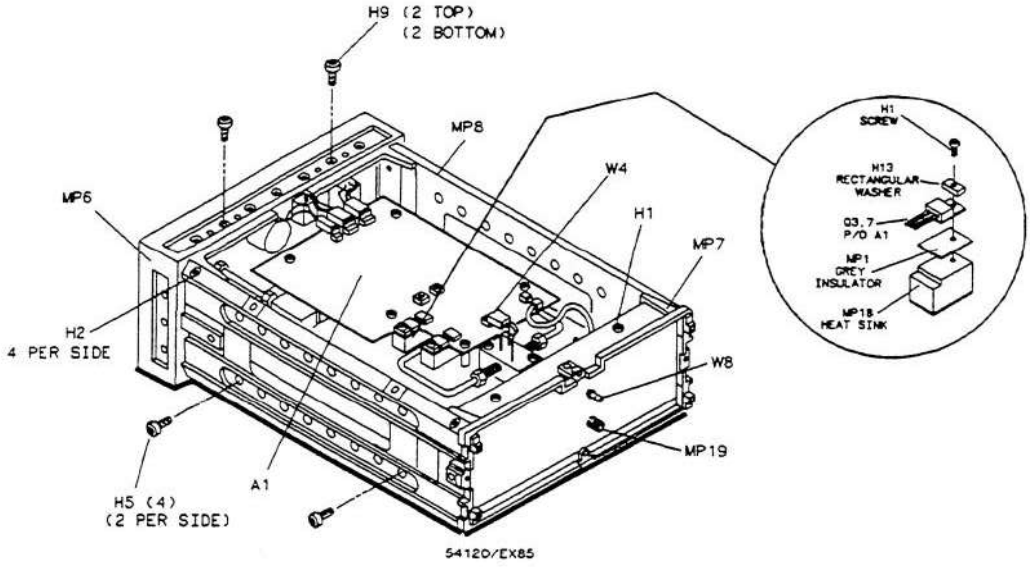


Figure 7-9. Top View with Covers Removed

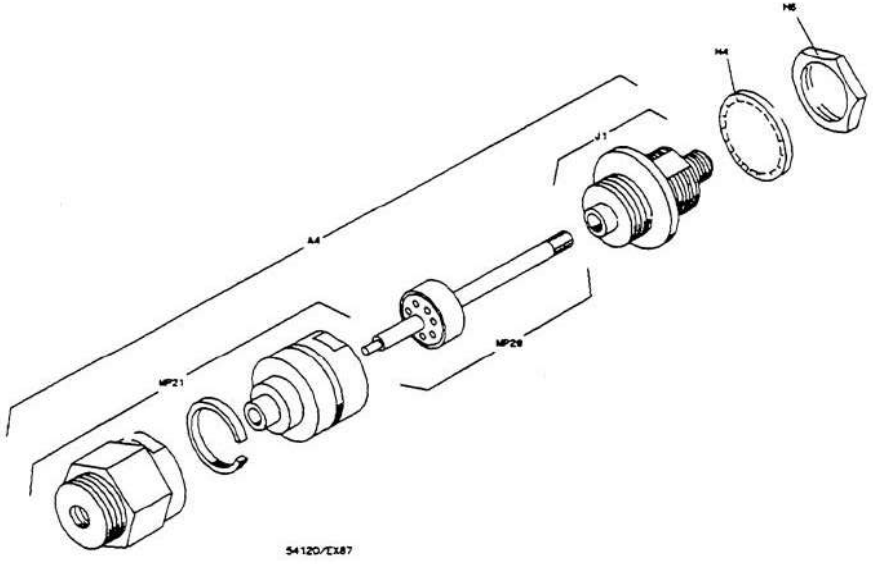


Figure 7-10. APC 3.5 Connector Exploded View

Table 7-2. Chassis Mounted Replaceable Parts

Reference Designator	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A1	54118-66501	4	1	Bias Control Assembly	28480	54118-66501
A2	5180-2755	3	1	Trigger Assembly	28480	5180-2755
A3	0955-0450	0	1	180° Phase Splitter	28480	0955-0450
A4	5062-1247	6	2	APC 3.5 Connector Assembly	28480	5062-1247
E1	1250-2153	0	1	50 Ω SMA (m) Termination	28480	1250-2153
J1	08513-20017	3	2	APC 3.5 Bulk Head Connector P/O A4	28480	08513-20017
H1	0515-0372	2	17	Screw M3 X 10	28480	0515-0374
H2	0515-1403	2	16	Screw M4 X 7	28480	0515-1403
H3	2190-0016	3	3	Washer	28480	2190-0016
H4	2190-0914	0	2	Lock Washer	28480	2190-0914
H5	2950-0043	8	3	Nut 3/8 X 32	28480	2950-0043
H6	2950-0132	6	2	Hex Nut 7/16	28480	2950-0132
H7	3030-0253	3	4	CS 4-40	28480	3030-0253
H8	0515-0666	7	2	Screw 3 X .5 MM	28480	0515-0666
H9	0515-1035	6	4	Flathead Screw M3	28480	0515-1035
H10	2190-0027	6	1	Washer	28480	2190-0027
H11	2950-0072	3	1	Nut 1/4 X 32	28480	2950-0072
H12	3050-1176	3	2	Flat Nylon Washer	28480	3050-1176
H13	5041-2676	3	2	Shoulder Washer	28480	5041-2676
H14	0515-1245	0	2	Cover Screw	28480	0515-1245
H15	0510-1253	8	2	Retainer Ring For Cover Screw	28480	0515-1253
MP1	0340-1074	2	2	Insulator	28480	0340-1074
MP2	0370-1091	6	1	Knob Base 1/2 Holdoff	28480	0370-1135
MP3	0370-1099	4	2	Knob Jade Gray Arming and Trigger	28480	0370-1099
MP4	1460-1345	5	2	Tilt Stand	28480	1460-1345
MP5	5001-0438	7	2	Side Trim	28480	5001-0438
MP6	5021-5813	4	1	Front Frame	28480	5021-5813
MP7	5021-5814	5	1	Rear Frame	28480	5021-5814
MP8	5021-5884	9	2	Side Strut	28480	5021-5884
MP9	5040-7201	8	2	Front Feet	28480	5040-7201
MP10	5040-7203	0	1	Top Front Trim	28480	5040-7203
MP11	5040-7222	3	2	Non Skid Rear Feet	28480	5040-7222
MP12	54118-00101	2	1	Main Deck	28480	54118-00101
MP13	54118-00201	3	1	Front Panel	28480	54118-00201
MP14	54118-00202	4	1	Front Sub Panel	28480	54118-00202
MP15	54118-00203	5	1	Rear Panel	28480	54118-00203
MP16	54120-04104	7	1	Top Cover	28480	54120-04104
MP17	54120-04105	8	1	Bottom Cover	28480	54120-04105
MP18	54120-21103	2	2	Heat Sink	28480	54120-21102
MP19	1510-0038	8	1	Binding Post	28480	1510-0038
MP20	5062-1243	2	2	APC 3.5 Center Conductor P/O A4	28480	5062-1243

Table 7-2. Chassis Mounted Replaceable Parts

Rerence Designator	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
MP21	5062-1245	4	2	APC 3.5 Connector Body P/O A4	28480	5062-1245
W1	54118-61601	5	1	Output From Trigger Assembly, Semi-rigid Cable	28480	54118-61601
W2	54118-61602	6	1	Trigger Semi-rigid Cable	28480	54118-61602
W3	54118-61603	7	1	Arming Semi-rigid Cable	28480	54118-61603
W4	54118-61604	8	1	Trigger Control Cable	28480	54118-61604
W5	54118-61611	7	1	Trigger Level Cable Assembly	28480	54118-61611
W6	54118-61610	6	1	Holdoff Cable Assembly	28480	54118-61610
W7	54118-61612	8	1	Arming Level Cable Assembly	28480	54118-61612
W8	54120-61617	7	1	Trigger Power Cable	28480	54120-61617
W9	54120-61604	7	1	Input to 180° Phase Splitter, Semi-rigid Cable	28480	54120-61609

Table 7-3. Bias Assembly (A1) Replaceable Parts

Reference Designator	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
C1	0180-3770	9	4	Capacitor Fixed 2.2 µF ±10% 35 VDC TA	28480	0180-3770
C2	0160-4831	3	2	Capacitor Fixed 4700 pF ±10% 100 VDC TA	28480	0160-4831
C3				Not Assigned		
C4	0180-3831	3	3	Capacitor Fixed 10 µF ±10% 35 VDC TA	28480	0180-3831
C5	0160-6500	7	5	Capacitor Fixed .01 µF ±10% 100 VDC Ceramic	28480	0160-6500
C6	0180-3770	9	0	Capacitor Fixed 2.2 µF ±10% 35 VDC TA	28480	0180-3770
C7	0160-6500	7	0	Capacitor Fixed .01 µF ±10% 100 VDC Ceramic	28480	0160-6500
C8	0180-3770	9	0	Capacitor Fixed 2.2 µF ±10% 35 VDC TA	28480	0180-3770
C9	0180-3831	3	0	Capacitor Fixed 10 µF ±10% 35 VDC TA	28480	0180-3831
C10	0180-3770	9	0	Capacitor Fixed 2.2 µF ±10% 35 VDC TA	28480	0180-3770
C11	0180-3831	3	0	Capacitor Fixed 10 µF ±10% 35 VDC TA	28480	0180-3831
C12	0160-6500	7	0	Capacitor Fixed .01 µF ±10% 100 VDC Ceramic	28480	0160-6500
C13	0160-4574	1	2	Capacitor Fixed 1000 pF ±10% 100 VDC Ceramic	28480	0160-4574
C14	0160-4808	4	1	Capacitor Fixed 470 pF ±5% 100 VDC Ceramic	28480	0160-4808
C15	0160-4574	1	0	Capacitor Fixed 1000 pF ±10% 100 VDC Ceramic	28480	0160-4574
C16	0160-4830	2	1	Capacitor Fixed 2200 pF æ10% 100 VDC Ceramic	28480	0160-4830
C17	0160-6500	7	0	Capacitor Fixed .01 µF æ10% 100 VDC Ceramic	28480	0160-6500
C18	0160-6500	7	0	Capacitor Fixed .01 µF æ10% 100 VDC Ceramic	28480	0160-6500
C19	0160-4831	3	0	Capacitor Fixed 4700 pF æ10% 100 VDC Ceramic	28480	0160-4831
J1	1250-2201	9	1	Connector RF SMB Male PC 50 Ω	28480	1250-2201
J2	1251-5971	8	3	Connector Post 2.5 Pin SPCG 3 Pin	28480	1251-5971
J3	1251-4836	2	1	Connector Post 2.5 Pin SPCG 2 Pin	28480	1251-4836
J4	1251-5971	8	0	Connector Post 2.5 Pin SPCG 3 Pin	28480	1251-5971
J5	1251-5971	8	0	Connector Post 2.5 Pin SPCG 3 Pin	28480	1251-5971
L1	5081-7682	5	1	RF Choke	28480	5081-7682
Q1	1853-0036	2	2	Transistor PNP SI PD = 310 mW FT = 250 MHz	27014	2N3906
Q2	1854-0467	5	2	Transistor NPN SI TO-92 PD = 310 mW	04713	2N4401
Q3	1853-0431	1	2	Transistor PNP SI PD = 65 W	01295	TIP42C
Q4	1826-0772	6	1	IC V Rgltr-Adj-Pos 1.2/32 V TO 92 Pkg	04713	LM317LZ
Q5	1853-0036	2	0	Transistor PNP SI PD = 310 mW FT = 250 MHz	27014	2N3906
Q6	1854-0467	5	0	Transistor NPN SI TO-92 PD = 310 mW	04713	2N4401
Q7	1853-0431	1	0	Transistor PNP SI PD = 65 W	01295	TIP42C
R1	0698-6619	8	8	Resistor 15 K .1% .125 W TF TC = 0 æ25	28480	0698-6619
R2	0698-4157	5	4	Resistor 10 K .1% .125 W TF TC = 0 æ50	28480	0698-4157
R3	0698-6619	8	0	Resistor 15 K .1% .125 W TF TC = 0 æ 25	28480	0698-6619
R4	0757-0291	6	2	Resistor 24.9 1% .125 W TF TC = 0 æ100	19701	5033R1/8TO2492F
R5	0698-6619	8	0	Resistor 15 K .1% .125 W TF TC = 0 æ25	28480	0698-6619

Table 7-3. Bias Assembly (A1) Replaceable Parts (Continued)

Reference Designator	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
R6	0698-4157	5	0	Resistor 10 K .1% .125 W TF TC=0 ±50	28480	0698-4157
R7	0757-0439	4	1	Resistor 6.81 K 1% .125 W TF TC=0 ±100	24546	CT41/8TO6811F
R8	0757-0283	6	2	Resistor 2 K 1% .125 W TF TC=0 ±100	24546	CT41/8TO2001F
R9	0698-3558	8	2	Resistor 4.02 K 1% .125 W TF TC=0 ±100	24546	CT41/8TO4021F
R10	0698-4409	0	1	Resistor 127 1% .125 W TF TC=0 ±100	24546	CT41/8TO127RF
R11	0698-3446	3	1	Resistor 383 1% .125 W TF TC=0 ±100	24546	CT41/8TO383RF
R12	0757-0442	9	4	Resistor 10 K 1% .125 W TF TC=0 ±100	24546	CT41/8TO1002F
R13	0698-6619	8	0	Resistor 15 K .1% .125 W TF TC=0 ±25	28480	0698-6619
R14	0698-3558	8	0	Resistor 4.02 K 1% .125 W TF TC=0 ±100	24546	CT41/8TO4021F
R15	0757-0283	6	0	Resistor 2 K 1% .125 W TF TC=0 ±100	24546	CT41/8TO2001F
R16	0698-4469	2	1	Resistor 1.15 K 1% .125 W TF TC=0 ±100	24546	CT41/8TO1151F
R17	0757-0291	6	0	Resistor 24.9 1% .125 W TF TC=0 ±100	19701	5033R1/8TO2492F
R18	0698-4157	5	0	Resistor 10 K .1% .125 W TF TC=0 ±50	28480	0698-4157
R19	0698-6619	8	0	Resistor 15 K .1% .125 W TF TC=0 ±25	28480	0698-6619
R20	0698-6619	8	0	Resistor 15 K .1% .125 W TF TC=0 ±25	28480	0698-6619
R21	0757-0411	2	1	Resistor 332 1% .125 W TF TC=0 ±100	24546	CT41/8TO322RF
R22	0757-0442	9	0	Resistor 10 K 1% .125 W TF TC=0 ±100	24546	CT41/8TO1002F
R23	0698-6619	8	0	Resistor 15 K .1% .125 W TF TC=0 ±25	28480	0698-6619
R24	0698-6619	8	0	Resistor 15 K .1% .125 W TF TC=0 ±25	28480	0698-6619
R25	0698-4157	5	0	Resistor 10 K .1% .125 W TF TC=0 ±50	28480	0698-4157
R26	0757-0419	0	1	Resistor 681 1% .125 W TF TC=0 ±100	24546	CT41/8TO681RF
R27	0698-4460	3	1	Resistor 649 1% .125 W TF TC=0 ±100	24546	CT41/8TO649RF
R28	2100-3211	7	2	Resistor-Trmr 1 K 10% TKF Top-Adj 1-Trn	28480	2100-3211
R29	2100-3211	7	2	Resistor-Trmr 1 K 10% TKF Top-Adj 1-Trn	28480	2100-3211
R30	0757-4433	0	2	Resistor 2.26 K 1% .125 W TF TC=0 ±100	24546	CT41/8TO2261F
R31	0757-4433	0	0	Resistor 2.26 K 1% .125 W TF TC=0 ±100	24546	CT41/8TO2261F
R32	0757-0280	3	3	Resistor 1 K 1% .125 W TF TC=0 ±100	24546	CT41/8TO1001F
R33	0698-3454	3	1	Resistor 215 K 1% .125 W TF TC=0 ±100	24546	CT41/8TO2153F
R34	0698-4477	2	1	Resistor 10.5 K 1% .125 W TD TC=0 ±100	24546	CT41/8TO1052F
R35	0698-3136	8	1	Resistor 17.8 K 1% .125 W TF TC=0 ±100	24546	CT41/8TO1782F
R36	0757-0442	9	0	Resistor 10 K 1% .125 W TF TC=0 ±100	24546	CT41/8TO1002F
R37	0698-4009	6	1	Resistor 50 K 1% .125 W TF TC=0 ±100	24546	CT41/8TO5002F
R38	0683-2255	9	1	Resistor 2.2 M 5% .25 W CF TC=0-900	28480	0683-2255
R39	0757-0280	3	0	Resistor 1 K 1% .125 W TF TC=0 ±100	24546	CT41/8TO1001F
R40	0698-4539	7	1	Resistor 402 K 1% .125 W TF TC=0 ±100	28480	0698-4539
R41	0698-6975	9	1	Resistor 10.1 K .1% .125 W TF TC=0 ± 25	28480	0698-6975
R42	0698-4002	9	1	Resistor 5 K 1% .125 W TF TC=0 ±100	24546	CT41/8TO5001F
R43	0757-0442	9	0	Resistor 10 K 1% .125 W TF TC=0 ±100	24546	CT41/8TO1002F
R44	0757-0280	3	0	Resistor 1 K 1% .125 W TF TC=0 ±100	24546	CT41/8-TO1001F

Table 7-3. Bias Assembly (A1) Replaceable Parts (Continued)

Reference Designator	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
TP1	0360-1971	0	4	Terminal Test Point 0.563 in Long; 0.118	28480	0360-1971
TP2	0360-1971	0	0	Terminal Test Point 0.563 in Long; 0.118	28480	0360-1971
TP3	0360-1971	0	0	Terminal Test Point 0.563 in Long; 0.118	28480	0360-1971
TP4	0360-1971	0	0	Terminal Test Point 0.563 in Long; 0.118	28480	0360-1971
U1	1826-0708	8	1	IC V Rgltr V-Ref-Fxd 9.9/10.1 V 8 Pin Dip	06665	Ref-01CP
U2	1826-0524	6	1	IC Op Amp GP Quad 14 Pin Dip Pkg	27014	LM324AN
U3	1826-0412	1	1	IC Comparator PPCN Dual 8 Pin Dip Pkg	27014	LM393N
U4	1820-3203	2	1	IC MV CMOS/74HC Monostable Retrig/Reset	04713	MC74HC4538N
U5	1820-1963	7	1	IC FF CMOS D Type Pos Edge Trig Dual	04713	MC14013BCP
XQ3	1200-0690	1	2	3 Pin Transistor Socket Dip Sldr	28480	1200-0690
XQ7	1200-0690	1	0	3 Pin Transistor Socket Dip Sldr	28480	1200-0690

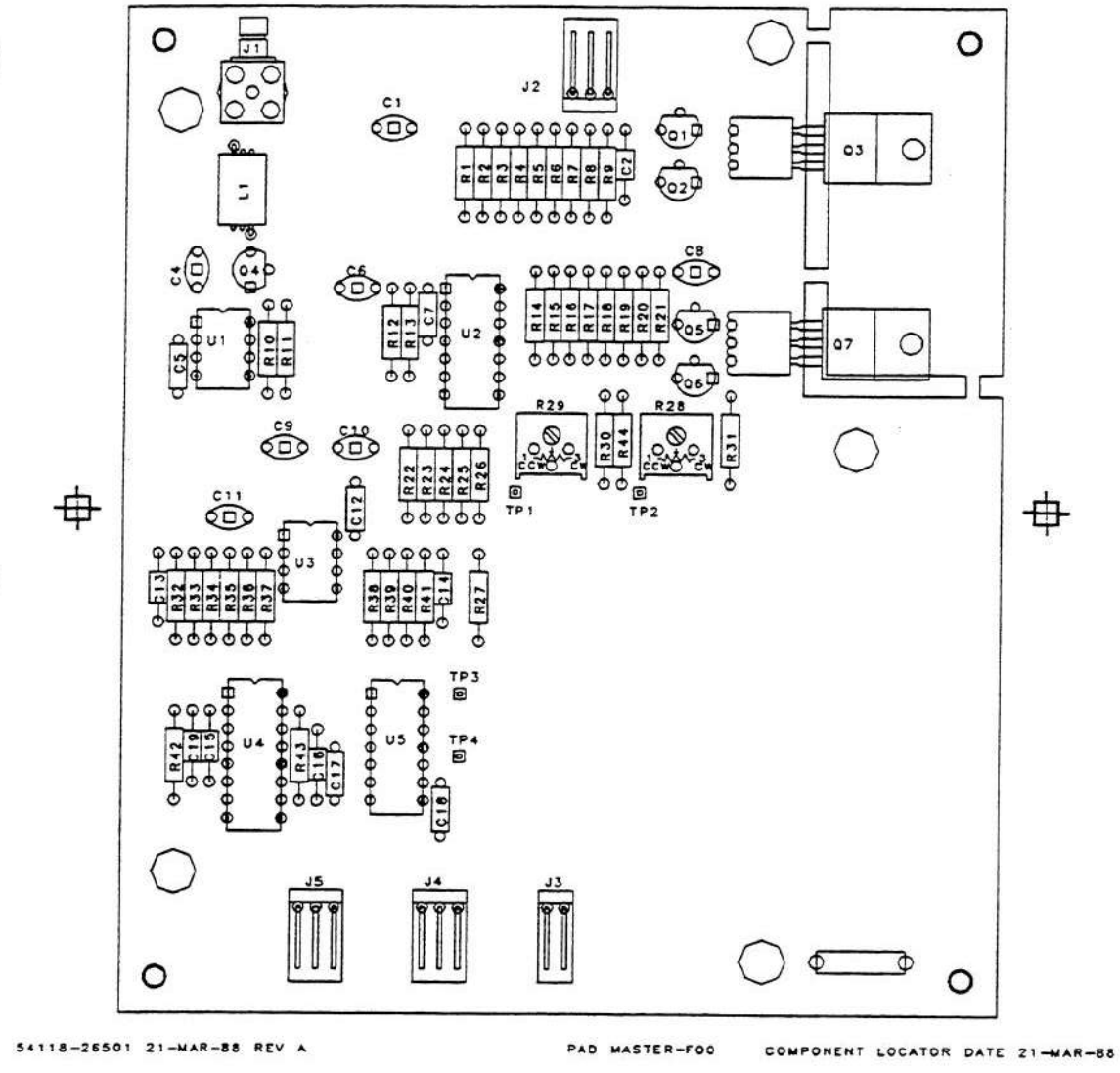


Figure 7-11. Bias Control Assembly Component Locator

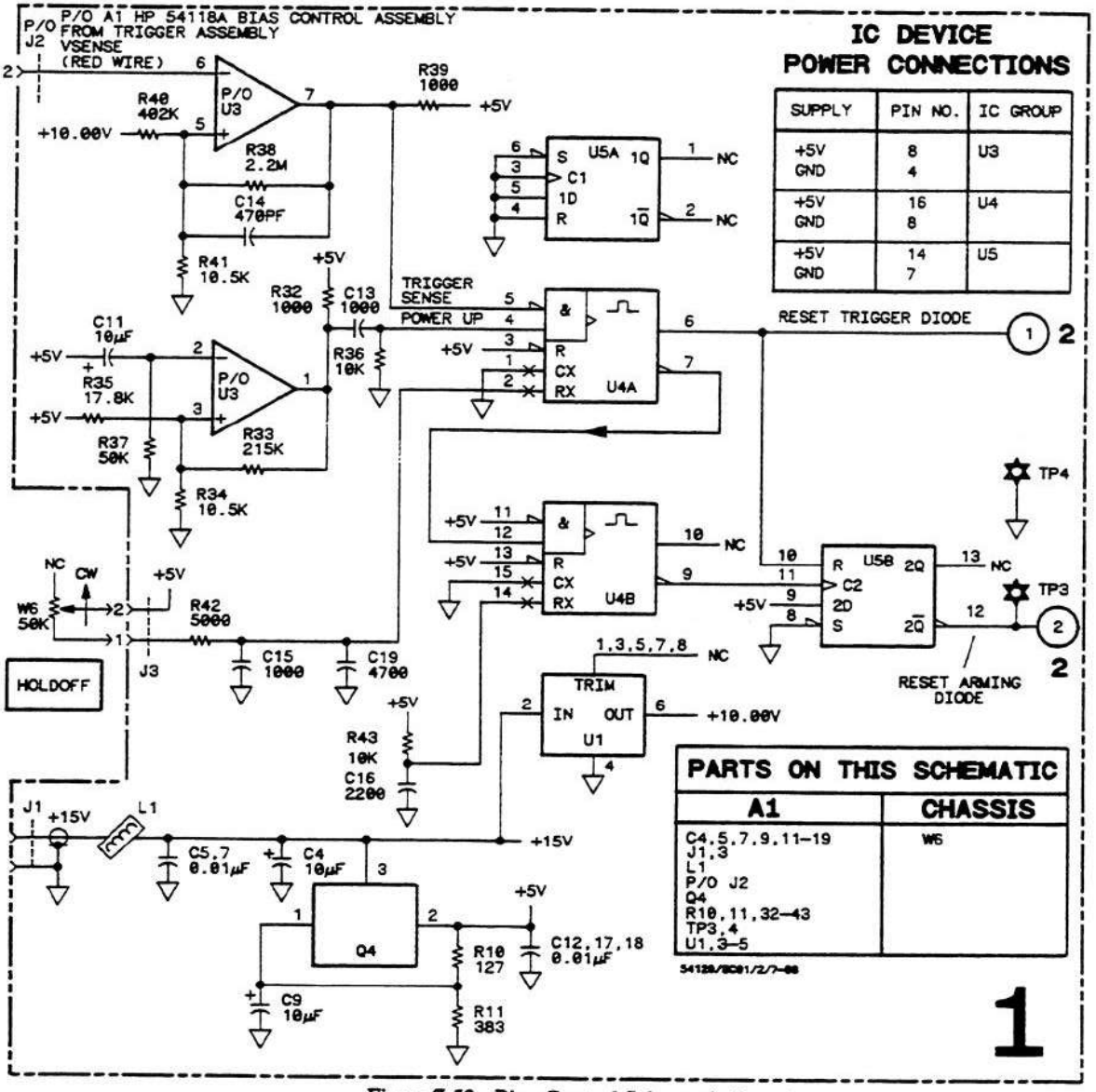


Figure 7-12. Bias Control Schematic 1.

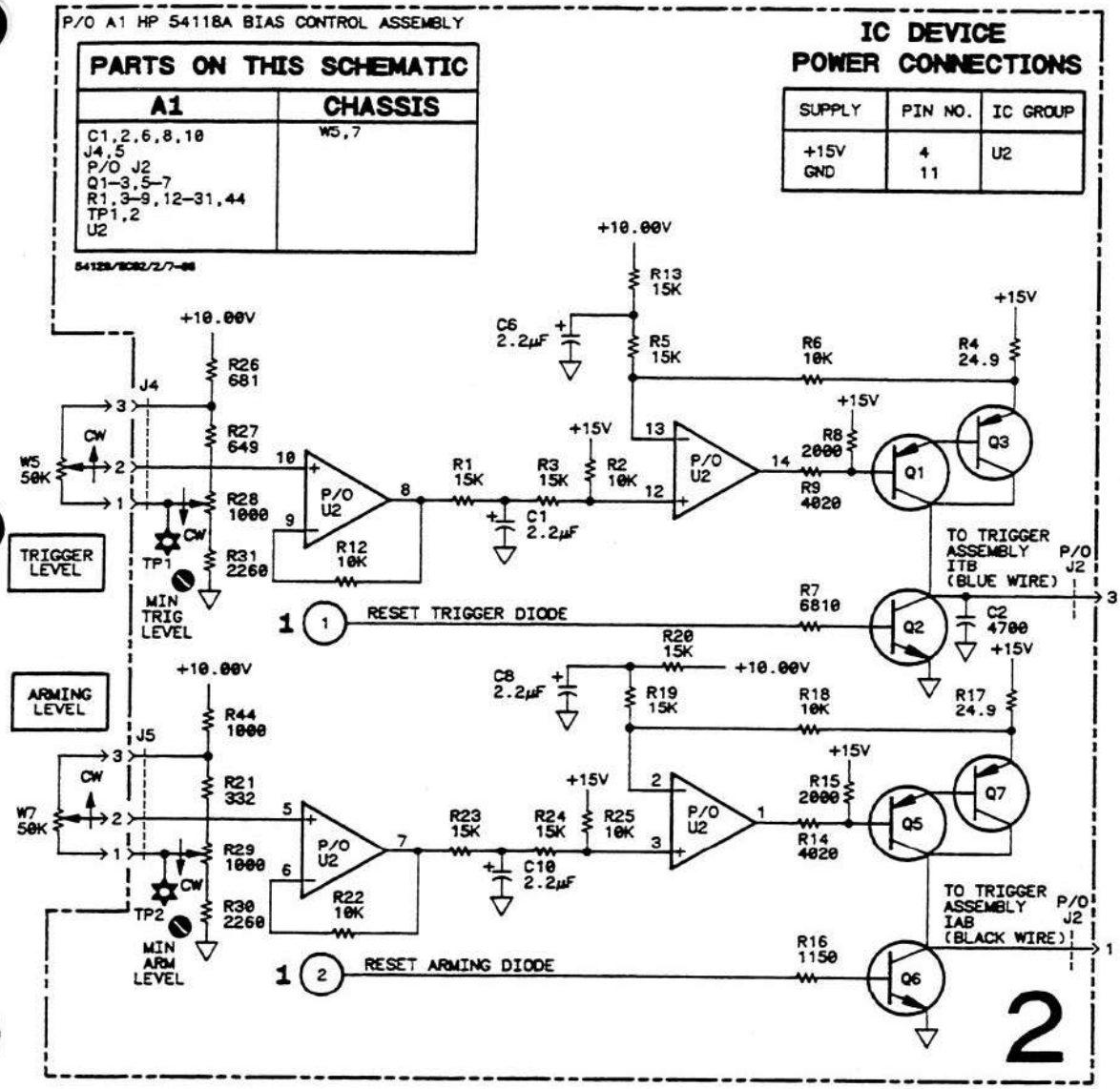


Figure 7-13. Bias Control Schematic 2.

Specifications and Characteristics

8

Introduction

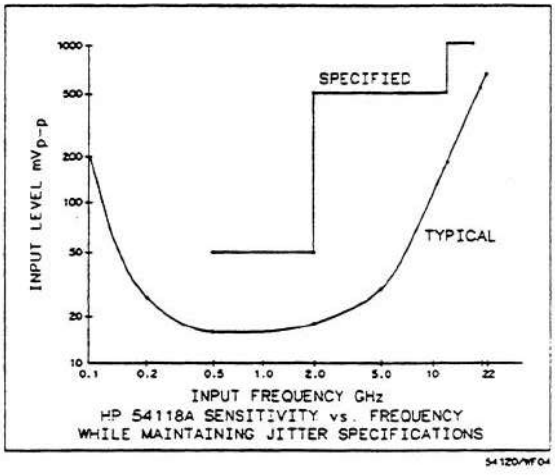
This chapter contains a list of specifications for your reference and performance verification reference. Also included are supplemental characteristics which are typical parameters that are included in this manual as additional information.

Specifications

The following specifications are divided into two groups: input and output.

Input

Sensitivity 50 mVp-p (− 22 dBm) from 500 MHz to 2 GHz
500 mVp-p (− 2 dBm) from 2 GHz to 12.4 GHz
1 Vp-p (+ 4 dBm) from 12.4 GHz to 18 GHz



% Reflection <5% with 30 ps step

Frequency Coverage 0.5 GHz to 18 GHz

Connector 3.5 mm (male)

Nominal Impedance 50 Ω

Coupling ac

Maximum Safe Input 25 Vdc, 4Vp-p ac (+ 16 dBm)

Trigger Level range 0 V to 2 Vp-p (+ 10 dBm)

Arming Level Range 0 V to 2 Vp-p (+ 10 dBm)

Output

Jitter (one sigma) specified for the system HP 54120T plus HP54118A
<3% of input signal period
i.e. <2.5 ps @ 12.4 GHz
<1.7 ps @ 18 GHz

Connector 3.5 mm (male)

Nominal Impedance 50 Ω

Coupling ac

Maximum Safe External Voltage 25 Vdc, 4Vp-p ac (+ 16 dBm)

Holdoff Range 50 μs to 200 μs

Characteristics

The following characteristics are divided into four groups: output, power, environmental, and weight.

Input

Kickout (at signal input) 300 mV kickout (single pulse)

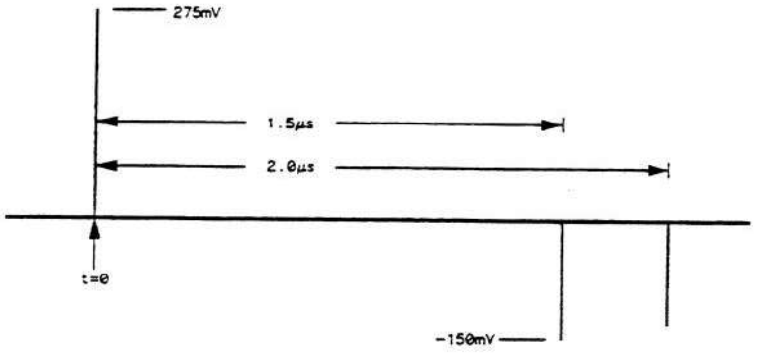


Figure 8-1. Typical Kickout Pulse

Output

Signal (into 50 Ω) 200 mV positive pulse 5 ns wide

Delay From Trigger Edge 4 ns (approximate)

Error Rate (trigger misfire rate) ≤ 1% of all trigger events

Power

Connector SMB snap on coaxial

Voltage + 15 Vdc ± 5%

Current 150 mA maximum, 130 mA typical

Power 2.4 Watts maximum

Environmental

Temperature Operating + 15° C to + 35° C (+ 59° F to + 95° F)
Temperature Non-operating – 40° C to + 70° C (– 40° F to + 150° F)

Humidity Operating 90% @ 35° C (+ 95° F)
Humidity Non-operating 90% @ 35° C (+ 95° F)

Altitude Operating 4600 metres (15,000 feet)
Altitude Non-operating 15300 metres (50,000 feet)

Vibration Operating 0.3 g random 5 to 500 Hz, 10 min/axis
Vibration Non-operating 2.41 g RMS random 5 to 500 Hz, 10 min/axis
0.75 g RMS sine 5-500 Hz, 5 min/resonance

Weight

Net Weight 1.8 kg (4 lbs) approximate

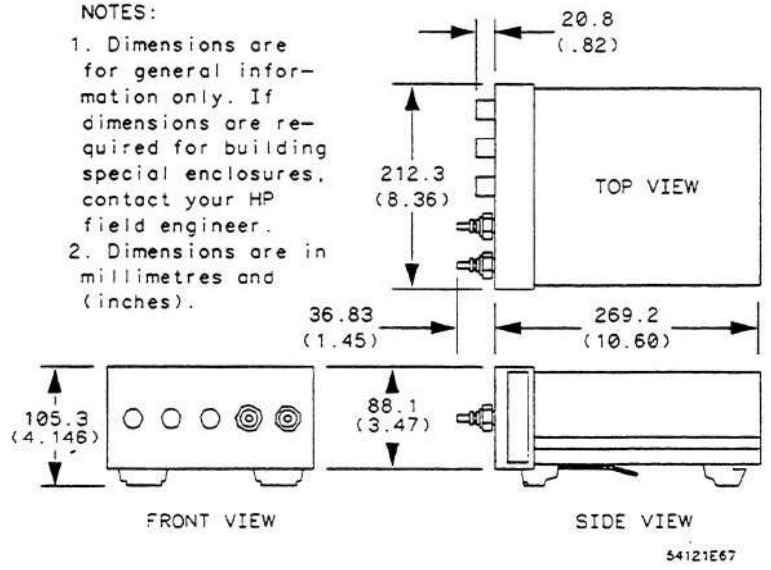


Figure 8-2. HP 5411&A's Dimensions

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