

**FLUKE®**

# **5820A**

Oscilloscope Calibrator

## Service Manual

PN 673142

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## Safety Information

This Calibrator complies with IEC publication 1010-1 (1992-1), Safety Requirements for Electrical Measuring, Control and Laboratory Equipment, and ANSI/ISA-S82.01-1994, and CAN/CSA-C22.2 No. 1010.1-92. This manual contains information, warnings, and cautions that must be followed to ensure safe operation and to maintain the Calibrator in a safe condition. Use of this Calibrator in a manner not specified herein may impair the protection provided by the Calibrator.

This Calibrator is designed for IEC 1010-1 Installation Category II use. It is not designed for connection to circuits rated over 4800 VA.

**Warning** statements identify conditions or practices that could result in personal injury or loss of life.

**Caution** statements identify conditions or practices that could result in damage to equipment.

### SYMBOLS MARKED ON THE CALIBRATOR



**WARNING** Risk of electric shock. Refer to the manual (see the Index for references).



**GROUND** Ground terminal to chassis (earth).



**Attention** Refer to the manual (see the Index for references). This symbol indicates that information about usage of a feature is contained in the manual.

### AC POWER SOURCE

The Calibrator is intended to operate from an ac power source that will not apply more than 264V ac rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is required for safe operation.

### USE THE PROPER FUSE

To avoid fire hazard, use only the specified replacement fuse:

- For 100 V or 120 V operation, use a 5A/250V time delay fuse (Fluke PN 109215).
- For 220 V or 240 V operation, use a 2.5A/250V time delay fuse (Fluke PN 851931).

### GROUNDING THE CALIBRATOR

The Calibrator uses controlled overvoltage techniques that require the Calibrator to be grounded whenever normal mode or common mode ac voltages or transient voltages may occur. The enclosure must be grounded through the grounding conductor of the power cord, or through the rear panel CHASSIS GROUND binding post.

### **USE THE PROPER POWER CORD**

Use only the power cord and connector appropriate for the voltage and plug configuration in your country.

Use only a power cord that is in good condition.

Refer power cord and connector changes to qualified service personnel.

### **DO NOT OPERATE IN EXPLOSIVE ATMOSPHERES**

To avoid explosion, do not operate the Calibrator in an atmosphere of explosive gas.

### **CHECK INSULATION RATINGS**

Verify that the voltage applied to the unit under test does not exceed the insulation rating of the UUT and the interconnecting cables.

### **DO NOT REMOVE COVER DURING OPERATION**

To avoid personal injury or death, do not remove the Calibrator cover without first removing the power source connected to the rear panel. Do not operate the Calibrator without the cover properly installed. Normal calibration is accomplished with the cover closed. Access procedures and the warnings for such procedures are contained in the Service Manual. Service procedures are for qualified service personnel only.

### **DO NOT ATTEMPT TO OPERATE IF PROTECTION MAY BE IMPAIRED**

If the Calibrator appears damaged or operates abnormally, protection may be impaired. Do not attempt to operate the Calibrator under these conditions. Refer all questions of proper Calibrator operation to qualified service personnel.

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# **Chapter 1**

## **Introduction and Specifications**

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## 1-1. Introduction

The Fluke Model 5820A Oscilloscope Calibrator (Figure 1-1) is a precise instrument that calibrates analog and digital oscilloscopes. Specifications are provided in this chapter.



### Warning

**To prevent electric shock or other possible injuries, the 5820A Calibrator must be operated in the way specified by this manual or other documentation provided by Fluke.**

### Caution

**Input voltages exceeding 30 V dc may cause damage to the instrument. Do not apply voltages except in voltage measurement mode.**

Features of the 5820A Calibrator include the following:

- Automatic meter error calculation.
-  and  keys that change the output value to pre-determined cardinal values for various functions.
- Programmable entry limits that prevent invalid amounts from being entered.
- Edge, Leveled Sine, Pulse, Marker, and Wave Generation modes.
- Accurate oscilloscopic input impedance measurement.
- Tunnel Diode Pulse compatibility.
- DC Volt Measure Mode.
- Current Mode generates both DC and low frequency ac current.
- 1 ns to 500 ns pulse width capability with skew controlled trigger.

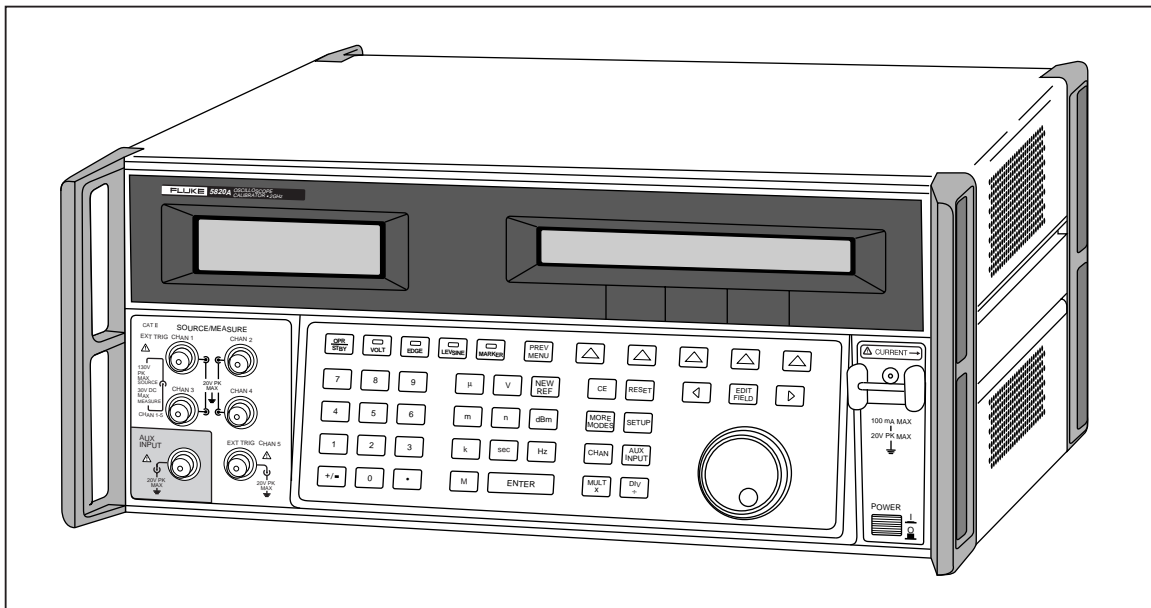


Figure 1-1. 5820A Oscilloscope Calibrator

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- External reference.
- Auxiliary input.
- 5-channel output (5-Channel Option). The 5-Channel Option allows you to calibrate up to five oscilloscope channels simultaneously without changing cables.
- Simultaneous output of a signal and a trigger signal.
- 600 MHz, Leveled Sine wave output.
- Optional 600 MHz - 2.1 GHz, Leveled Sine wave output with 150 ps fast edge.
- Standard IEEE-488 (GPIB) interface, complying with ANSI/IEEE Standards 488.1-1987 and 488.2-1987.
- EIA Standard RS-232-C serial data interface for printing, displaying, or transferring internally stored calibration constants, and for remote control of the 5820A.
- Pass-through RS-232-C serial data interface for communicating with the Unit Under Test (UUT).
- Extensive automatic internal self testing and diagnostics of analog and digital functions.

## **1-2. How to Contact Fluke**

USA and Canada: 1-888-99-FLUKE (1-888-993-5853)

Europe: +31 402-675-200

Japan: +81-3-3434-0181

Singapore: +65-738-5655

Anywhere in the world: +1-425-446-5500

For additional information about Fluke, its products, and services, visit Fluke's web site at: [www.fluke.com](http://www.fluke.com)

## **1-3. Instruction Manuals**

The 5820A Manual Set provides complete information for operators and service or maintenance technicians. The set includes:

- *5820A Operators Manual* (PN 802154)
- *5820A Service Manual* (PN 673142)

The *5820A Operators Manual* ships with the instrument. The *5820A Service Manual* is optional. Order additional copies of the manuals separately using the part number provided. For ordering instructions, refer to the Fluke Catalog, or ask a Fluke sales representative. These manuals are also available on Fluke's web site [www.fluke.com](http://www.fluke.com).

### **1-4. 5820A Operators Manual**

The *5820A Operators Manual* provides complete information for installing the 5820A Oscilloscope Calibrator and operating it from the front panel keys and in remote configurations. The manual also provides a glossary of calibration, specifications, and error code information. The *5820A Operators Manual* includes the following topics:

- Installation
- Operating controls and features, including front panel operation
- Remote operation (IEEE-488 bus or serial port remote control)



- Serial port operation (printing, displaying, or transferring data, and setting up for serial port remote control)
- Operator maintenance, including verification procedures and calibration approach for the 5820A
- Accessories
- Error Messages

### **1-5. 5820A Service Manual**

This *5820A Service Manual* includes: product specifications, appropriate theory of operation, calibration and verification procedures, maintenance information, and options.

### **1-6. Specifications**

The following paragraphs describe the details for the 5820A specifications. All specifications are valid after allowing a warm-up period of 30 minutes, or twice the time the 5820A has been turned off. (For example, if the 5820A has been turned off for 5 minutes, the warm-up period is 10 minutes.)

All specifications apply for the temperature and time period indicated. For temperatures outside of  $t_{cal} \pm 5\text{ }^{\circ}\text{C}$  ( $t_{cal}$  is the ambient temperature when the 5820A was calibrated), the temperature coefficient is less than 0.1 times the 1-year specification per  $^{\circ}\text{C}$  (limited to  $0\text{ }^{\circ}\text{C} - 50\text{ }^{\circ}\text{C}$ ).

If you ordered the GHz Option, the following specification tables are supplemented by the tables with similar headings in Chapter 5:

- Edge Specifications
- Leveled Sine Wave Specifications

Refer to Figure 1-2 for the dimensional outline of the 5820A Calibrator.

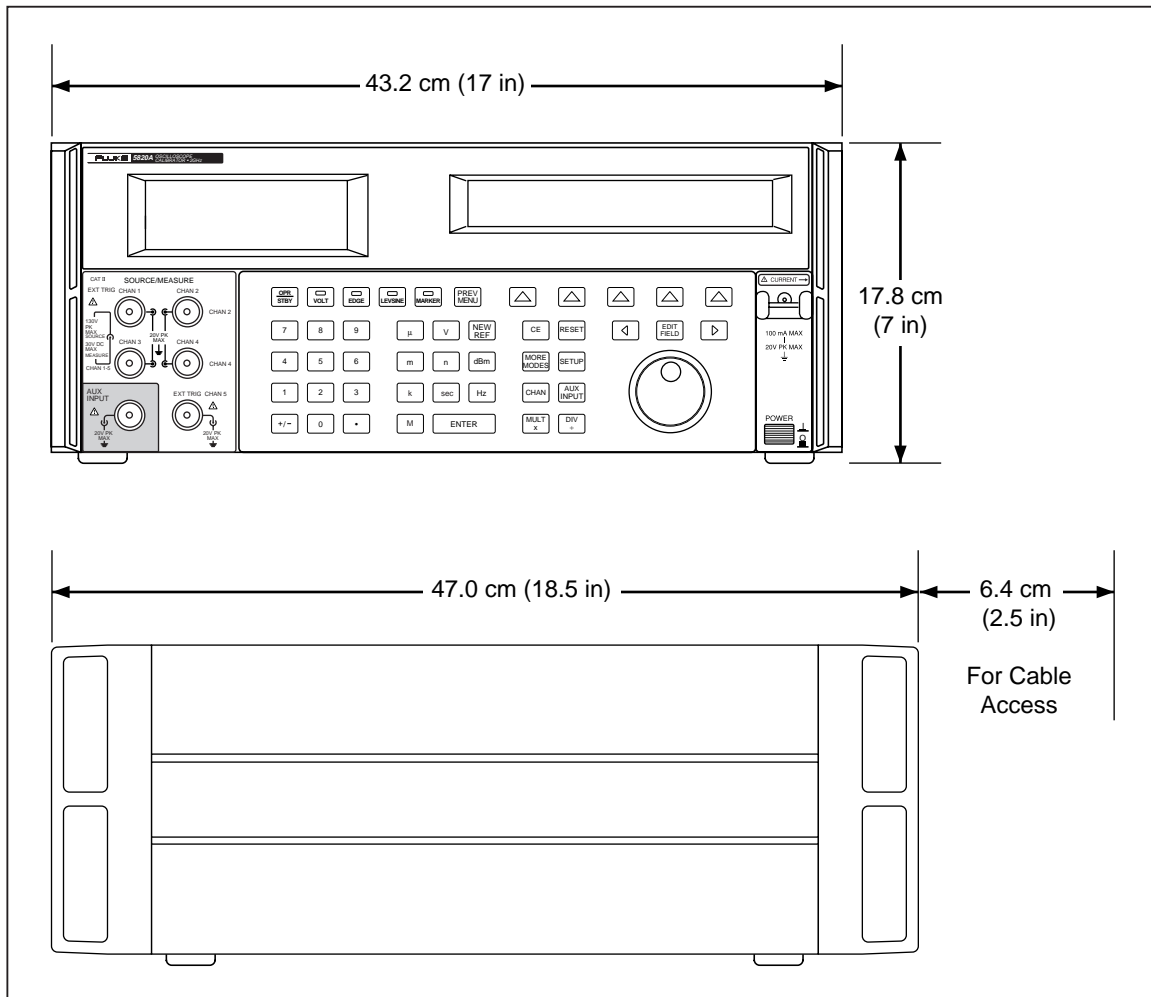


Figure 1-2. 5820A Calibrator Dimensional Outline

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## 1-7. General Specifications

Table 1-1. General Specifications

|                                      |  |
|--------------------------------------|--|
| <b>Warmup Time</b>                   | Twice the time since last warmed up, to a maximum of 30 minutes  |
| <b>Settling Time</b>                 | 5 seconds or faster for all functions and ranges   |
| <b>Standard Interfaces</b>           | IEEE-488 (GPIB), RS-232  |
| <b>Temperature Performance</b>       | Operating: 0 °C to 50 °C   |
|                                      | Calibration (tcal): 15 °C to 35 °C   |
|                                      | Storage: -20 °C to 70 °C   |
| <b>Electromagnetic Compatibility</b> | Designed to operate in Standard Laboratory environments where the Electromagnetic environment is highly controlled. If used in areas with Electromagnetic fields > 1 V/m, there could be errors in output values.<br>From 80 -252 MHz, the current output is susceptible to a field strength of > 0.165 V/M. |

|                                |   |
|--------------------------------|---|
| <b>Temperature Coefficient</b> | Temperature Coefficient for temperatures outside tcal $\pm 5$ °C is 0.1X/°C of 1-year specification.  |
| <b>Relative Humidity</b>       | Operating: < 80 % to 30 °C, < 70 % to 40 °C, < 40 % to 50 °C<br>Storage: < 95 %, noncondensing  |
| <b>Altitude</b>                | Operating: 3,050 m (10,000 ft) maximum<br>Nonoperating: 12,200 m (40,000 ft) maximum  |
| <b>Safety</b>                  | Designed to comply with IEC 1010-1 (1992-1); ANSI/ISA-S82.01-1994; CAN/CSA-C22.2 No. 1010.1-92  |
| <b>Interface Impedance</b>     | The 5820A is designed to drive both 50 $\Omega$ and 1M $\Omega$ loads.  |
| <b>Analog Low Isolation</b>    | 20 V  |
| <b>EMC</b>                     | Complies with EN 61326-1  |
| <b>Line Power</b>              | Line Voltage (selectable): 100 V, 120 V, 220 V, 240 V   |
|                                | Line Frequency: 47 to 63 Hz   |
|                                | Line Voltage Variation: $\pm 10$ % about line voltage setting   |
| <b>Power Consumption</b>       | 250 VA  |
| <b>Dimensions</b>              | Height: 17.8 cm (7 inches), standard rack increment, plus 1.5 cm (0.6 inch) for feet on bottom of unit;<br>Width: 43.2 cm (17 inches), standard rack width<br>Depth: 47.3 cm (18.6 inches) overall. |
| <b>Weight</b>                  | 20 kg (44 pounds)   |

## 1-8. Volt Specifications

Table 1-2. Volt Specifications

| Volt Function   |                    | DC Signal                         |                                    | Square Wave Signal [1]            |                                      |
|---|--------------------|-----------------------------------|------------------------------------|-----------------------------------|--------------------------------------|
| Load  |                    | into<br>50 Ω                      | into<br>1 MΩ                       | into<br>50 Ω                      | into<br>1 M Ω                        |
| <b>Amplitude Characteristics</b>  |                    |                                   |                                    |                                   |                                      |
| Range   |                    | 0 V to ± 6.6 V                    | 0 V to ± 130 V                     | ±1 mV to<br>±6.6 V p-p            | ±1 mV to<br>±130 V p-p               |
| Resolution  | range              | resolution                        |                                    |                                   |                                      |
|   | 1mV to 24.999 mV   | 1 μV                              |                                    |                                   |                                      |
|   | 25 mV to 109.99 mV | 10 μV                             |                                    |                                   |                                      |
|   | 110 mV to 2.1999 V | 100 μV                            |                                    |                                   |                                      |
|   | 2.2 V to 10.999 V  | 1 mV                              |                                    |                                   |                                      |
|   | 11 V to 130 V      | 10 mV                             |                                    |                                   |                                      |
| Adjustment Range  |                    | Continuous                        |                                    |                                   |                                      |
| 1-Year Absolute Uncertainty, tcal ± 5 °C  |                    | ± (0.25% of<br>output<br>+ 40 μV) | ± (0.025%<br>of output +<br>25 μV) | ± (0.25%<br>of output<br>+ 40 μV) | ± (0.05%<br>of output<br>+ 5 μV) [2] |
| Sequence  |                    | 1-2-5 (e.g., 10 mV, 20 mV, 50 mV) |                                    |                                   |                                      |
| <b>Square Wave Frequency Characteristics</b>  |                    |                                   |                                    |                                   |                                      |
| Range   |                    | 10 Hz to 10 kHz                   |                                    |                                   |                                      |
| 1-Year Absolute Uncertainty, tcal ± 5 °C  |                    | ± (0.33 ppm of setting)           |                                    |                                   |                                      |
| <b>Typical Aberration</b> (from 50% of<br>leading/trailing edge)<br>25 mV to 130 V: within 4 μs<br>10 mV to 25 mV: within 8 μs<br>1 mV to 10 mV: within 14 μs |                    | < (0.5% of output + 100 μV)       |                                    |                                   |                                      |
| [1] Positive or negative, zero referenced square wave.  |                    |                                   |                                    |                                   |                                      |
| [2] Above 1 kHz, ± (0.25% of output + 40 μV). Assumes connectors and cables are in good condition.  |                    |                                   |                                    |                                   |                                      |

### ⚠ Caution

**Input voltages exceeding 30 V dc may cause damage to the instrument.**

## 1-9. DC Volt Measure Specifications

Table 1-3. DC Volt Measure Specifications

| Voltage Range                           | Voltage Accuracy  |
|---|---|
| DCV ± 10 V maximum with 1 mV resolution | 0 to ± 5.99 V - 0.05% ± 1 mV<br>6 to ± 10 V - 0.25% ± 10 mV<br>> 1 MΩ input impedance (measure voltage across<br>1 MΩ input resistor) |

**1-10. Edge Specifications**

*Note*

*The GHz Option offers a Fast Edge function. The specifications for the Fast Edge function can be found in Chapter 5.*

**Table 1-4. Edge Specifications**

| <b>Edge Characteristics into 50 Ω Load</b>   |   | <b>1-Year Absolute Uncertainty, tcal ± 5 °C</b> |
|--|---|---|
| Rise Time  | ≤ 300 ps  | +0, -100 ps                                     |
| Amplitude Range (p-p)  | 4.0 mV to 2.5 V   | ± (2 % of output + 200 μV)                      |
| Resolution   | 4 digits  |   |
| Adjustment Range   | ± 10 % around each sequence value (indicated below)   |   |
| Sequence Values  | 5 mV, 10 mV, 25 mV, 50 mV, 60 mV, 80 mV, 100 mV, 200 mV, 250 mV, 300 mV, 500 mV, 600 mV, 1 V, 2.5 V |   |
| Frequency Range [1]  | 1 kHz to 10 MHz   | ± (0.33 ppm of setting)                         |
| Typical Jitter, edge to trigger  | < 3 ps (p-p)  |   |
| Leading Edge Aberrations[2]  | within 2 ns from 50 % of rising edge  | < (3 % of output + 2 mV)                        |
|  | 2 to 5 ns   | < (2 % of output + 2 mV)                        |
|  | 5 to 30 ns  | < (1 % of output + 2 mV)                        |
|  | after 30 ns   | < (0.5 % of output + 2 mV)                      |
| Typical Duty Cycle   | 45 % to 55 %  |   |
| <p>[1] Frequency range above 2 MHz has rise time specification 350 ps typical.</p> <p>[2] The leading edge aberrations below 250 mV are typical. All readings are referenced to a Tek11801 with an SD26 module or a Tek820 oscilloscope with a 8 GHz bandwidth option.</p> |   |   |

## 1-11. Leveled Sine Wave Specifications

### Note

The GHz Option offers an extended 600 MHz to 2.1 GHz Leveled Sine Wave range. If the GHz Option is installed, see the Leveled Sine Wave Specifications (> 600 MHz ) table in Chapter 5.

Table 1-5. Leveled Sine Wave Specifications (≤ 600 MHz )

| Leveled Sine Wave   | Frequency Range                          |                              |                            |                              |                            |
|---|--|------------------------------|----------------------------|------------------------------|----------------------------|
|   | 50 kHz (reference)                       | 50 kHz to 100 MHz            | 100 MHz to 300 MHz         | 300 MHz to 500 MHz           | 500 MHz to 600 MHz         |
| <b>Characteristics into 50 Ω</b>  |  |                              |                            |                              |                            |
| <b>Amplitude Characteristics</b>  |  |                              |                            |                              |                            |
| Range (p-p)   | 5 mV to 5.0 V                            |                              |                            |                              |                            |
| Resolution  | < 100 mV: 3 digits<br>≥ 100 mV: 4 digits |                              |                            |                              |                            |
| Adjustment Range  | continuously adjustable                  |                              |                            |                              |                            |
| 1-Year Absolute Uncertainty, tcal ± 5 °C  | ± (2 % of output + 300 μV)               | ± (3.5 % of output + 300 μV) | ± (4 % of output + 300 μV) | ± (5.5 % of output + 300 μV) | ± (6 % of output + 300 μV) |
| Flatness [1] (relative to 50 kHz)   | not applicable                           | ± (1.5 % of output + 100 μV) | ± (2 % of output + 100 μV) | ± (3.5 % of output + 100 μV) | ± (4 % of output + 100 μV) |
| Short-Term Amplitude Stability  | ≤ 1 % [2]                                |                              |                            |                              |                            |
| <b>Frequency Characteristics</b>  |  |                              |                            |                              |                            |
| Resolution  | 10 kHz                                   |                              |                            |                              |                            |
| 1-Year Absolute Uncertainty, tcal ± 5 °C  | ± 0.33 ppm                               |                              |                            |                              |                            |
| <b>Distortion Characteristics [3]</b>   |  |                              |                            |                              |                            |
| 2nd Harmonic  | ≤ -33 dBc                                |                              |                            |                              |                            |
| 3rd and Higher Harmonics  | ≤ -38 dBc                                |                              |                            |                              |                            |
| [1] As measured near Oscilloscope bandwidth frequency.<br>[2] Within one hour after reference amplitude setting, provided temperature varies no more than ± 5 °C.<br>[3] Harmonics above 500 MHz are typical. |  |                              |                            |                              |                            |

**1-12. Time Marker Specifications**

*Note*

*If you ordered the GHz Option, the following specification table is superseded by the table with the same heading in Chapter 5.*

**Table 1-6. Time Marker Specifications**

| <b>Time Marker into 50 Ω</b>  | <b>5 s to 50 ms</b>   | <b>20 ms to 100 ns</b>      | <b>50 ns to 20 ns</b> | <b>10 ns</b>   | <b>5 ns to 2 ns</b> |
|---|---|-----------------------------|-----------------------|----------------|---------------------|
| Wave Shape  | spike or square   | spike, square, or 20%-pulse | spike or square       | square or sine | sine                |
| Typical Output Level  | > 1 V p-p [1]   | > 1 V p-p [1]               | > 1 V p-p [1]         | >1 V p-p [1]   | > 1 V p-p           |
| Typical Jitter (p-p)  | < 10 ppm  | < 1 ppm                     | < 1 ppm               | < 1 ppm        | < 1 ppm             |
| Sequence  | 5-2-1 from 5 s to 2 ns (e.g., 500 ms, 200 ms, 100 ms )      |                             |                       |                |                     |
| Adjustment Range  | At least ± 10 % around each sequence value indicated above. |                             |                       |                |                     |
| Amplitude Resolution  | 4 digits  |                             |                       |                |                     |
| 1-Year Absolute Uncertainty, tcal ± 5 °C [3]  | ± (2.5 ppm + 5 μHz) [2]                                     | ± 0.33 ppm                  | ± 0.33 ppm            | ± 0.33 ppm     | ± 0.33 ppm          |
| <p>[1] Typical rise time of square wave and 20%-pulse (20 % duty cycle pulse) is &lt; 1.5 ns.</p> <p>[2] With 10 MHz external reference selected, the uncertainty becomes that of the external clock plus 5 μHz.</p> <p>[3] Time marker uncertainty is ± 50 ppm when measured off of cardinal points:<br/>                     5 s, 2 s, 1 s, 500 ms, 200 ms, 100 ms, 50 ms, 20 ms, 10 ms, 5 ms, 2 ms, 1 ms, 500 μs, 200 μs, 100μs, 50 μs, 20 μs, 10 μs, 5 μs, 2 μs, 1 μs, 500 ns, 200 ns, 100 ns, 50 ns, 20 ns, 10 ns, 5 ns and 2 ns</p> |   |                             |                       |                |                     |

### 1-13. Wave Generator Specifications

Table 1-7. Wave Generator Specifications

| Wave Generator Characteristics   | Square Wave and Sine Wave into 50 $\Omega$ or 1 M $\Omega$                       | Triangle Wave into 50 $\Omega$ or 1 M $\Omega$                                   |
|--|--|--|
| <b>Amplitude</b>   |  |  |
| Range  | into 1 M $\Omega$ : 1.8 mV to 55 V p-p<br>into 50 $\Omega$ : 1.8 mV to 2.5 V p-p | into 1 M $\Omega$ : 1.8 mV to 55 V p-p<br>into 50 $\Omega$ : 1.8 mV to 2.5 V p-p |
| 1-Year Absolute Uncertainty, tcal $\pm$ 5 $^{\circ}$ C, 10 Hz to 10 kHz  | $\pm$ (3 % of p-p output + 100 $\mu$ V)  | $\pm$ (3 % of p-p output + 100 $\mu$ V)  |
| Sequence   | 1-2-5 (e.g., 10 mV, 20 mV, 50 mV)  | 1-2-5 (e.g., 10 mV, 20 mV, 50 mV)  |
| Typical DC Offset Range  | 0 to $\pm$ ( $\geq$ 40 % of p-p amplitude) [1]                                   | 0 to $\pm$ ( $\geq$ 40 % of p-p amplitude) [1]                                   |
| Ramp Linearity [2]   |  | better than 0.1 % 10 Hz to 10 kHz [3]  |
| <b>Frequency</b>   |  |  |
| Range  | 0.01 Hz to 100 kHz   | 0.01 Hz to 100 kHz   |
| Resolution   | 4 or 5 digits depending upon frequency   | 4 or 5 digits depending upon frequency   |
| 1-Year Absolute Uncertainty, tcal $\pm$ 5 $^{\circ}$ C [5]   | $\pm$ (2.5 ppm + 5 $\mu$ Hz) [4]   | $\pm$ (2.5 ppm + 5 $\mu$ Hz) [4]   |
| <p>[1] The DC offset plus the wave signal must not exceed 30 V rms.<br/>                     [2] Applies to the 10 % to 90 % of the triangle waveform 500 mV p-p to 10 V p-p.<br/>                     [3] No specification below 10 Hz or above 10 kHz.<br/>                     [4] With 10 MHz external reference selected, the uncertainty becomes that of the external clock plus 5 <math>\mu</math>Hz.<br/>                     [5] Uncertainties below 10 Hz are typical.<br/>                     [6] Square wave rise/fall time typically less than 500 ns.</p> |  |  |



**1-14. 1 ns Pulse Generator Specifications**

**Table 1-8. Pulse Generator Specifications**

| Pulse Generator Characteristics  | Positive pulse into 50 Ω                         |
|--|--|
| Typical Rise/fall Time   | ≤ 500 ps   |
| Typical Available Amplitudes   | 1.5 V, 600 mV, 150 mV, 60 mV, 15 mV              |
| <b>Pulse Width</b>   |  |
| Range [1]  | 1 ns to 500 ns                                   |
| Uncertainty  | 5% ± 200 ps                                      |
| <b>Pulse Period</b>  |  |
| Pulse width < 1 ns   | 20 ms to 200 ns                                  |
| 1 ns ≤ Pulse width ≤ 9.9 ns  | 20 ms to 200 ns                                  |
| 10 ns ≤ Pulse width ≤ 79.9 ns  | 20 ms to 2 μs                                    |
| 80 ns ≤ Pulse width ≤ 500 ns   | 20 ms to 10 μs                                   |
| Resolution   | 4 or 5 digits depending upon frequency and width |
| 1-Year Absolute Uncertainty, tcal ± 5 °C   | ± 0.33 ppm                                       |
| <b>Pulse Skew with Trigger[3]</b>  |  |
| Range [2]  | +30 ns to -10ns with 250 ps resolution           |
| Uncertainty [4]  | ± 500 ps   |
| [1] May generate pulses below 1ns but pulse width accuracy is not specified.<br>[2] Assumes that trigger used in divide by 1 mode. Other divide modes are not specified.<br>[3] Pulse skew measured from 30% of trigger signal amplitude to 30% of pulse range amplitude.<br>[4] Uncertainty specification applies only for pulse periods that are 3 μs or greater in duration.<br>Otherwise, skew uncertainty is typical. |  |

**1-15. Trigger Signal Specifications (Pulse Function)**

**Table 1-9. Trigger Signal Specifications (Pulse Function)**

| Pulse Period  | Division Ratio | Amplitude into 50 Ω (p-p) | Typical Rise Time |
|---|----------------|---------------------------|-------------------|
| 20 ms to 200 ns   | off/1/10/100   | ≥ 1 V                     | ≤ 2 ns            |
| Skew between Pulse and Trigger programmable from -10 ns to +30 ns |                |                           |                   |

**1-16. Trigger Signal Specifications (Time Marker Function)**

**Table 1-10. Trigger Signal Specifications (Time Marker Function)**

| Pulse Period      | Division Ratio [1] | Amplitude into 50 Ω (p-p) | Typical Rise Time |
|-------------------|--------------------|---------------------------|-------------------|
| 5 s to 750 ns     | off/1              | ≥ 1 V                     | ≤ 2 ns            |
| 34.9 ms to 7.5 ns | off/10             | ≥ 1 V                     | ≤ 2 ns            |
| 34.9 ms to 2 ns   | off/1/10/100       | ≥ 1 V                     | ≤ 2 ns            |

### 1-17. Trigger Signal Specifications (Edge Function)

Table 1-11. Trigger Signal Specifications (Edge Function)

| Edge Signal Frequency | Division Ratio | Typical Amplitude into 50 $\Omega$ (p-p) | Typical Rise Time | Typical Lead Time |
|-----------------------|----------------|--|-------------------|-------------------|
| 1 kHz to 10 MHz       | off/1          | $\geq 1$ V                               | $\leq 2$ ns       | 40 ns             |

### 1-18. Trigger Signal Specifications (Square Wave Voltage Function)

Table 1-12. Trigger Signal Specifications (Square Wave Voltage Function)

| Edge Signal Frequency | Division Ratio | Typical Amplitude into 50 $\Omega$ (p-p) | Typical Rise Time | Typical Lead Time |
|-----------------------|----------------|--|-------------------|-------------------|
| 10 Hz to 10 kHz       | off/1          | $\geq 1$ V                               | $\leq 2$ ns       | 2 $\mu$ s         |

### 1-19. Trigger Signal Specifications (TV)

Table 1-13. TV Trigger Signal Specifications

| Trigger Signal Type              | Parameters  |
|----------------------------------|---|
| Frame Formats                    | Selectable NTSC, SECAM, PAL, PAL-M                                |
| Polarity                         | Positive or negative  |
| Amplitude into 50 $\Omega$ (p-p) | Adjustable 0 to 1.5 V p-p into 50 ohm load, ( $\pm 7$ % accuracy) |
| Line Marker                      | Selectable Line Video Marker                                      |

### 1-20. Tunnel Diode Drive Capability

Table 1-14. Tunnel Diode Drive Capability

|                |   |
|----------------|---|
| TD Pulse Drive | Square wave at 100 Hz to 100 kHz with variable amplitude of 60 to 100 V p-p |
|----------------|---|

### 1-21. Oscilloscope Input Resistance Measurement Specifications

Table 1-15. Oscilloscope Input Resistance Measurement Specifications

| Scope Input Selected | 50 $\Omega$                | 1 M $\Omega$                     |
|----------------------|----------------------------|----------------------------------|
| Measurement Range    | 40 $\Omega$ to 60 $\Omega$ | 500 k $\Omega$ to 1.5 M $\Omega$ |
| Uncertainty          | 0.1 %                      | 0.1 %                            |

### 1-22. Oscilloscope Input Capacitance Measurement Specifications

Table 1-16. Oscilloscope Input Capacitance Measurement Specifications

| Scope Input Selected  | 1 M $\Omega$                      |
|---|-----------------------------------|
| Measurement Range   | 5 pF to 50 pF                     |
| Uncertainty   | $\pm$ (5 % of input + 0.5 pF) [1] |
| [1] Measurement made within 30 minutes of capacitance zero reference. |                                   |

**1-23. Overload Measurement Specifications**

The Overload test function applies dc or ac (1 kHz square wave) power into the 50 Ω oscilloscope input and monitors the current. A time measurement counter indicates the time duration of the applied overload signal. When the input protection circuit reacts and opens up the 50 Ω load, the calibrator indication is set to ‘off’ on the right hand display. In order to prevent front end damage to the oscilloscope, a limited amount of energy is applied by a user selectable time limit.

**Table 1-17. Overload Measurement Specifications**

| Source Voltage | Typical ‘On’ current indication | Typical ‘Off’ current indication | Maximum Time Limit DC or AC (1 kHz) |
|----------------|---------------------------------|----------------------------------|-------------------------------------|
| 5 V to 9 V     | 100 mA to 180 mA                | 10 mA                            | setable 5 to 60 sec                 |

**1-24. External Reference Input Specifications**

The External Reference Input selection allows the user to provide their own high stability 10 MHz reference clock for the 5820A for all functions except the Wave Generator function. For all other modes, the frequency stability is determined by the external reference stability. The external reference input must be between 1 to 5 V p-p.

**1-25. Auxiliary Input Specifications**

Maximum input voltage into the auxiliary input is 40 V p-p.

**Table 1-18. Auxiliary Input Performance**

| Channel Configuration | Frequency        | Typical Loss | Typical VSWR |
|-----------------------|------------------|--------------|--------------|
| 1-Channel             | < 600 MHz        | ≤ 1.1 dB     | ≤ 1.2:1      |
| 1-Channel             | 600 MHz to 1 GHz | ≤ 1.3 dB     | ≤ 1.4:1      |
| 1-Channel             | 1 GHz to 2.0 GHz | ≤ 2.0 dB     | ≤ 1.7:1      |
| 1-Channel             | 2 GHz to 3 GHz   | ≤ 3.0 dB     | ≤ 2.0:1      |
| 5-Channel             | < 600 MHz        | ≤ 1.1 dB     | ≤ 1.2:1      |
| 5-Channel             | 600 MHz to 1 GHz | ≤ 1.3 dB     | ≤ 1.4:1      |
| 5-Channel             | 1 GHz to 2.0 GHz | ≤ 2.0 dB     | ≤ 1.7:1      |
| 5-Channel             | 2 GHz to 3 GHz   | ≤ 3.0 dB     | ≤ 2.0:1      |

**1-26. Current Output Specifications**

**Table 1-19. Current Output Specifications**

|  | DC                   | Squarewave             |
|--|----------------------|------------------------|
| <b>Amplitude (compliance voltage 2 V max)</b>  | ± 100 µA to ± 100 mA | 100 µAp-p to 100 mAp-p |
| Accuracy   | ± (0.25% + 0.5 µA)   | ± (0.25% + 0.5 µA) [1] |
| <b>Frequency Range</b>   | N/A                  | 10 Hz to 100 KHz       |
| Accuracy   |                      | 2.5 ppm +5 µHz         |
| Steps  |                      | 1,2,5 or continuous    |
| [1] Amplitude uncertainty for frequency range 45 Hz to 1 kHz at < 120 mV compliance voltage. |                      |                        |



## **Chapter 2**

# **Theory of Operation**

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## 2-1. Introduction

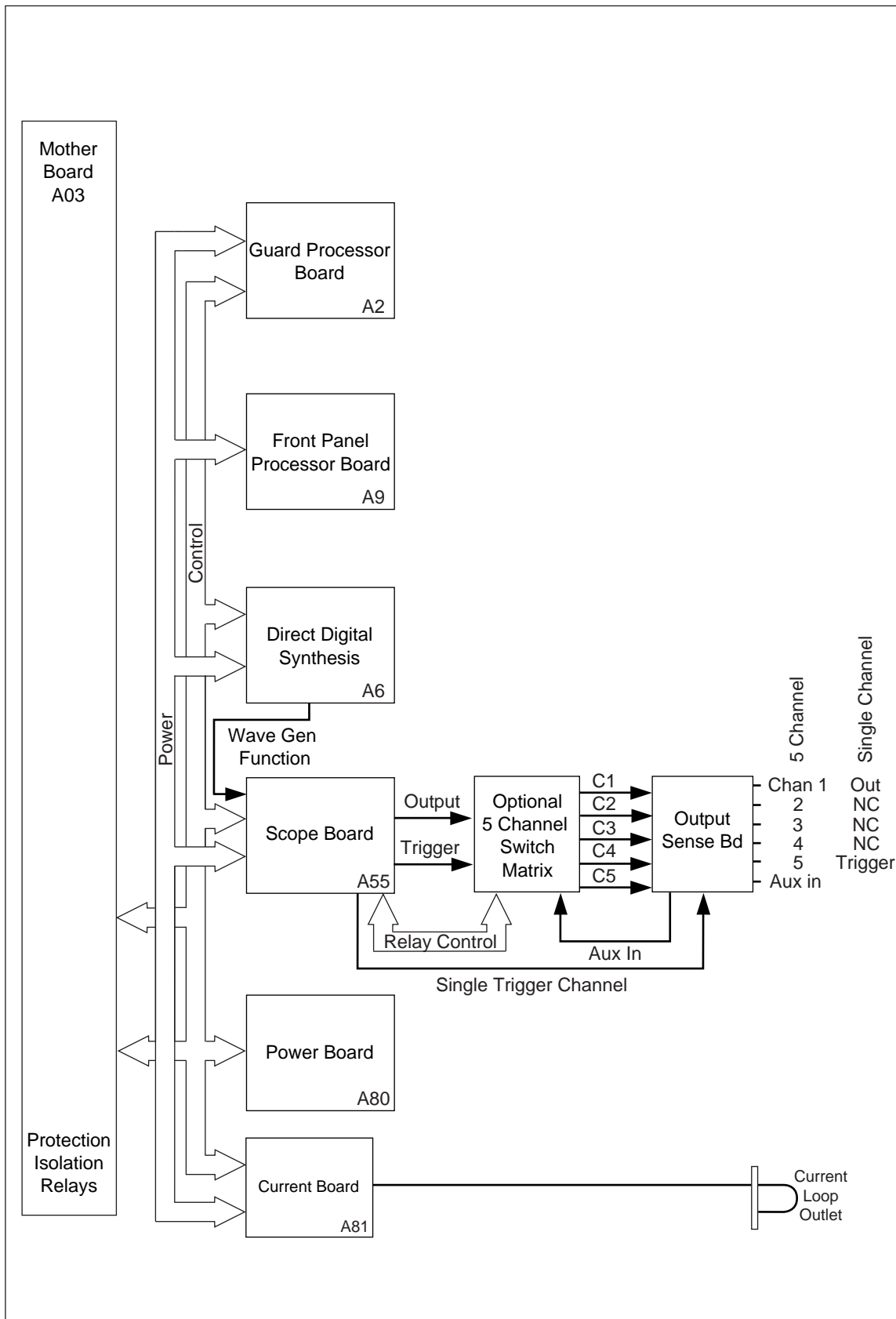
The following discussion provides a brief overview of the following 5820A operating modes:

- Voltage
- Edge
- Leveled sine wave
- Time marker
- Wave generator
- Video
- Pulse generator
- Input impedance
- Overload
- Current
- 5 Channel Option
- DC Volts Measure
- GHz Option (2.1 GHz Leveled Sine and Fast Edge).

This discussion will allow you to identify which of the main plug-in boards of the Calibrator Mainframe are defective. Figure 2-1 shows a block diagram of the 5820A. Note that while ac power is filtered on the A3 Mother Board, most supply voltages are derived on the A80 Voltage Board.

The components in the scope module are shown in Figure 2-2. A signal diagram is shown in Figure 2-3. The scope module consists of the following:

- The A55 Main Scope Board, which generates leveled sine, marker, capacitance measurement, and trigger.
- The A51 Voltage/Video Board, which generates precision dc and ac low frequency square wave, video, overload measurement and resistance measurement.
- The A90 Attenuator/Edge Attenuator, which attenuates the signal by 0 to -48 dB and generates the < 300 ps edge.
- The A52 Pulse Board, which generates pulse generator signals.



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Figure 2-1. Signal Diagram of Chassis



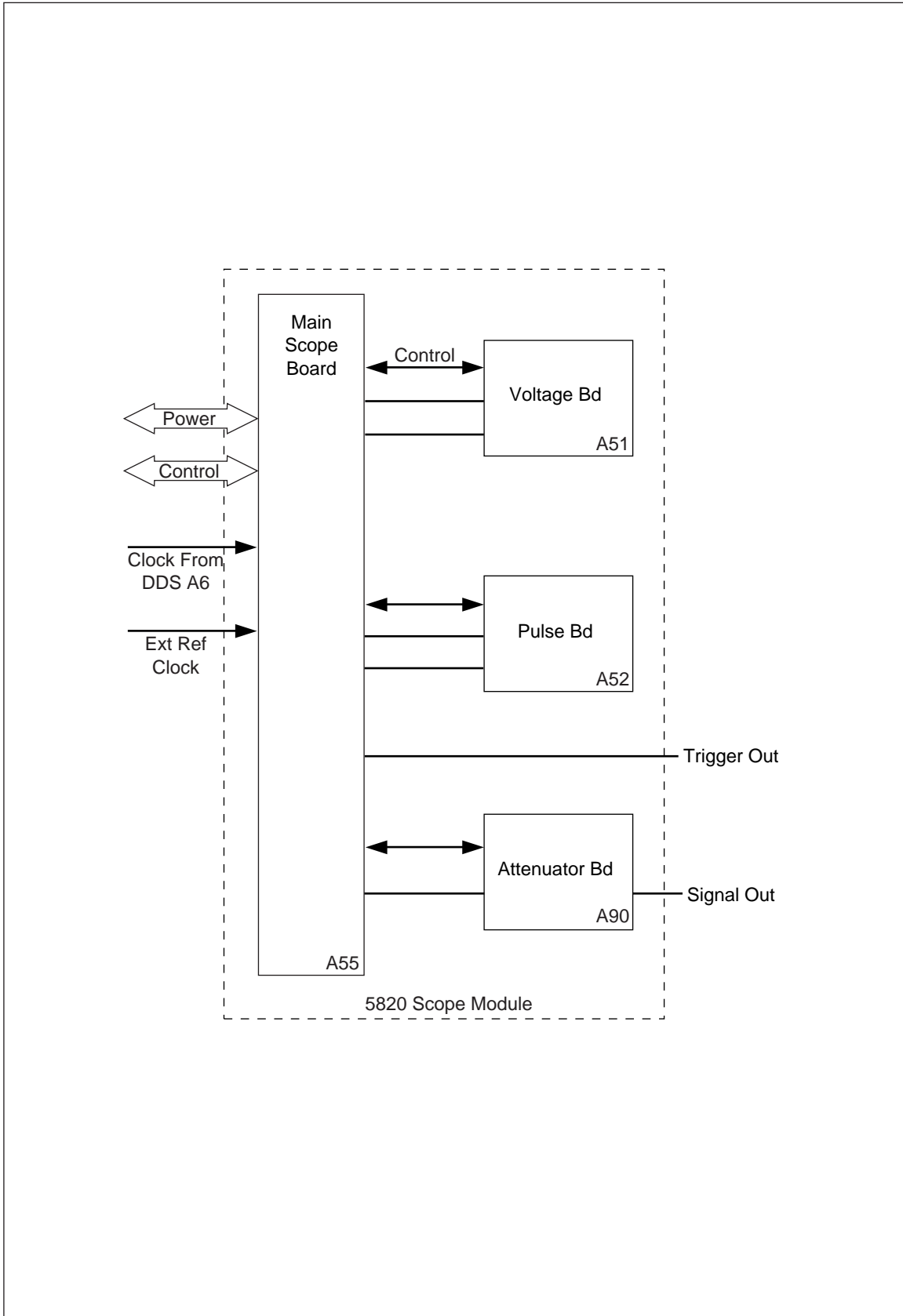


Figure 2-2. Block Diagram of Scope Module

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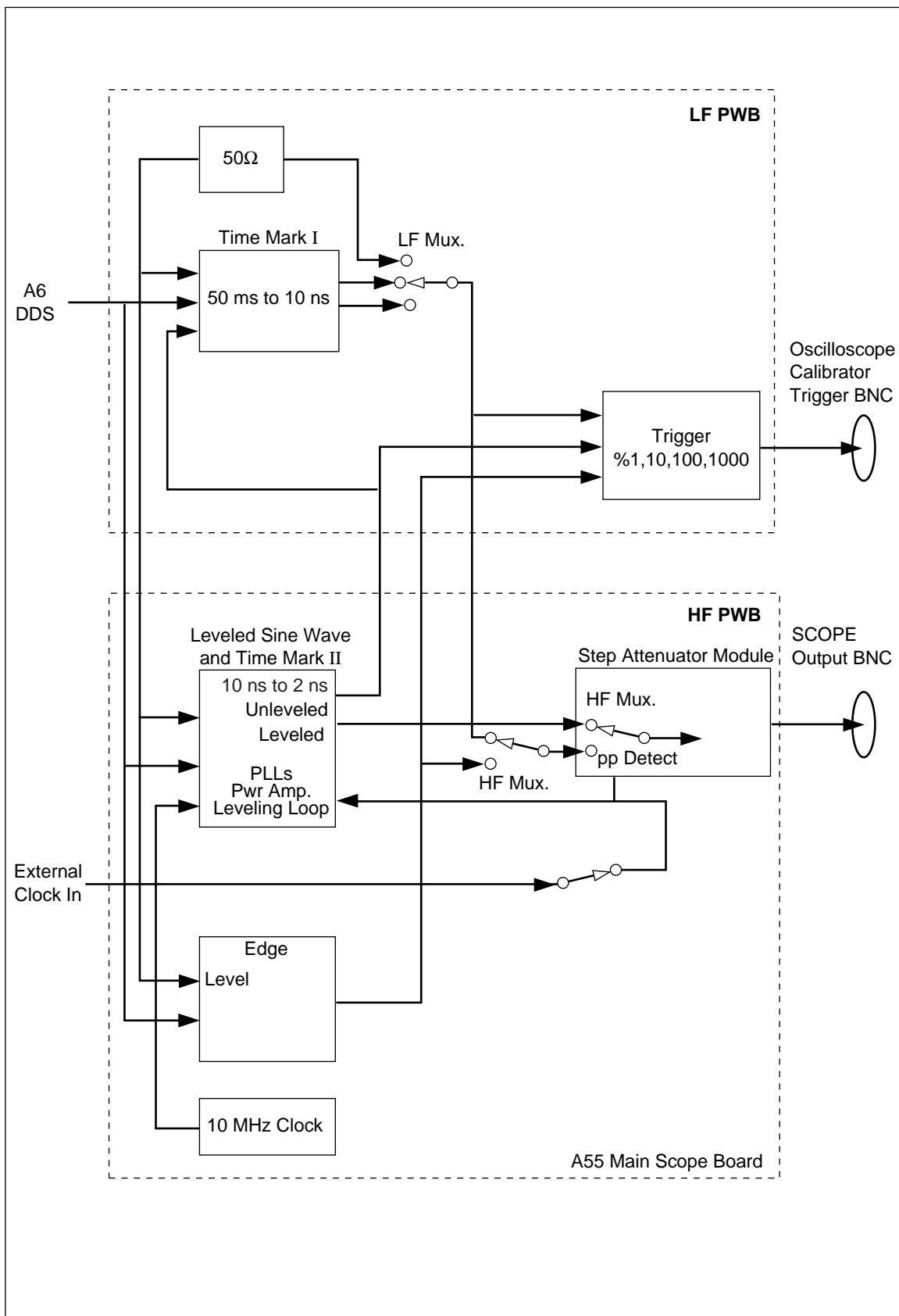


Figure 2-3. Signal Diagram of Scope Module

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Other than the scope module, the A81 Current Board, the A6 Direct Digital Synthesis Board, and the A3 Mother Board, provide the other functions in the 5820A. Digital controls are provided by the 5520A-4002 for the front panel display and by 5520A-4009 Out-Guard CPU on the rear panel for all external and internal communication.

The A6 provides low frequency marker frequencies, the wave generator functions and also contains the acquisition circuitry used in the dc voltage measurement. In addition, the main voltage reference signals are generated on this board.

The A3 is used to provide the routing for all control signals from the guard processor and the signal path for all low frequency signals including the voltage sense signals. An auxiliary input, Auxin, is a feature that allows a signal to be routed from the front panel to the output port.

Optional features for the 5820A include 5-channel multiplexing capability and GHz extended frequency capability. The 5-channel option allows the output signals to be routed to one of five output ports. The GHz (gigahertz) option provides a 2.1 GHz leveled sine and 150 ps fast edge. Information about the optional feature can be found in the “Options” chapter of this manual.

*Note*

*In the following discussion, the circuit boards are generally referenced by their last two digits. As an example, the 5820A-4055 Main Scope Board is referred to as the A55.*

## **2-2. Voltage Mode**

All ac and dc voltage function signals are generated from the A51 Voltage/Video Board, a daughter card to the A55 Main Scope Board. A dc reference voltage is supplied to A51 from the A6 Direct Digital Synthesis Board; this reference is used for all dc and ac amplitudes. All frequency signals (clock) are generated on the A55. The output of the A51 is passed to the A55 board, which then passes through the A90 Edge/Attenuator Board. The signal is then passed to the front panel high frequency switch. The dc reference signal is used to generate both positive (+) and negative (-) dc and ac signals that are amplified or attenuated to provide the complete range of output voltage signals. Output trigger capability is available with the ac voltage signal.

## **2-3. Edge Mode**

The edge clock originates on A55 and is used on A90 to generate the < 300 ps edge signal. The edge signal is passed through the attenuator section of A90 and then, like all of the signals, is passed to the front panel high frequency switch. Output trigger capability is available with this signal.

## **2-4. Leveled Sine Wave Mode**

Leveled sine wave signals from 50 kHz to 600 MHz are produced on A55. The leveled sine wave signal is passed from A55 to the A90. The A90 provides range attenuation and also contains a power detector that maintains the amplitude flatness across the frequency range. The signal is then passed to the front panel high frequency switch. Output trigger capability is not available with this signal.

## **2-5. Time Marker Mode**

There are 4 primary “ranges” of time marker operation: 5 s to 50 ms, 20 ms to 2  $\mu$ s, 1  $\mu$ s to 20 ns and 10 ns to 2 ns.

The 5 s to 50 ms markers are generated on A6 and are passed to A55 for filtering and shaping. The 20 ms to 2  $\mu$ s markers are derived from a square wave signal that is generated on A55 and passed through wave shaping and external trigger generation. The 1  $\mu$ s to 20 ns periods are derived from leveled sine or square wave signals.

The 10 ns to 2 ns sine markers are generated from the leveled sine wave generator on A55. This signal is also split to drive the external trigger circuits. If the trigger is turned on, the signal is then connected to the Trig Out on the front panel. The other path routes the signal to the marker circuits on A55, where the signal is shaped into the other marker waveforms. The marker signals are passed from A55 to the A90 and on to the front panel high frequency switch.

Filters on A55 shape the signal into spike and 20% pulse. The marker signal passing through A55 is connected to the A90 assembly. The signal is then passed to the front panel high frequency switch. Output trigger capability is available with these signals.

### **2-6. Wave Generator Mode**

All amplitude and frequency for the Wavegen function are generated on A6 and the signals are routed through A55. The signals are then sent to the A90 assembly, where range attenuation occurs. Wavegen signals are then sent to front panel high frequency switch. Output trigger capability is not available with these signals.

### **2-7. Pulse Generator**

Pulse Gen (Pulse Generator Modes) signals are derived from A52. While the maximum pulse period is 20 ms or 50 Hz, the minimum is 200 ns. The pulse width can be set to less than 1 ns or set as wide as 500 ns. The pulse can be skewed with the output trigger so that it leads or lags the trigger in 250 ps increments. Output trigger capability is available with this signal.

### **2-8. Input DC Voltage Measurement Mode**

The dc voltage measurement mode is provided through A6. The input signal to be measured is filtered on A3. The DCV reference signal and measuring signals are on A6. Maximum input voltage is 10 V dc.

#### **Caution**

**Input voltages above 30 V dc may cause damage to the unit.**

### **2-9. Input Impedance Mode (Resistance)**

The reference resistors for input resistances are on A51, while the actual measurement takes place on A6.

### **2-10. Input Impedance Mode (Capacitance)**

Capacitance measurement circuits are contained on A55. Signals from the leveled sine signals are used in the measurement.

**2-11. Current Module**

For the A81 Current Board, A55 supplies the reference signal. This signal is inverted with respect to polarity of the output current (a negative voltage results in a positive current output). A81 has three ranges: 100  $\mu$ A to 1.0999 mA, 1.1 mA to 10.999 mA and 11 mA to 100 mA. The board limits the compliance to 2 V.

**2-12. Overload Mode**

The source voltage for the overload mode is generated on the A51 Voltage/Video Board. The voltage is applied to the external 50  $\Omega$  load, and the circuit current is monitored by A6.

**2-13. Trigger**

The A55 marker clock signal is used to generate the trigger signals. There are two trigger output SMB connectors on A55. The right angle SMB should be used to route the trigger signal to the front panel. The vertical connector should be used to route the trigger signal to the optional GHz module, if installed.

**2-14. High Frequency Switching**

For the standard single channel calibrator, output signals, except for current and trigger, are routed to a high frequency switch. From the switch, the signals are cabled to the 5820A-4096 output block. For the single channel unit, the trigger signal and current signal are cabled directly to the output block and current loop, respectively. A high frequency relay is used to select between the auxiliary input signal, Auxin, and the output signal. The selected signal is cabled to connectors on the front panel. In five channel units, additional high frequency switches are used to route the trigger signal out channel 1 or channel 5.

**2-15. 5 Channel Option**

This option multiplexes the output to one of the 5 channels. All signals, except for current, are routed through this switch system.

**2-16. GHz Option Module**

The GHz option extends leveled sine from 600 MHz to 2.1 GHz and adds a 150 ps, 250 mV fast edge signal. For more information on the GHz Option Module, see the Options Chapter.



## **Chapter 3**

# **Calibration and Verification**

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### 3-1. Introduction

Use this chapter as a guide to calibration and for verification of the Scope Calibrator’s performance to specifications.

### 3-2. Equipment Required for Calibration and Verification

Table 3-1 lists the equipment, recommended models, and minimum specifications required for each calibration and verification procedure.

**Table 3-1. Scope Calibrator Calibration and Verification Equipment**

| <b>Wave Generator and Edge Amplitude Calibration, AC Voltage and TD Pulser Verification Minimum Use Specifications</b> |  |  |  |
|--|--|--|--|
| Instrument   | Model  |  |  |
| Digital Multimeter   | HP 3458A   | Voltage  | 1.8 mV to $\pm 130$ V p-p Uncertainty: 0.06% |
|  |  | Edge   | 4.5 mV to 2.75 V p-p Uncertainty: 0.06%      |
| Adapter  | Pomona #1269   | BNC(f) to Double Banana Plug   |  |
| Termination  |  | Feedthrough $50 \Omega \pm 1\%$ (used with Edge Amplitude Calibration and AC Voltage Verification) |  |
| N to BNC Cable   | (supplied with Scope Calibrator)   |  |  |
| <b>Edge Rise Time and Aberrations Verification</b>   |  |  |  |
| High-Frequency Digital Storage Oscilloscope  | Tektronix 11801 with Tektronix SD-22/26 sampling head, or Tektronix TDS 820 with 8 GHz bandwidth [1] | Frequency  | 8 to 20 GHz                                  |
|  |  | Resolution   | 4.5 mV to 2.75 V                             |
| Attenuator   | Weinschel 9-10 (SMA) or Weinschel 18W-10 or equivalent   | 10 dB, SMA (m/f)   |  |
| Adapter  |  | BNC(f) to SMA (m)  |  |
| N to BNC Cable   | (supplied with Scope Calibrator)   |  |  |
| <b>DC and AC Voltage Calibration and Verification, DC Voltage Verification</b>   |  |  |  |
| Digital Multimeter   | HP 3458A   |  |  |
| Adapter  | Pomona #1269   | BNC(f) to Double Banana Plug   |  |
| Termination  |  | Feedthrough $50 \Omega \pm 1\%$ .  |  |
| N to BNC Cable   | (supplied with Scope Calibrator)   |  |  |
| [1] Note that Fluke Met/Cal certified procedures use the Tek 11801 scope.  |  |  |  |

**Table 3-1. Scope Calibrator Calibration and Verification Equipment (cont.)**

| <b>Current Calibration, AC/DC Current Verification Minimum Use Specifications</b> |  |   |  |
|---|--|---|--|
| <b>Instrument</b><br>Digital Multimeter Adapter                                   | <b>Model</b><br>HP 3458A   | Voltage   | 1 mV to $\pm 2$ V p-p Uncertainty: 0.06% |
|   | Pomona #1269   | BNC(f) to Double Banana Plug                                      |  |
| 1 $\Omega$ Resistor Assembly  | User Supplied  | Measured to $\pm 0.05\%$ , 125 mW, including banana jack mounting |  |
| 10 $\Omega$ Resistor Assembly   | User Supplied  | Measured to $\pm 0.05\%$ , 250 mW, including banana jack mounting |  |
| 100 $\Omega$ Resistor Assembly  | User Supplied  | Measured to $\pm 0.05\%$ , 125 mW, including banana jack mounting |  |
| 1000 $\Omega$ Resistor Assembly   | User Supplied  | Measured to $\pm 0.05\%$ , 125 mW, including banana jack mounting |  |
| N to BNC Cable  | (supplied with Scope Calibrator)   |   |  |
| <b>Pulse Width Calibration and Verification</b>                                   |  |   |  |
| High-Frequency Digital Storage Oscilloscope                                       | Tektronix 11801 with Tektronix SD-22/26 sampling head or Tektronics TDS 820 scope with 8 GHz option. |   |  |
| Attenuator (2)  |  | 3 dB, SMA (m/f)   |  |
| SMA T connector   |  | (m)-(f)-(m)   |  |
| 0.5 M SMA cable   |  | (m)-(m)   |  |
| Adapter (2)   |  | BNC(f) to SMA(m)  |  |
| N to BNC Cable (2)  | (supplied with Scope Calibrator)   |   |  |
| <b>Leveled Sine Wave Frequency Verification</b>                                   |  |   |  |
| Frequency Counter   | PM 6680 with option (PM 9621, PM 9624, or PM 9625) and (PM 9690 or PM 9691)                          | 50 kHz to 600 MHz, <0.1 ppm uncertainty                           |  |
| Adapter   | Pomona #3288   | BNC(f) to Type N(m)   |  |
| N to BNC Cable  | (supplied with Scope Calibrator)   |   |  |
| <b>Leveled Sine Wave Flatness (Low Frequency) Calibration and Verification</b>    |  |   |  |
| AC Measurement Standard   | Fluke 5790A with -03 option  | Range   | 5 mV p-p to 5.5 V p-p                    |
|   |  | Frequency   | 50 kHz to 10 MHz                         |
| Adapter   | Pomona #3288   | BNC(f) to Type N(m)   |  |
| N to BNC Cable  | (supplied with Scope Calibrator)   |   |  |
| <b>Leveled Sine Wave Harmonics Verification</b>                                   |  |   |  |
| Spectrum Analyzer   | HP 8590A   | 600 MHz and below   |  |
|   | HP 8592L   | Above 600 MHz (GHz Option)  |  |
| Adapter   | Pomona #3288   | BNC(f) to Type N(m)   |  |
| N to BNC Cable  | (supplied with Scope Calibrator)   |   |  |
| <b>Pulse Period, Edge Frequency, AC Voltage Frequency Verification</b>            |  |   |  |
| Frequency Counter   | PM 6680 with option (PM 9690 or PM 9691)   | 20 ms to 150 ns, 10 Hz to 10 MHz: < 0.12 ppm uncertainty          |  |
| N to BNC Cable  | (supplied with Scope Calibrator)   |   |  |

**Table 3-1. Scope Calibrator Calibration and Verification Equipment (cont.)**


| <b>Edge Duty Cycle Minimum Use Specifications</b>                               |   |  |                        |
|---|---|--|------------------------|
| <b>Instrument</b>   | <b>Model</b>  |  |                        |
| Frequency Counter   | PM 6680   |  |                        |
| N to BNC Cable  | (supplied with Scope Calibrator)  |  |                        |
| <b>Overload Functional Verification</b>   |   |  |                        |
| Termination   |   | Feedthrough 50 Ω ± 1%.   |                        |
| N to BNC Cable  | (supplied with Scope Calibrator)  |  |                        |
| <b>MeasZ Resistance, Capacitance Verification</b>                               |   |  |                        |
| Resistors   | User supplied   | 40 Ω, 60 Ω, 600 kΩ and 1.5 MΩ nominal values                       |                        |
| Capacitors  | User supplied   | 5 pF, 28 pF and 50 pF nominal value at the end of BNC(f) connector |                        |
| Adapters  |   | to connect resistors and capacitors to BNC(f) connector            |                        |
| N to BNC Cable  | (supplied with Scope Calibrator)  |  |                        |
| <b>Leveled Sine Wave Flatness (High Frequency) Calibration and Verification</b> |   |  |                        |
| Power Meter   | Hewlett-Packard 437B  | Range  | -42 to +5.6 dBm        |
|   |   | Frequency  | 10 - 600 MHz           |
| Power Sensor  | Hewlett-Packard 8482A   | Range  | -20 to +19 dBm         |
|   |   | Frequency  | 10 - 600 MHz           |
| Power Sensor  | Hewlett-Packard 8481D   | Range  | -42 to -20 dBm         |
|   |   | Frequency  | 10 - 600 MHz           |
| 30 dB Reference Attenuator  | Hewlett-Packard 11708A<br>(supplied with HP 8481D)                          | Range  | 30 dB                  |
|   |   | Frequency  | 50 MHz                 |
| Adapter   | Hewlett-Packard PN 1250-1474  | BNC(f) to Type N(f)  |                        |
| N to BNC Cable  | (supplied with Scope Calibrator)  |  |                        |
| <b>Leveled Sine Wave Frequency, Time Marker Verification</b>                    |   |  |                        |
| Frequency Counter   | PM 6680 with option (PM 9621, PM 9624, or PM 9625) and (PM 9690 or PM 9691) | 2 ns to 5 s, 50 kHz to 600 MHz: < 0.1 ppm uncertainty              |                        |
| Adapter   | Pomona #3288  | BNC(f) to Type N(m)  |                        |
| N to BNC Cable  | (supplied with Scope Calibrator)  |  |                        |
| <b>Wave Generator Verification</b>  |   |  |                        |
| AC Measurement Standard   | Fluke 5790A   | Range  | 1.8 mV p-p to 55 V p-p |
|   |   | Frequency  | 10 Hz to 100 kHz       |
| Adapter   | Pomona #1269  | BNC(f) to Double Banana  |                        |
| Termination   |   | Feedthrough 50 Ω ± 1%.   |                        |
| N to BNC Cable  | (supplied with Scope Calibrator)  |  |                        |

### 3-3. Calibration Setup

The procedures in this manual have been developed to provide users the ability to calibrate the Scope Calibrator at their own site if they are required to do so. It is strongly recommended that, if possible, you return your unit to Fluke for calibration and verification.

The hardware adjustments are intended to be one-time adjustments performed in the factory, however, adjustment may be required after repair. Hardware adjustments must be performed prior to calibration. Calibration must be performed after any hardware adjustments. See “Hardware Adjustments” in this chapter.

The AC Voltage function is dependent on the DC Voltage function. Calibration of the AC Voltage function is required after the dc voltage is calibrated.

The Calibrator Mainframe must complete a warm-up period prior to calibration to allow internal components to thermally stabilize. The Calibrator Mainframe warm-up period is at least twice the length of time the calibrator was powered off, up to a maximum of 30 minutes. The Scope Calibrator is enabled by pressing the Operate/Standby key ().

Much of the Scope Calibrator can be calibrated interactively from the front panel. Enter 5820A Cal mode by pressing the front panel **SETUP** key, **CAL** blue softkey, and **5820A CAL** blue softkey. Entering the **CAL** mode prior to a 30 minute warmup period will cause a warning message to be displayed.

All equipment specified for Scope Calibrator calibration must be calibrated, certified traceable if traceability is to be maintained, and operating within their normal specified operating environment. It is also important to ensure that the equipment has had sufficient time to warm up prior to its use. Refer to the operating manuals for each piece of equipment for details.

Before you begin calibration, you may wish to review all of the procedures in advance to ensure you have the resources to complete them.

The Calibrator Mainframe first prompts the user to calibrate the DC Voltage function. If another function is to be calibrated, alternately press the **NEXT SECTION** blue softkey until the desired function is reached.

### 3-4. Calibration and Verification of Square Wave Voltage Functions

The Voltage, Edge, and Wave Generator functions have square wave voltages that need to be calibrated or verified. The HP3458A digital multimeter can be programmed from either the front panel or over the remote interface to make these measurements.

#### 3-5. Overview of HP3458A Operation

The Hewlett-Packard 3458A digital multimeter is setup as a digitizer to measure the peak-to-peak value of the signal. It is set to DCV, using various analog-to-digital integration times and triggering commands to measure the topline and baseline of the square wave signal.

#### 3-6. Setup for Scope Calibrator Voltage Square Wave Measurements

By controlling the HP 3458A's integration and sample time, it can be used to make accurate, repeatable measurements of both the topline and baseline of the Voltage Square Wave up to 10 kHz. To make these measurements, the HP 3458A's External Trigger function is used in conjunction with the Scope Calibrator External Trigger

output. In general, the HP 3458A is setup to make an analog-to-digital conversion after receiving the falling edge of an external trigger. The conversion does not take place until a time determined by the 3458A “DELAY” command. The actual integration time is set according to the frequency that the DMM is measuring. Table 3-2 below summarizes the DMM settings required to make topline and baseline measurements. Figure 3-1 shows the proper equipment connections.

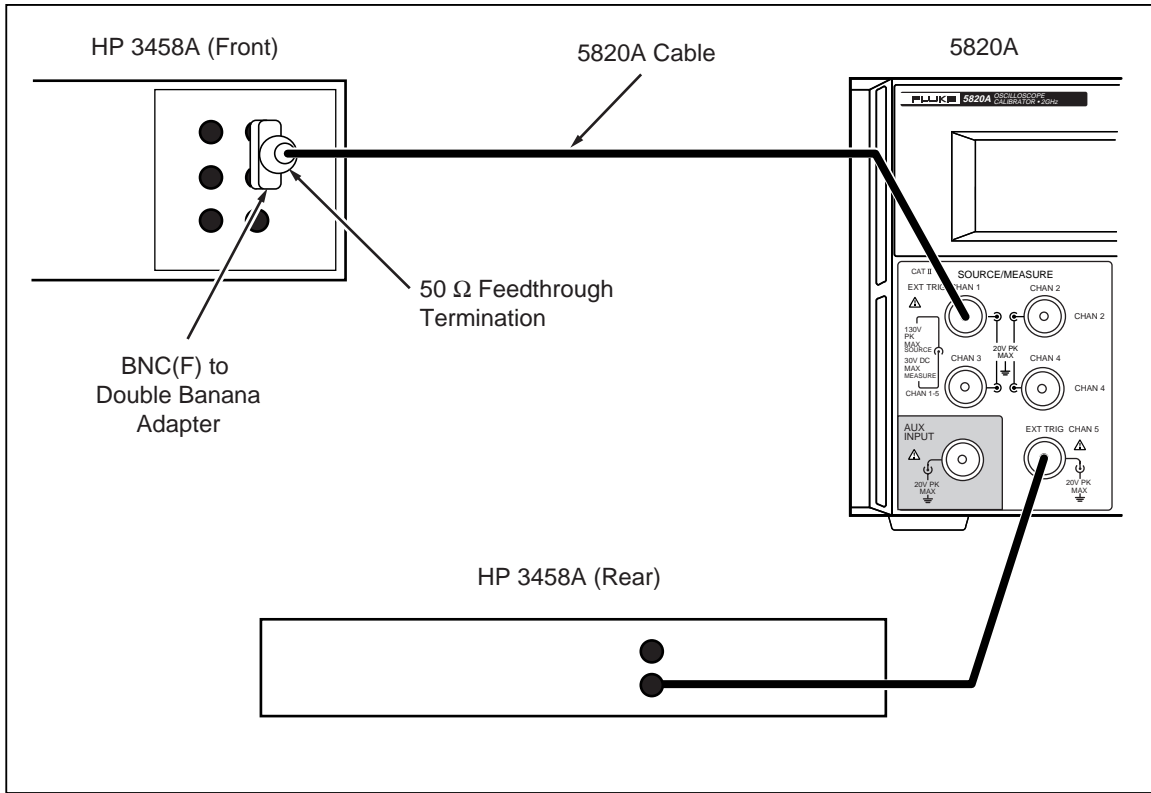
**Table 3-2. Voltage HP3458A Settings**

| Voltage<br>Input Frequency | HP 3458A Settings |                 |                  |
|----------------------------|-------------------|-----------------|------------------|
|                            | NPLC              | DELAY (topline) | DELAY (baseline) |
| 100 Hz                     | .1                | .007 s          | .012 s           |
| 1 kHz                      | .01               | .0007 s         | .0012 s          |
| 5 kHz                      | .002              | .00014          | .00024           |
| 10 kHz                     | .001              | .00007          | .00012           |

For all measurements, the HP 3458A is in DCV, manual ranging, with external trigger enabled. A convenient method to make these measurements from the HP 3458A’s front panel is to program these settings into several of the user defined keys on its front panel. For example, to make topline measurements at 1 kHz, you would set the DMM to “NPLC .01; DELAY .0007; TRIG EXT”. To find the average of multiple readings, you can program one of the keys to “MATH OFF; MATH STAT” and then use the “RMATH MEAN” function to recall the average or mean value.

*Note*

*For this application, if making measurements of a signal > 1 kHz, the HP 3458A has been known to have .05% to 0.1% peaking. For these signals, lock the HP 3458A to the 1V range.*



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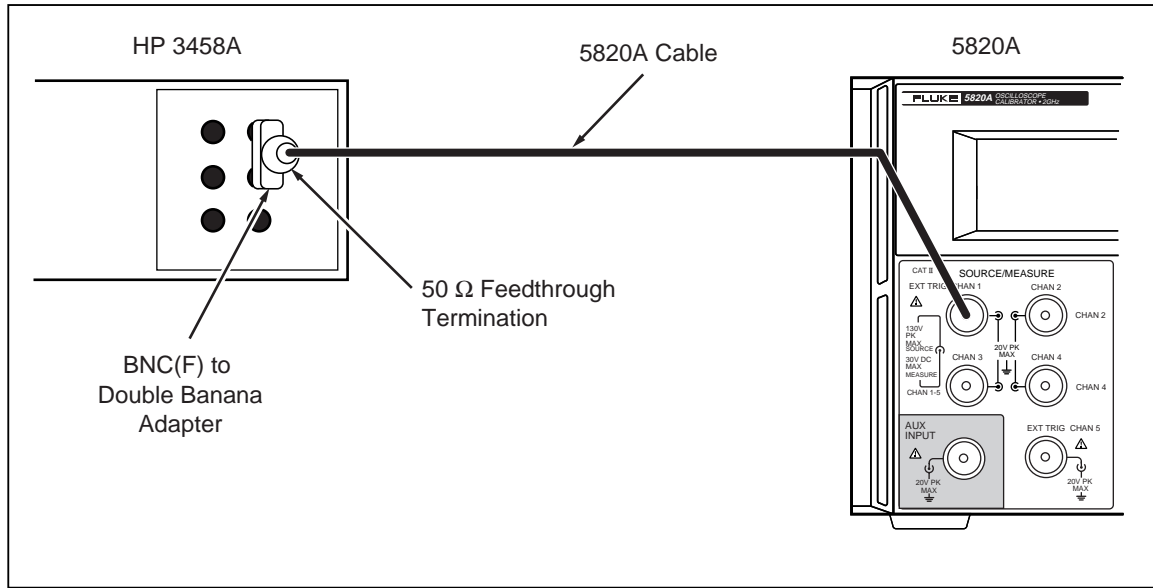
Figure 3-1. Setup for Scope Calibrator Voltage Square Wave Measurements

### 3-7. Setup for Scope Calibrator Edge and Wave Gen Square Wave Measurements

The setup to measure the topline and baseline of Edge and Wave Generator signals differs slightly from the Voltage Square Wave method described above. The HP 3458A is triggered by a change in input level instead of an external trigger. The trigger level is set to 1% of the DCV range, with ac coupling of the trigger signal. The delay after the trigger event is also changed for the Edge and Wave Generator functions. See Table 3-2. Refer to Figure 3-2 for the proper equipment connections.

Table 3-3. Edge and Wave Generator HP3458A Settings

| Input Frequency | HP 3458A Settings |                 |                  |
|-----------------|-------------------|-----------------|------------------|
|                 | NPLC              | DELAY (topline) | DELAY (baseline) |
| 1 kHz           | .01               | .0002 s         | .0007 s          |
| 10 kHz          | .001              | .00002 s        | .00007 s         |



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**Figure 3-2. Setup for Scope Calibrator Edge and Wave Gen Square Wave Measurements**

For all measurements, the HP 3458A is in DCV, manual ranging, with level triggering enabled. A convenient method to make these measurements from the HP 3458A’s front panel is to program these settings into several of the user defined keys on its front panel. For example, to make topline measurements at 1 kHz, you would set the DMM to “NPLC .01; LEVEL 1; DELAY .0002; TRIG LEVEL”. To find the average of multiple readings, you can program one of the keys to “MATH OFF; MATH STAT” and then use the “RMATH MEAN” function to recall the average or mean value.

### 3-8. DC Voltage Calibration

This procedure uses the following equipment:

- Hewlett-Packard 3458A Digital Multimeter
- BNC(f) to Double Banana adapter
- N to BNC cable supplied with the Scope Calibrator

*Note*

*Calibrating dc voltage requires ac voltage calibration.*

*Note*

*When dc voltage calibration is started, the calibrator uses a special configuration of WAVEGEN mode (with a zero frequency, ordinarily undefined) to source approximately 3 Vdc. After the operator enters the true dc value, this value is then transferred to the internal DACs and A/D through a series of internal calibration steps. On firmware version 1.5 and earlier, the output displayed is 6 V-pp @ 0.00 Hz at this step. This is a side-effect of the special configuration used. As of firmware version 1.6, the output display indicates 3 V @ 0.00 Hz.*

Set the Calibrator to Cal DCV by pressing the **SETUP**, **CAL** and **5820A CAL** blue softkeys then follow these steps to calibrate dc voltage.

1. Connect the Calibrator Mainframe's CHAN 1 connector to the HP 3458A input, using the N to BNC cable and the BNC(f) to Double Banana adapter.
2. Set the HP 3458A to DCV, Auto Range, NPLC = 10, FIXEDZ = on.
3. Press the **GO ON** blue softkey.
4. Ensure the HP 3458A reading is  $0.0 \text{ V dc} \pm 10 \mu\text{V}$ . If not, adjust R121 on A41 (see "Hardware Adjustments" in this chapter.)
5. Press the **GO ON** blue softkey.
6. Calibration voltages 33 V and greater will automatically put the Calibrator Mainframe output in standby. When this occurs, press **OPR STBY** on the Calibrator Mainframe to activate the output. Allow the HP 3458A dc voltage reading to stabilize. Enter the reading via the Calibrator Mainframe front panel keypad, then press **ENTER**.

*Note*

*The Calibrator Mainframe will warn when the entered value is out of bounds. If this warning occurs, recheck the setup and carefully re-enter the reading insuring proper multiplier (i.e., m,  $\mu$ , n, p). If the warning still occurs, repair may be necessary.*

7. Repeat steps 6 until the Calibrator Mainframe display indicates that the next steps calibrate ac Voltage. Press the **STORE CONSTS** blue softkey to store the new calibration constants.

AC Voltage must now be calibrated. Continue with the next section.

### **3-9. AC Voltage Calibration**

This procedure uses the same equipment and setup as dc voltage calibration. DC voltages are measured and entered in the Calibrator Mainframe to calibrate the AC Voltage function.

Set up the Calibrator Mainframe to Cal ACV. Press the **NEXT SECTION** blue softkey until the display reads "The next steps calibrate Scope Calibrator ACV". Then follow these steps to calibrate ac voltage.

1. Press the **GO ON** blue softkey.
2. Allow the HP 3458A dc voltage reading to stabilize. Enter the reading via the Calibrator Mainframe front panel keypad, then press **ENTER**.

*Note*

*The Calibrator Mainframe will warn when the entered value is out of bounds. If this warning occurs recheck the setup and carefully re-enter the reading insuring proper multiplier (i.e., m, u, n, p). If the warning still occurs, repair may be necessary.*

3. Repeat step 2 until the Calibrator Mainframe display indicates that the next steps calibrate WAVEGEN. Press the **STORE CONSTS** blue softkey to store the new calibration constants.



### 3-10. DC Measurement Calibration

This procedure uses the following equipment:

- 5520A calibrator  
 To set 5820A to the Voltage Measurement Calibration mode, select the **CAL**, **MORE CAL**, and **MEAS V CAL** blue softkeys.
1. Using the N to BNC cable, connect the CHAN 1 connector on the Calibrator Mainframe to the Fluke 5520A Calibrator voltage binding posts using a BNC to banana connector.
  2. Set the Fluke 5520A Calibrator to 6 Vdc (Operate).
  3. Enter the actual Fluke 5520A Calibrator output.
  4. When prompted by the Calibrator Mainframe, set the Fluke 5520A Calibrator to -6 Vdc (Operate).
  5. Enter the actual Fluke 5520A Calibrator output.

The Calibrator Mainframe will display that the calibration is complete. Press the **STORE CONST** blue softkey to store the new calibration constants.

### 3-11. Current Calibration

These procedures use the following equipment:

- Hewlett-Packard 3458A Digital Multimeter with cable
- 10  $\Omega$ , 100  $\Omega$ , and 1000  $\Omega$  precision resistor assemblies

Set the Calibrator Mainframe in **CURRENT CAL** mode. Remove the front panel Current Loop using the 2 mm hex head driver and proceed with the following procedures.

#### 3-12. DC Current Calibration

1. Set the DMM to measure dc current.
2. Connect the DMM directly to the vacant banana jacks.
3. Take dc current measurements at 110  $\mu$ A, 1.10 mA and 11.0 mA and enter the values on the Calibrator front panel.
4. Press the **GO ON** blue softkey to proceed through the calibration points.
5. Follow the procedures on the front panel until the display reads “900  $\mu$ A 1000 Hz”.

#### 3-13. AC Current Calibration

For the ac calibration, the offset from 0 mA current (called the baseline) is measured and stored in the Calibrator. Remove the DMM direct connection and set up the DMM to measure dc volts. Follow the instructions in the section “Setup for Scope Calibrator Voltage AC Current Measurements” above for setting up the DMM.

1. Plug in the 1000  $\Omega$  precision resistor into the Calibrator front panel.
2. Attach the DMM to the ends of the precision resistor.
3. Take voltage measurement across the resistor at 900  $\mu$ A, convert to mA, and enter the DMM value on the Calibrator front panel.
4. Press the **GO ON** blue softkey.

5. Plug in the 100  $\Omega$  precision resistor into the Calibrator front panel.
6. Take voltage measurement across the resistor at 9.00 mA, convert to mA, and enter the DMM value on the Calibrator front panel.
7. Press the **GO ON** blue softkey.
8. Plug in the 10  $\Omega$  precision resistor into the Calibrator front panel.
9. Take voltage measurement across the resistor at 90.0 mA, convert to mA, and enter the DMM value on the Calibrator front panel.
10. Press the **GO ON** blue softkey.
11. To complete the Current calibration, press the **STORE CONSTS** blue softkey to store the new calibration constants.

*Note*

*The Calibrator Mainframe will warn when the entered value is out of bounds. If this warning occurs, check the setup again and carefully re-enter the reading insuring proper multiplier (i.e., m,  $\mu$ , n, p). If the warning still occurs, repair may be necessary.*

### **3-14. Wave Generator Calibration**

This procedure uses the following equipment:

- Hewlett-Packard 3458A Digital Multimeter
- BNC(f) to Double Banana adapter
- N to BNC cable supplied with the Scope Calibrator

Within the calibration menu, press the **NEXT SECTION** blue softkey until the display reads “WAVEGEN Cal:”. Then follow these steps to calibrate the Wave Generator:

1. Connect the Calibrator Mainframe’s CHAN 1 connector to the HP 3458A input, using the N to BNC cable and the BNC(f) to Double Banana adapter.
2. Set the HP 3458A to DCV, NPLC = .01, LEVEL 1, TRIG LEVEL, and the DELAY to .0002 for measuring the upper part of the wave form (i.e. topline), and the DELAY to .0007 for measuring the lower part of the wave form (i.e. baseline). Manually range lock the HP 3458A to the range that gives the most resolution for the topline measurements. Use this same range for the corresponding baseline measurements at each step.
3. For each calibration step, take samples for at least two seconds, using the HP 3458A MATH functions to retrieve the average or mean value. See “Setup for Scope Calibrator Edge and Wave Generator Measurements” for more details.

### **3-15. Edge Amplitude Calibration**

This procedure uses the following equipment:

- Hewlett-Packard 3458A Digital Multimeter
- BNC(f) to Double Banana adapter
- N to BNC cable supplied with the Scope Calibrator
- 50  $\Omega$  feedthrough termination

Press the **NEXT SECTION** blue softkey until the display reads “Set up to measure fast edge amplitude”. Then follow these steps to calibrate edge amplitude:

1. Connect the Calibrator Mainframe’s CHAN 1 connector to the HP 3458A input, using the N to BNC cable and the BNC(f) to Double Banana.
2. Set the HP 3458A to DCV, NPLC = .01, LEVEL 1, TRIG LEVEL, and the DELAY to .0002 for measuring the upper part of the wave form (i.e. topline), and the DELAY to .0007 for measuring the lower part of the wave form (i.e. baseline). Manually lock the HP 3458A to the range that gives the most resolution for the baseline measurements. Use this same range for the corresponding baseline measurements at each step. Note that in the EDGE function, the topline is very near 0 V, and the baseline is a negative voltage.
3. For each calibration step, take samples for at least two seconds, using the HP 3458A MATH functions to enter the average or mean value. See “Setup for Scope Calibrator Edge and Wave Generator Measurements” for more details.


The “true amplitude” of the wave form is the difference between the topline and baseline measurements, correcting for the load resistance error. To make this correction, multiply the readings by  $(0.5 * (50 + R_{load})/R_{load})$ , where  $R_{load}$  = actual feedthrough termination resistance.

### **3-16. Leveled Sine Wave Amplitude Calibration**

This procedure uses the following equipment:

- HP 437A Power Meter or equivalent
- HP 8481D Power Sensor
- HP 8482A Power Sensor
- N (female) to BNC (female) adapter
- N to BNC cable supplied with the Scope Calibrator

Select the **NEXT SECTION** blue softkey until the display reads “Set up to measure leveled sine amplitude”. Then follow these steps to calibrate Leveled Sine Wave amplitude.

1. Connect the N to BNC cable to the Calibrator Mainframe’s CHAN 1 connector. Connect the other end of the N to BNC cable to the 50 Ω feedthrough termination then to the 5790A INPUT 2 using the BNC(f) to Double Banana adapter. Refer to Figure 3-3 for the proper equipment connections.
2. Set the 5790A to AUTORANGE, digital filter mode to FAST, restart fine, and Hi Res on.
3. Press the **GO ON** blue softkey.
4. Press  to activate operating mode on the Calibrator Mainframe.
5. Allow the 5790A rms reading to stabilize. Multiply the 5790A reading by  $(0.5 * (50 + R_{load}) / R_{load})$ , where  $R_{load}$  = the actual feedthrough termination resistance, to correct for the resistance error. Enter the corrected rms reading via the Calibrator Mainframe front panel keypad, then press **ENTER**.

*Note*

*The Calibrator Mainframe will warn when the entered value is out of bounds. If this warning occurs recheck the setup and calculation and carefully re-enter the corrected rms reading insuring proper multiplier (i.e., m, u, n, p). If the warning still occurs, repair may be necessary.*

- Repeat step 5 until the Calibrator Mainframe display indicates that the next steps calibrate Leveled Sine flatness. Press the **STORE CONSTS** blue softkey to store the new calibration constants.

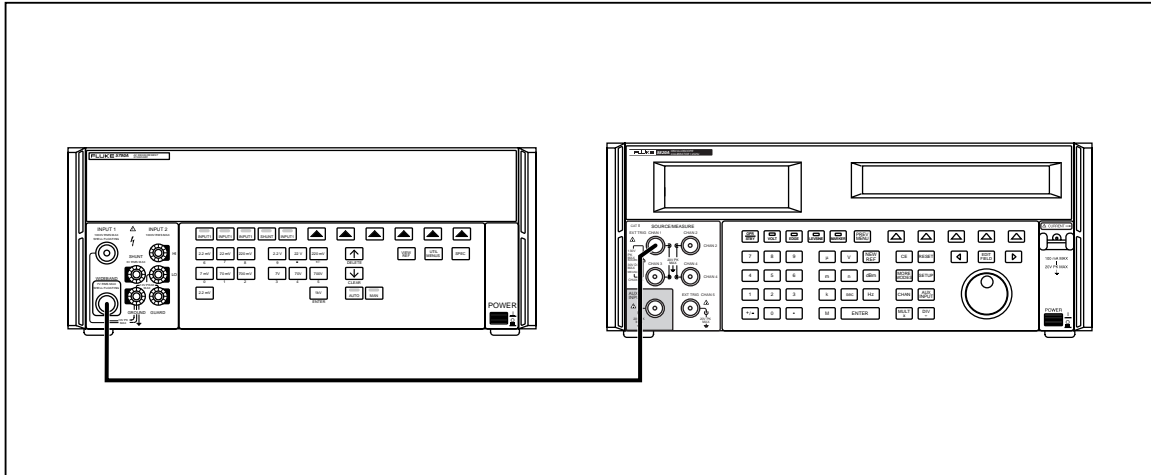


Figure 3-3. Connecting the Calibrator Mainframe to the 5790A AC Measurement Standard

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### 3-17. Leveled Sine Wave Flatness Calibration

Leveled Sine Wave flatness calibration is divided into two frequency bands: 50 kHz to 10 MHz (low frequency) and >10 MHz to 600 MHz (high frequency). The equipment setups are different for each band. Flatness calibration of the low frequency band is made relative to 50 kHz. Flatness calibration of the high frequency band is made relative to 10 MHz.

Leveled Sine Wave flatness is calibrated at multiple amplitudes. Both low and high frequency bands are calibrated at each amplitude. Calibration begins with the low frequency band, then the high frequency band for the first amplitude, followed by the low frequency band, then the high frequency band for the second amplitude, and so on, until the flatness calibration is complete.

Press the **NEXT SECTION** blue softkey until the display reads “Set up to measure leveled sine flatness”.

#### 3-18. Low Frequency Calibration

Connect the Calibrator Mainframe CHAN 1 connector to the 5790A WIDEBAND input as described under “Equipment Setup for Low Frequency Flatness”.

Follow these steps to calibrate low frequency Leveled Sine Wave flatness for the amplitude being calibrated.

- Press the **GO ON** blue softkey.
- Establish the 50 kHz reference:
  - Allow the 5790A rms reading to stabilize.

- Press the 5790A **Set Ref** blue softkey. (Clear any previous reference by pressing the 5790A **Clear Ref** blue softkey prior to setting the new reference if required.)
3. Press the **GO ON** blue softkey.
  4. Adjust the amplitude using the Calibrator Mainframe front panel knob until the 5790A reference deviation matches the 50 kHz reference within 1000 ppm.
  5. Repeat steps 1 to 4 until the Calibrator Mainframe display indicates that the reference frequency is now 10 MHz. Continue with the high frequency calibration.

### **3-19. High Frequency Calibration**

Connect the Calibrator Mainframe CHAN 1 connector to the power meter and power sensor as described under “Equipment Setup for High Frequency Flatness”.

Follow these steps to calibrate high frequency Leveled Sine Wave flatness for the amplitude being calibrated.

1. Press the **GO ON** blue softkey.
2. Establish the 10 MHz reference:
  - Press the power meter **SHIFT** key, then **FREQ** key and use the arrow keys to enter the power sensor’s 10 MHz Cal Factor. Ensure that the factor is correct, then press the power meter **ENTER** key.
  - Allow the power meter reading to stabilize.
  - Press the Power meter **REL** key.
3. Press the **GO ON** blue softkey.
4. Press the power meter **SHIFT** key, then **FREQ** key and use the arrow keys to enter the power sensor’s Cal Factor for the frequency displayed on the Calibrator Mainframe. Ensure that the factor is correct, then press the power meter **ENTER** key.
5. Adjust the amplitude using the Calibrator Mainframe front panel knob until the power sensor reading matches the 10 MHz reference within 0.1%.
6. Repeat steps 1 to 5 until the Calibrator Mainframe display indicates that either the reference frequency is now 50 kHz or that the next steps calibrate pulse width. Repeat the low frequency calibration procedure for the next amplitude unless the Calibrator Mainframe display indicates that the next steps calibrate pulse width. Press the **STORE CONSTS** blue softkey to store the new calibration constants.

### **3-20. Pulse Width Calibration**

This procedure uses the following equipment:

- High Frequency Digital Storage Oscilloscope: Tektronix 11801 with Tektronix SD-22/26 sampling head
- 3 dB attenuator, 3.5 mm (m/f)
- BNC(f) to 3.5 mm(m) adapter (2)
- 2 N to BNC cables supplied with the Scope Calibrator

Press the **NEXT SECTION** blue softkey until the display reads “Set up to measure Pulse Width”. Then follow these steps to calibrate pulse width:

1. Connect the N to BNC cable supplied with the Scope Calibrator to the Calibrator Mainframe’s CHAN 1 connector. Connect the other end of the N to BNC cable to

- one BNC(f) to 3.5 mm(m) adapter then to the DSO's sampling head through the 3 dB attenuator.
- Using the second BNC(f) to 3.5 mm(m) adapter and N to BNC cable, connect the Calibrator Mainframe's TRIG OUT connector to the 11801's Trigger Input.
  - Set the DSO to these parameters:
    - Main Time Base position (initial): 40 ns
    - Vertical scale: 200 mV/div, +900 mV offset
    - Trigger: source = ext; level = 0.5 V; ext atten = x10; slope = +; mode = auto
    - Measurement Function: positive width
  - Press the **GO ON** blue softkey.
  - Adjust the DSO horizontal scale and main time base position until the pulse signal spans between half and the full display. If no pulse is output, increase the pulse width using the Calibrator Mainframe front panel knob until a pulse is output.
  - If prompted to adjust the pulse width by the Calibrator Mainframe display, adjust the pulse width to as close to the displayed value as possible using the Calibrator Mainframe front panel knob, then press the **GO ON** blue softkey.
  - Allow the DSO width reading to stabilize. Enter the reading via the Calibrator Mainframe front panel keypad, then press **ENTER**.

*Note*

*The Calibrator Mainframe issues a warning when the entered value is out of bounds. If this warning occurs, recheck the setup and carefully re-enter the reading with the proper multiplier (i.e., m, u, n, p). If the warning still occurs, enter a value between the displayed pulse width and the previously entered value. Keep attempting this, moving closer and closer to the displayed pulse width, until the value is accepted. Complete the pulse width calibration procedure. The pulse width calibration procedure must now be repeated until all entered values are accepted the first time without warning.*

- Repeat steps 5 to 7 until the Calibrator Mainframe display prompts to connect a resistor. Press the **STORE CONSTS** blue softkey to store the new calibration constants.

### **3-21. MeasZ Calibration**

The MeasZ function is calibrated using resistors and capacitors of known values. The actual resistance and capacitance values are entered while they are being measure by the Calibrator Mainframe.

The resistors and capacitor must make a solid connection to a BNC(f) to enable a connection to the end of the N to BNC cable supplied with the Scope Calibrator. The resistance and capacitance values must be known at this BNC(f) connector. Fluke uses a HP 3458A DMM to make a 4-wire ohms measurement at the BNC(f) connector to determine the actual resistance values and an HP 4192A Impedance Analyzer at 10 MHz to determine the actual capacitance value.

This procedure uses the following equipment:

- Resistors of known values: 40  $\Omega$ , 60  $\Omega$ , 600 k $\Omega$  and 1.5 M $\Omega$  nominal
- adapters to connect resistors to BNC(f) connector

- adapters and capacitors to achieve 5 pF, 28 pF, and 50 pF nominal value at the end of BNC(f) connector
- N to BNC cable supplied with the Scope Calibrator

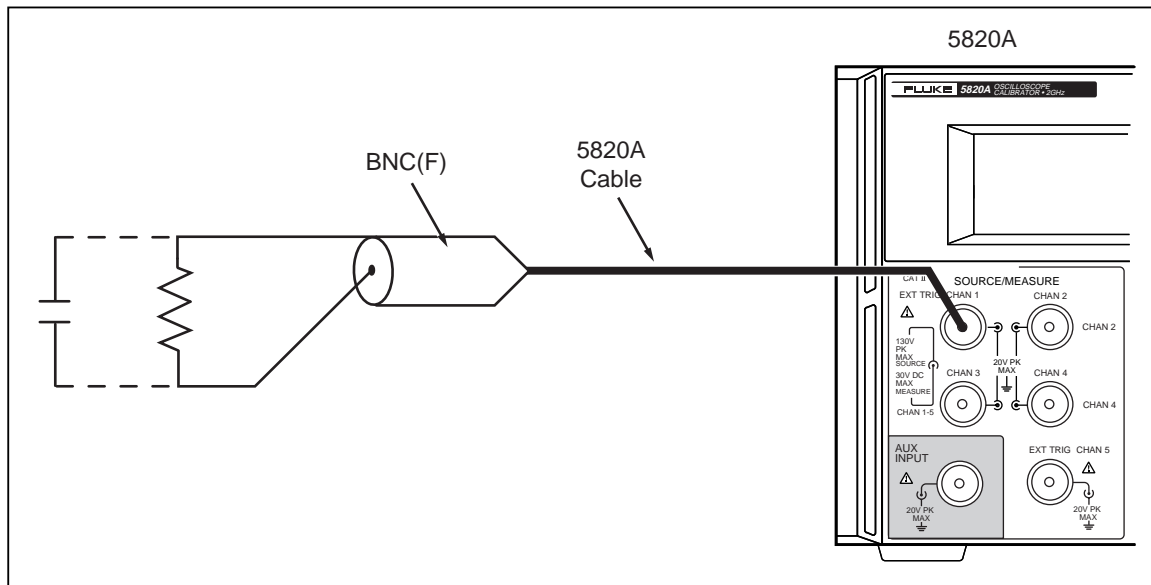


Figure 3-4. Setup for MeasZ Calibration

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Set the Calibrator Mainframe in Scope Cal mode at the prompt to connect a 40  $\Omega$  resistor. Then follow these steps to calibrate MeasZ.

1. Connect the N to BNC cable to the SCOPE connector. Connect the other end of the N to BNC cable to the BNC(f) connector attached to the 40  $\Omega$  resistance. Refer to Figure 3-4 for the proper equipment connections.
2. Press the **GO ON** blue softkey.
3. Enter the actual 40  $\Omega$  resistance.
4. When prompted by the Calibrator Mainframe, disconnect the 40  $\Omega$  resistance and connect the 60  $\Omega$  resistance.
5. Press the **GO ON** blue softkey.
6. Enter the actual 60  $\Omega$  resistance.

*Note*

*The Calibrator Mainframe will warn when the entered value is out of bounds. If this warning occurs, recheck the setup and carefully re-enter the actual resistance insuring proper multiplier (i.e., m, u, n, p). If the warning still occurs, repair may be necessary.*

7. When prompted by the Calibrator Mainframe, disconnect the 60  $\Omega$  resistance and connect the 0.6 M $\Omega$  resistance to the end of the N to BNC cable.
8. Press the **GO ON** blue softkey.
9. Enter 0.6 M $\Omega$  resistance
10. When prompted by the Calibrator Mainframe, disconnect the 0.6 M $\Omega$  resistance and connect the 1.5 M $\Omega$  resistance to the end of the N to BNC cable
11. Press the **GO ON** blue softkey.



*Note*

*Calibrating the capacitance for the Scope Calibrator uses 4 capacitors, 0 pF, 5 pF, 28 pF, and 50 pF. Starting with 0 (or no input) you proceed through each capacitor entering the exact value each time.*

12. When prompted for the first reference capacitor by the Calibrator Mainframe, disconnect the 1.5 M $\Omega$  resistance and leave nothing attached to the end of the N to BNC cable.
13. Press the **GO ON** blue softkey.
14. Enter 0.
15. When prompted by the Calibrator Mainframe, connect the 5 pF capacitor to the end of the N to BNC cable.
16. Press the **GO ON** blue softkey.
17. Enter the actual 5 pF capacitance value.
18. When prompted by the Calibrator Mainframe, disconnect the 5 pF capacitor and connect the 28 pF to the end of the N to BNC cable.
19. Press the **GO ON** blue softkey.
20. Enter the actual 28 pF capacitance value.
21. When prompted by the Calibrator Mainframe, disconnect the 28 pF capacitor and connect the 50 pF to the end of the N to BNC cable.
22. Press the **GO ON** blue softkey.
23. Enter the actual 50 pF capacitance.
24. The Calibrator Mainframe will prompt that the calibration is complete. Press the **STORE CONSTS** blue softkey to store the new calibration constants.

### **3-22. Leveled Sine Wave Flatness Calibration (GHz Option)**

Leveled Sine Wave Flatness Calibration is only applicable if the 5820A has the GHz Option installed. This calibration procedure uses the same equipment as in the 5820A Leveled Sine Wave Flatness (High Frequency) calibration procedure. See the GHz section for details.

### **3-23. 5820A-5 Option**

The 5820A-5 Option allows you to calibrate up to five oscilloscope channels simultaneously without changing cables. This allows you to perform fast, automated calibrations with documented procedures and results while freeing the operator to complete other work. You can find this option discussed throughout the manual where appropriate.

*Note*

*If the 5820A is equipped with the 5-channel option, the Mainframe will indicate when to move to the next channel.*

### **3-24. Verification**

All of the Oscilloscope Calibration functions should be verified at least once per year, or each time the Scope Calibrator is calibrated. The verification procedures in this section provide traceable results; however the factory uses different procedures of higher precision than those described here. The procedures in this manual have been developed to provide users the ability to verify the Scope Calibrator at their own site if they are



required to do so. Fluke strongly recommends that, if possible, you return your unit to Fluke for calibration and verification.

All equipment specified for Scope Calibrator verification must be calibrated, certified traceable if traceability is to be maintained, and operating within their normal specified operating environment. It is also important to ensure that the equipment has had sufficient time to warm up prior to its use. Refer to the operating manual for each piece of equipment for details.

Before you begin verification, you may wish to review all of the procedures in advance to ensure you have the resources to complete them.

All of the Scope Calibrator functions are listed in Table 3-4, with the verification technique indicated.

**Table 3-4. Verification Methods for Scope Calibrator Functions**

| Function  | Verification Method   |
|---|---|
| DC Voltage  | Procedure provided in this manual.  |
| AC Voltage amplitude  | Procedure provided in this manual.  |
| AC Voltage frequency  | Procedure provided in this manual.  |
| DC Voltage Measurement  | Procedure provided in this manual.  |
| Current   | Procedure provided in this manual.  |
| Edge amplitude  | Procedure provided in this manual.  |
| Edge frequency, duty cycle, rise time                           | Procedure provided in this manual.  |
| Tunnel Diode Pulser amplitude                                   | Procedure provided in this manual. See "Voltage and Edge Calibration and Verification" for details. |
| Leveled sine wave amplitude, frequency, harmonics, and flatness | Procedures provided in this manual.   |
| Time marker period  | Procedure provided in this manual.  |
| Wave generator amplitude  | Procedure provided in this manual.  |
| Pulse width, period   | Procedure provided in this manual.  |
| MeasZ resistance, capacitance                                   | Procedure provided in this manual.  |
| Overload functionality  | Procedure provided in this manual.  |

### 3-25. DC Voltage Verification

This procedure uses the following equipment:


- Hewlett-Packard 3458A Digital Multimeter
- BNC(f) to Double Banana adapter
- 50  $\Omega$  feedthrough termination
- N to BNC cable supplied with the Scope Calibrator

Set the Calibrator Mainframe to the Volt menu. Follow these steps to verify the wave generator function.

### 3-26. Verification at 1 M $\Omega$

For the 1 M $\Omega$  verification, connect the Calibrator Mainframe's CHAN 1 connector to the HP 3458A input, using the cable and the BNC(f) to Double Banana adapter.

Make sure the Calibrator Mainframe impedance is set to 1 M $\Omega$  (The blue softkey under **Output @** toggles the impedance between 50  $\Omega$  and 1 M $\Omega$ ).

1. Set the HP 3458A to DCV, Auto Range, NPLC = 10, FIXEDZ = on.
2. Program the Calibrator Mainframe to output the voltage listed in Table 3-5. Press  on the Calibrator Mainframe to activate the output.
3. Allow the HP 3458A reading to stabilize, then record the HP 3458A reading for each voltage in Table 3-5.
4. Compare result to the tolerance column.

### 3-27. Verification at 50 $\Omega$

For the 50  $\Omega$  verification, connect the CHAN 1 connector to the HP 3458A input, using the cable and the 50  $\Omega$  termination connected to the N to BNC to Banana Plug adapter.

Make sure the Calibrator Mainframe impedance is set to 50  $\Omega$  (The blue softkey under **Output @** toggles the impedance between 50  $\Omega$  and 1 M $\Omega$ ).


1. Set the HP 3458A to DCV, Auto Range, NPLC = 10, FIXEDZ = on.
2. Program the Calibrator Mainframe to output the voltage listed in Table 3-6. Press  on the Calibrator Mainframe to activate the output.
3. Allow the HP 3458A reading to stabilize, then record the HP 3458A reading for each voltage in Table 3-6.
4. Multiply the readings by  $(0.5 * (50 + R_{load}) / R_{load})$ , where  $R_{load}$  = the actual feedthrough termination resistance, to correct for the resistance error.

Table 3-5. DC Voltage Verification

| (Into 1 MΩ Impedance Unless Noted) |                          |                     |              |
|------------------------------------|--------------------------|---------------------|--------------|
| Nominal Value<br>(V dc)            | Measured Value<br>(V dc) | Deviation<br>(V dc) | 1-Year Spec. |
| 0                                  |                          |                     | 25 μV        |
| 0.00125                            |                          |                     | 25.3 μV      |
| -0.00125                           |                          |                     | 25.3 μV      |
| 0.00249                            |                          |                     | 25.6 μV      |
| -0.00249                           |                          |                     | 25.6 μV      |
| 0.0025                             |                          |                     | 25.6 μV      |
| -0.0025                            |                          |                     | 25.6 μV      |
| 0.00625                            |                          |                     | 26.5 μV      |
| -0.00625                           |                          |                     | 26.5 μV      |
| 0.0099                             |                          |                     | 27.5 μV      |
| -0.0099                            |                          |                     | 27.5 μV      |
| 0.01                               |                          |                     | 27.5 μV      |
| -0.01                              |                          |                     | 27.5 μV      |
| 0.0175                             |                          |                     | 29.4 μV      |
| -0.0175                            |                          |                     | 29.4 μV      |
| 0.0249                             |                          |                     | 31.2 μV      |
| -0.0249                            |                          |                     | 31.2 μV      |
| 0.025                              |                          |                     | 31.2 μV      |
| -0.025                             |                          |                     | 31.2 μV      |
| 0.0675                             |                          |                     | 41.8 μV      |
| -0.0675                            |                          |                     | 41.8 μV      |
| 0.1099                             |                          |                     | 52.5 μV      |
| -0.1099                            |                          |                     | 52.5 μV      |
| 0.11                               |                          |                     | 52.5 μV      |
| -0.11                              |                          |                     | 52.5 μV      |
| 0.305                              |                          |                     | 101.50 μV    |
| -0.305                             |                          |                     | 101.50 μV    |
| 0.499                              |                          |                     | 150 μV       |
| -0.499                             |                          |                     | 150 μV       |

Table 3-5. DC Voltage Verification (cont.)

| Nominal Value<br>(V dc) | Measured Value<br>(V dc) | Deviation<br>(V dc) | 1-Year Spec.  |
|-------------------------|--------------------------|---------------------|---------------|
| 0.5                     |                          |                     | 150 $\mu$ V   |
| -0.5                    |                          |                     | 150 $\mu$ V   |
| 1.35                    |                          |                     | 362.5 $\mu$ V |
| -1.35                   |                          |                     | 362.5 $\mu$ V |
| 2.19                    |                          |                     | 572 $\mu$ V   |
| -2.19                   |                          |                     | 572 $\mu$ V   |
| 2.2                     |                          |                     | 572 $\mu$ V   |
| -2.2                    |                          |                     | 572 $\mu$ V   |
| 6.6                     |                          |                     | 1.67 mV       |
| -6.6                    |                          |                     | 1.67 mV       |
| 10.99                   |                          |                     | 2.77 mV       |
| -10.99                  |                          |                     | 2.77 mV       |
| 11                      |                          |                     | 2.77 mV       |
| -11                     |                          |                     | 2.77 mV       |
| 70.5                    |                          |                     | 17.65 mV      |
| -70.5                   |                          |                     | 17.65 mV      |
| 130                     |                          |                     | 32.5 mV       |
| -130                    |                          |                     | 32.5 mV       |
| 6.599 (50 $\Omega$ )    |                          |                     | 16.5 mV       |

Table 3-6. DC Voltage Verification at 50  $\Omega$

| Calibrator<br>Mainframe<br>Output | HP 3458A Rdg (V dc) | Reading x Correction | Tolerance (V dc) |
|-----------------------------------|---------------------|----------------------|------------------|
| 0 mV                              |                     |                      | 0.00004 V        |
| 2.49 mV                           |                     |                      | 4.623E-05 V      |
| -2.49 mV                          |                     |                      | 4.623E-05 V      |
| 9.90 mV                           |                     |                      | 6.475E-05 V      |
| -9.90 mV                          |                     |                      | 6.475E-05 V      |
| 24.9 mV                           |                     |                      | 0.0001023 V      |
| -24.9 mV                          |                     |                      | 0.0001023 V      |
| 109.9 mV                          |                     |                      | 0.0003148 V      |
| -109.9 mV                         |                     |                      | 0.0003148 V      |
| 499 mV                            |                     |                      | 0.0012875 V      |
| -499 mV                           |                     |                      | 0.0012875 V      |
| 2.19 V                            |                     |                      | 0.005515 V       |
| -2.19 V                           |                     |                      | 0.005515 V       |
| 6.599 V                           |                     |                      | 0.0165375 V      |
| -6.599 V                          |                     |                      | 0.0165375 V      |

**3-28. AC Voltage Amplitude Verification**

This procedure uses the following equipment:

- Hewlett-Packard 3458A Digital Multimeter
- BNC(f) to Double Banana adapter
- 50  $\Omega$  feedthrough termination
- N to BNC cable supplied with the Scope Calibrator
- N to BNC cable to connect the Calibrator Mainframe TRIG OUT to the HP 3458A Ext Trig

Set the Calibrator Mainframe to the Volt menu. Follow these steps to verify the ac voltage function.

**3-29. Verification at 1 M $\Omega$** 

For the 1 M $\Omega$  verification, connect the Calibrator Mainframe's CHAN 1 connector to the HP 3458A input, using the cable supplied with the Calibrator Mainframe and the BNC(f) to Double Banana adapter. Connect the Calibrator Mainframe TRIG OUT connector to the HP 3458A Ext Trig connector located on the rear of that instrument.

Make sure the Calibrator Mainframe impedance is set to 1 M $\Omega$ . (The blue softkey under Output @ toggles the impedance between 50  $\Omega$  and 1 M $\Omega$ .)

1. When making measurements at 1 kHz, set the HP 3458A to DCV, NPLC = .01, TRIG EXT, and the DELAY to .0007 for measuring the topline of the wave form, and the DELAY to .0012 for measuring the baseline of the wave form. Manually lock the HP 3458A to the range that gives the most resolution for the topline measurements. Use this same range for the corresponding baseline measurements at each step.
2. Enable the Calibrator Mainframe external trigger by toggling the blue softkey under TRIG to /1.
3. Measure the topline first, as indicated in Table 3-7. For each measurement, take samples for at least two seconds, using the HP 3458A MATH functions to determine the average or mean value.
4. Measure the baseline of each output after the corresponding topline measurement, as indicated in Table 3-7. The peak-to-peak value is the difference between the topline and baseline measurements. Compare the result to the tolerance column.
5. When making measurements at the other frequencies, set up the HP 3458A (NPLC and topline and baseline DELAY) per Table 3-2.

Table 3-7. AC Voltage Amplitude Verification

| (Into 1 M $\Omega$ Impedance Unless Noted) |                   |                           |                      |                         |
|--|-------------------|---------------------------|----------------------|-------------------------|
| Nominal Value<br>(V p-p)                   | Frequency<br>(Hz) | Measured Value<br>(V p-p) | Deviation<br>(V p-p) | 1-year Spec.<br>(V p-p) |
| 0.001                                      | 1000              |                           |                      | 5.5 $\mu$ V             |
| -0.001                                     | 1000              |                           |                      | 5.5 $\mu$ V             |
| 0.025                                      | 1000              |                           |                      | 17.5 $\mu$ V            |
| -0.025                                     | 1000              |                           |                      | 17.5 $\mu$ V            |
| 0.11                                       | 1000              |                           |                      | 60 $\mu$ V              |
| -0.11                                      | 1000              |                           |                      | 60 $\mu$ V              |
| 0.5  | 1000              |                           |                      | 255 $\mu$ V             |
| -0.5                                       | 1000              |                           |                      | 255 $\mu$ V             |
| 2.2  | 1000              |                           |                      | 1.1 mV                  |
| -2.2                                       | 1000              |                           |                      | 1.1 mV                  |
| 11   | 1000              |                           |                      | 5.5 mV                  |
| -11  | 1000              |                           |                      | 5.5 mV                  |
| 130  | 1000              |                           |                      | 6.5 mV                  |
| -130                                       | 1000              |                           |                      | 6.5 mV                  |

### 3-30. Verification at 50 $\Omega$

For the 50  $\Omega$  verification, connect the Calibrator Mainframe's CHAN 1 connector to the HP 3458A input, using the cable supplied with the Calibrator Mainframe, the external 50  $\Omega$  termination, and the BNC(f) to Double Banana adapter. (The 50  $\Omega$  termination is closest to the HP 3458A input.) Connect the Calibrator Mainframe TRIG OUT connector to the HP 3458A Ext Trig connector located on the rear of that instrument. Make sure the Calibrator Mainframe impedance is set to 50  $\Omega$ . (The blue softkey under Output @ toggles the impedance between 50  $\Omega$  and 1 M $\Omega$ ). Proceed with the following steps:

1. Set the HP 3458A to DCV, NPLC = .01, TRIG EXT, and the DELAY to .0007 for measuring the topline of the wave form, and the DELAY to .0012 for measuring the baseline of the wave form. Manually lock the HP 3458A to the range that gives the most resolution for the topline measurements. Use this same range for the corresponding baseline measurements at each step. See Table 3-8.
2. Enable the Calibrator Mainframe external trigger by toggling the blue softkey under TRIG to /1.
3. Measure the topline first, as indicated in Table 3-8. For each measurement, take samples for at least two seconds, using the HP 3458A MATH functions to determine the average or mean value.
4. Measure the baseline of each output after the corresponding topline measurement, as indicated in Table 3-8. The peak-to-peak value is the difference between the topline and baseline measurements. Compare the result to the tolerance column.

Table 3-8. AC Voltage Verification at 50 Ω

| Calibrator Mainframe Output (1 kHz) | HP 3458A Range | Topline Reading | Baseline Reading | Peak-to-Peak | Peak-to-Peak x Correction | Tolerance (±V) |
|-------------------------------------|----------------|-----------------|------------------|--------------|---------------------------|----------------|
| 1 mV                                | 100 mV dc      |                 |                  |              |                           | 0.000043       |
| -1 mV                               | 100 mV dc      |                 |                  |              |                           | 0.000043       |
| 10 mV                               | 100 mV dc      |                 |                  |              |                           | 0.000065       |
| -10 mV                              | 100 mV dc      |                 |                  |              |                           | 0.000065       |
| 25 mV                               | 100 mV dc      |                 |                  |              |                           | 0.000103       |
| -25 mV                              | 100 mV dc      |                 |                  |              |                           | 0.000103       |
| 110 mV                              | 100 mV dc      |                 |                  |              |                           | 0.000315       |
| -110 mV                             | 100 mV dc      |                 |                  |              |                           | 0.000315       |
| 500 mV                              | 1 V dc         |                 |                  |              |                           | 0.00129        |
| -500 mV                             | 1 V dc         |                 |                  |              |                           | 0.00129        |
| 2.2 V                               | 10 V dc        |                 |                  |              |                           | 0.00554        |
| -2.2 V                              | 10 V dc        |                 |                  |              |                           | 0.00554        |
| 6.6 V                               | 10 V dc        |                 |                  |              |                           | 0.01654        |
| -6.6 V                              | 10 V dc        |                 |                  |              |                           | 0.01654        |

**3-31. AC Voltage Frequency Verification**

This procedure uses the following equipment:

- PM 6680 Frequency Counter with an ovenized timebase (Option PM 9690 or PM 9691)
- N to BNC cable supplied with the Scope Calibrator

Refer to Figure 3-5 for the proper equipment connections.

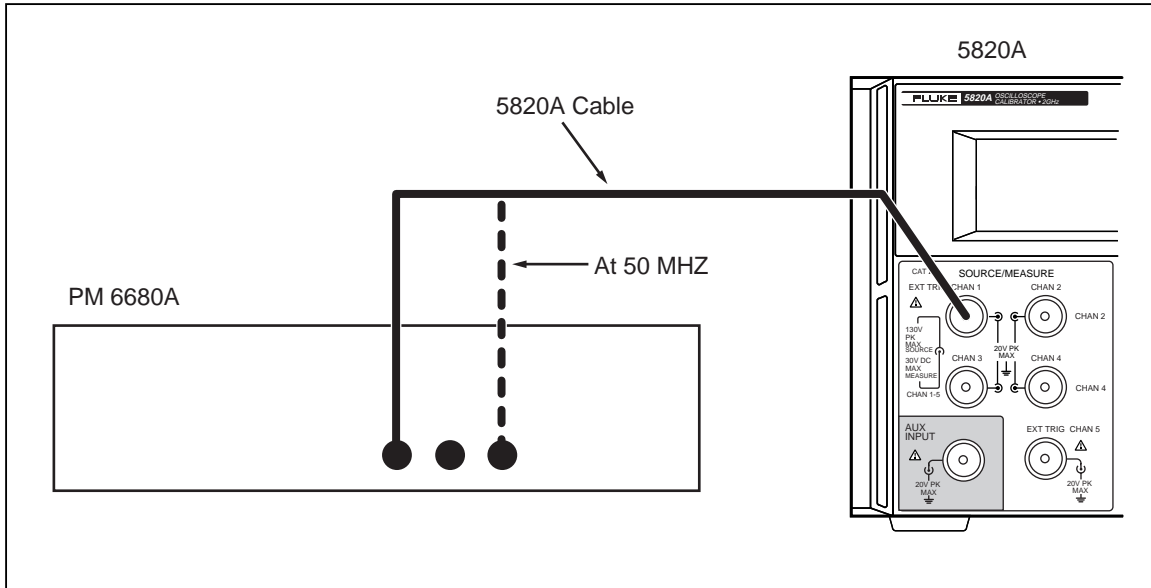


Figure 3-5. Setup for AC Voltage Frequency Verification

yu057f.eps

Set the Calibrator Mainframe to the Volt menu. Press **OPR** **STBY** on the Calibrator Mainframe to activate the output. Then follow these steps to verify ac voltage frequency.

1. Set the PM 6680's FUNCTION to measure frequency on channel A with auto trigger, measurement time set to 1 second or longer, 1M $\Omega$  impedance, and filter off.
2. Using the N to BNC cable, connect the CHAN 1 connector on the Calibrator Mainframe to PM 6680 channel A.
3. Program the Calibrator Mainframe to output 2.1 V at each frequency listed in Table 3-9.
4. Allow the PM 6680 reading to stabilize, then record the PM 6680 reading for each frequency listed in Table 3-9. Compare to the tolerance column of Table 3-9.

Table 3-9. AC Voltage Frequency Verification

| Calibrator Mainframe Frequency (Output @ 2.1 V p-p) | PM 6680 Reading (Frequency) | Tolerance             |
|---|-----------------------------|-----------------------|
| 10 Hz   |                             | 3.3 E <sup>-6</sup>   |
| 100 Hz  |                             | 33 E <sup>-6</sup>    |
| 1 kHz   |                             | 330 E <sup>-6</sup>   |
| 10 kHz  |                             | 3,300 E <sup>-6</sup> |

### 3-32. DC Measurement Verification

This procedure uses the following equipment:

- Fluke 5520A Calibrator

1. Select Voltage Measurement mode.



2. Using the N to BNC cable, connect the CHAN 1 connector on the Calibrator Mainframe to the Fluke 5520A Calibrator voltage binding posts using a BNC to banana connector.

Record the 5820A reading for each voltage in Table 3-10.

**Table 3-10. DC Voltage Measurement Verification**

| Nominal Value<br>(V dc) | Measured Value | Deviation | 1-year Spec.<br>(V p-p) |
|-------------------------|----------------|-----------|-------------------------|
| 0 V                     |                |           | 0.001                   |
| 1 V                     |                |           | 0.0015                  |
| 2.5 V                   |                |           | 0.00225                 |
| 5 V                     |                |           | 0.0035                  |
| 6.5 V                   |                |           | 0.02625                 |
| 9.9 V                   |                |           | 0.03475                 |
| -1 V                    |                |           | 0.0015                  |
| -2.5 V                  |                |           | 0.00225                 |
| -5 V                    |                |           | 0.0035                  |
| -6.5 V                  |                |           | 0.02625                 |
| -9.9 V                  |                |           | 0.03475                 |

**3-33. Current Verification**

This procedure uses the following equipment:

- Hewlett-Packard 3458A Digital Multimeter with cable
- 1 Ω, 10 Ω, 100 Ω, and 1000 Ω precision resistor assemblies

Remove the front panel Current Loop using the 2 mm hex head driver.

**3-34. DC Current Verification**


1. Connect the DMM directly to the vacant banana jacks on the calibrator.
2. Program the Calibrator Mainframe to output the Currents listed in Table 3-11. Press  on the Calibrator Mainframe to activate the output.
3. Allow the HP 3458A reading to stabilize, then record the HP 3458A reading for each current in Table 3-11.
4. Compare result to the tolerance column.

Table 3-11. DC Current Verification

| Calibrator Mainframe output | HP 3458A Reading (mA dc) | Tolerance (mA dc) |
|-----------------------------|--------------------------|-------------------|
| 0.100 mA                    |                          | 0.000750          |
| -0.100 mA                   |                          | 0.000750          |
| 0.550 mA                    |                          | 0.001875          |
| -0.550 mA                   |                          | 0.001875          |
| 1.099 mA                    |                          | 0.003248          |
| -1.099 mA                   |                          | 0.003248          |
| 1.100 mA                    |                          | 0.003250          |
| -1.100 mA                   |                          | 0.003250          |
| 5.50 mA                     |                          | 0.014250          |
| -5.50 mA                    |                          | 0.014250          |
| 10.99 mA                    |                          | 0.027975          |
| -10.99 mA                   |                          | 0.027975          |
| 11.00 mA                    |                          | 0.028000          |
| -11.00 mA                   |                          | 0.028000          |
| 50.00 mA                    |                          | 0.125500          |
| -50.00 mA                   |                          | 0.125500          |
| 100.0 mA                    |                          | 0.250500          |
| -100.0 mA                   |                          | 0.250500          |

**3-35. AC Current Verification**

The setup to measure the topline and baseline of ac current uses the HP 3458A triggered by a change in input level (see Table 3-12 for HP3458A settings). The trigger level is set to 1% of the DCV range, with ac coupling of the trigger signal. Connect the precision resistor assemblies, as indicated, to the banana jacks on the front panel. Connect the DMM to the precision resistor. Set the HP 3458A to DCV, Auto Range, NPLC = 10, FIXEDZ = on. Use the same delays and settings used in the section “AC Current Calibration”. Record the HP3458A readings in Table 3-13.

Table 3-12. AC Measurement HP3458A Settings

| Input Frequency | HP 3458A Settings |                 |                  |
|-----------------|-------------------|-----------------|------------------|
|                 | NPLC              | DELAY (topline) | DELAY (baseline) |
| 45 Hz           | .01               | .0002 s         | .012             |
| 500 Hz          | .01               | .0002 s         | .0012 s          |
| 1 kHz           | .01               | .0002 s         | .0005 s          |

Table 3-13. AC Current Verification

| Nominal Output Current @ Resistance Value | Frequency (Hz) | Actual Resistor Value 0.05% (W) | Topline Reading (Vdc) | Baseline Reading (Vdc) | Calculated Current (B-C) ÷ A (mA) | Error D - Nom | Tolerance (±mA) |
|---|----------------|---------------------------------|-----------------------|------------------------|-----------------------------------|---------------|-----------------|
|   |                | A                               | B                     | C                      | D                                 |               |                 |
| 0.10 mA @ 1k Ω                            | 45             | Ω                               |                       |                        |                                   |               | 0.000750        |
| -0.10 mA @ 1k Ω                           | 45             |                                 |                       |                        |                                   |               | 0.000750        |
| 0.10 mA @ 1k Ω                            | 500            |                                 |                       |                        |                                   |               | 0.000750        |
| -0.10 mA @ 1k Ω                           | 500            |                                 |                       |                        |                                   |               | 0.000750        |
| 0.10 mA @ 1k Ω                            | 1000           |                                 |                       |                        |                                   |               | 0.000750        |
| -0.10 mA @ 1k Ω                           | 1000           |                                 |                       |                        |                                   |               | 0.000750        |
| 1.099 mA @ 100 Ω                          | 45             |                                 |                       |                        |                                   |               | 0.003248        |
| -1.099 mA @ 100 Ω                         | 45             |                                 |                       |                        |                                   |               | 0.003248        |
| 1.099 mA @ 100 Ω                          | 500            |                                 |                       |                        |                                   |               | 0.003248        |
| -1.099 mA @ 100 Ω                         | 500            |                                 |                       |                        |                                   |               | 0.003248        |
| 1.099 mA @ 100 Ω                          | 1000           |                                 |                       |                        |                                   |               | 0.003248        |
| -1.099 mA @ 100 Ω                         | 1000           |                                 |                       |                        |                                   |               | 0.003248        |
| 1.10 mA @ 100 Ω                           | 45             |                                 |                       |                        |                                   |               | 0.003250        |
| -1.10 mA @ 100 Ω                          | 45             |                                 |                       |                        |                                   |               | 0.003250        |
| 1.10 mA @ 100 Ω                           | 500            |                                 |                       |                        |                                   |               | 0.003250        |
| -1.10 mA @ 100 Ω                          | 500            |                                 |                       |                        |                                   |               | 0.003250        |
| 1.10 mA @ 100 Ω                           | 1000           |                                 |                       |                        |                                   |               | 0.003250        |
| -1.10 mA @ 100 Ω                          | 1000           |                                 |                       |                        |                                   |               | 0.003250        |
| 10.99 mA @ 10 Ω                           | 45             |                                 |                       |                        |                                   |               | 0.027975        |
| -10.99 mA @ 10 Ω                          | 45             |                                 |                       |                        |                                   |               | 0.027975        |
| 10.99 mA @ 10 Ω                           | 500            |                                 |                       |                        |                                   |               | 0.027975        |
| -10.99 mA @ 10 Ω                          | 500            |                                 |                       |                        |                                   |               | 0.027975        |
| 10.99 mA @ 10 Ω                           | 1000           |                                 |                       |                        |                                   |               | 0.027975        |
| -10.99 mA @ 10 Ω                          | 1000           |                                 |                       |                        |                                   |               | 0.027975        |
| 11.00 mA @ 10 Ω                           | 45             |                                 |                       |                        |                                   |               | 0.028000        |
| -11.00 mA @ 10 Ω                          | 45             |                                 |                       |                        |                                   |               | 0.028000        |
| 11.00 mA @ 10 Ω                           | 500            |                                 |                       |                        |                                   |               | 0.028000        |
| -11.00 mA @ 10 Ω                          | 500            |                                 |                       |                        |                                   |               | 0.028000        |
| 11.00 mA @ 10 Ω                           | 1000           |                                 |                       |                        |                                   |               | 0.028000        |

### 3-36. Edge Amplitude Verification

For the edge amplitude verification, connect the Calibrator Mainframe's CHAN 1 connector to the HP 3458A input, using the cable supplied with the Calibrator Mainframe, the external 50 Ω termination, and the BNC(f) to double banana adapter. (The 50 Ω termination is closest to the HP 3458A input.)

1. For measurements of a 1 kHz signal, set the HP 3458A to DCV, NPLC = .01, LEVEL 1, TRIG LEVEL, and the DELAY to .0002 for measuring the upper part of the wave form (i.e. topline), and the DELAY to .0007 for measuring the lower part of the wave form (i.e. baseline). For measurements of a 10 kHz signal, set the HP 3458A to DCV, NPLC = .001, LEVEL 1, TRIG LEVEL, and the DELAY to .00002 for measuring the topline, and the DELAY to .00007 for measuring the baseline.
2. Manually lock the HP 3458A to the range that gives the most resolution for the baseline measurements. Use this same range for the corresponding baseline measurements at each step. Note that in the EDGE function, the topline is very near 0 V, and the baseline is a negative voltage. See Table 3-14.
3. For each calibration step, take samples for at least two seconds, using the HP 3458A MATH functions to enter the average or mean value.
4. The peak-to-peak value of the wave form is the difference between the topline and baseline measurements, correcting for the load resistance error. To make this correction, multiply the readings by  $(0.5 * (50 + R_{load})/R_{load})$ , where  $R_{load}$  = actual feedthrough termination resistance. Record each reading as indicated in Table 3-14.

Table 3-14. Edge Amplification Verification

| Calibrator Mainframe Edge Output | HP 3458A Range | Topline Reading | Baseline Reading | Peak-to-Peak | Peak-to-Peak x Correction | Tolerance (±V) |
|----------------------------------|----------------|-----------------|------------------|--------------|---------------------------|----------------|
| 100 mV, 1 kHz                    | 100 mV dc      |                 |                  |              |                           | 0.0022         |
| 1.00V, 1 kHz                     | 1 V dc         |                 |                  |              |                           | 0.0202         |
| 5 mV, 10 kHz                     | 100 mV dc      |                 |                  |              |                           | 0.0003         |
| 10 mV, 10 kHz                    | 100 mV dc      |                 |                  |              |                           | 0.0004         |
| 25 mV, 10 kHz                    | 100 mV dc      |                 |                  |              |                           | 0.0007         |
| 50 mV, 10 kHz                    | 100 mV dc      |                 |                  |              |                           | 0.0012         |
| 100 mV, 10 kHz                   | 1 V dc         |                 |                  |              |                           | 0.0022         |
| 500 mV, 10 kHz                   | 1 V dc         |                 |                  |              |                           | 0.0102         |
| 1.00 V, 10 kHz                   | 1 V dc         |                 |                  |              |                           | 0.0202         |
| 2.5 V, 10 kHz                    | 10 V dc        |                 |                  |              |                           | 0.0502         |

### 3-37. Edge Frequency Verification

This procedure uses the following equipment:

- PM 6680 Frequency Counter with an ovenized timebase (Option PM 9690 or PM 9691)
- N to BNC cable supplied with the Scope Calibrator

Set the Calibrator Mainframe to the Edge menu. Press **OPR** **STBY** on the Calibrator Mainframe to activate the output. Then follow these steps to verify Edge frequency.

1. Set the PM 6680's FUNCTION to measure frequency on channel A with auto trigger, measurement time set to 1 second or longer, 50 Ω impedance, and filter off.
2. Using the N to BNC cable, connect the CHAN 1 connector on the Calibrator Mainframe to PM 6680 channel A.
3. Program the Calibrator Mainframe to output 2.5 V at each frequency listed in Table 3-15.
4. Allow the PM 6680 reading to stabilize, then record the PM 6680 reading for each frequency listed in Table 3-15. Compare to the tolerance column of Table 3-15.

**Table 3-15. Edge Frequency Verification**

| Calibrator Mainframe<br>Frequency<br>(Output @ 2.5 V p-p) | PM 6680 Reading<br>(Frequency) | Tolerance |
|---|--------------------------------|-----------|
| 1 kHz   |                                | .001 Hz   |
| 10 kHz  |                                | 0.01 Hz   |
| 100 kHz   |                                | 0.1 Hz    |
| 1 MHz   |                                | 1 Hz      |
| 10 MHz  |                                | 10 Hz     |

**3-38. Edge Duty Cycle Verification**

This procedure uses the following equipment:

- PM 6680 Frequency Counter
- N to BNC cable supplied with the Scope Calibrator

Set the Calibrator Mainframe to the Edge menu. Press **OPR** **STBY** on the Calibrator Mainframe to activate the output. Then follow these steps to verify Edge duty cycle.

1. Set the PM 6680's FUNCTION to measure duty cycle on channel A with auto trigger, measurement time set to 1 second or longer, 50 Ω impedance, and filter off.
2. Using the N to BNC cable, connect the CHAN 1 connector on the Calibrator Mainframe to PM 6680 channel A.
3. Program the Calibrator Mainframe to output 2.5 V at 1 MHz.
4. Allow the PM 6680 reading to stabilize. Compare the duty cycle reading to 50% ± 5%.

**3-39. Edge Rise Time Verification**

This procedure tests the edge function's rise time. Aberrations are also checked with the Tektronix 11801 oscilloscope and SD-22/26 sampling head.

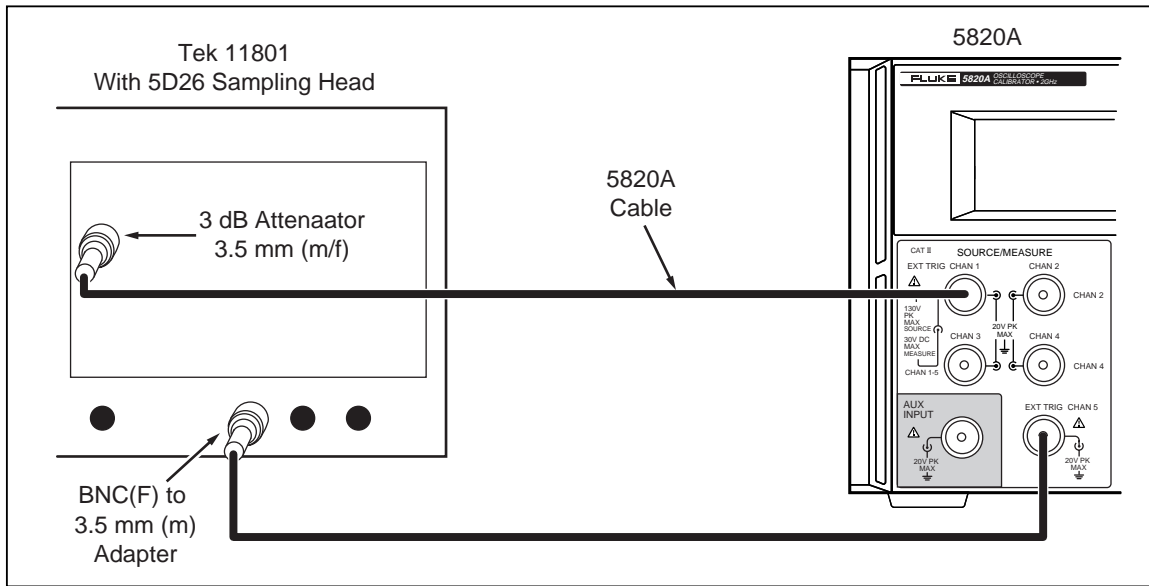
The following equipment is used to verify the edge rise time:

- High Frequency Digital Storage Oscilloscope: Tektronix 11801 with Tektronix SD-22/26 sampling head
- 3 dB attenuator, 3.5 mm (m/f)

- BNC(f) to 3.5 mm(m) adapter (2)
- N to BNC cable supplied with the Scope Calibrator
- second N to BNC cable

Connect the N to BNC cable supplied with the Scope Calibrator to the Calibrator Mainframe's CHAN 1 connector. Connect the other end of the N to BNC cable to one BNC(f) to 3.5 mm(m) adapter then to the DSO's sampling head through the 3 dB attenuator. Refer to Figure 3-6 for the proper equipment connections.

Using the second BNC(f) to 3.5 mm(m) adapter and N to BNC cable, connect the Calibrator Mainframe's EXT TRIG (channel 5) connector to the 11801's Trigger Input.



yu058f.eps

**Figure 3-6. Setup for Edge Rise Time Verification**

The Calibrator Mainframe should have the Edge menu on the display. Press **OPR STBY** on the Calibrator Mainframe to activate the output. Press the softkey under TRIG to select the TRIG/1 External Trigger output. Program the Calibrator Mainframe to output 250 mV @ 1 kHz. Set the DSO to these parameters:

**Digital Storage Oscilloscope Setup**

|                                   |            |
|-----------------------------------|------------|
| Main Time Base position (initial) | 40 ns      |
| Horizontal scale                  | 500 ps/div |
| Measurement Function              | Rise Time  |

1. Program the Calibrator Mainframe to output the voltage and frequency listed in Table 3-16. Press **OPR STBY** on the Calibrator Mainframe to activate the output.
2. Change the vertical scale of the DSO to the value listed in the table. Adjust the main time base position and vertical offset until the edge signal is centered on the display. Record the rise time measurement in column A of Table 3-16.
3. Correct the rise time measurement by accounting for the SD-22/26 sampling head's rise time. The SD-22/26 rise time is specified as <28 ps. Column B =  $\sqrt{(\text{Column A})^2 - (\text{SD-22/26 rise time})^2}$ .
4. The edge rise time measured should be less than the time indicated in Table 3-16.


**Table 3-16. Edge Rise Time Verification**

| Calibrator Mainframe Output |           | DSO Vertical Axis (mV/div) | A<br>11801 Reading | B<br>Corrected Reading | Tolerance |
|-----------------------------|-----------|----------------------------|--------------------|------------------------|-----------|
| Voltage                     | Frequency |                            |                    |                        |           |
| 250 mV                      | 1 kHz     | 20.0                       |                    |                        | < 300 ps  |
| 250 mV                      | 1 MHz     | 20.0                       |                    |                        | < 300 ps  |
| 250 mV                      | 10 MHz    | 20.0                       |                    |                        | < 350 ps  |
| 500 mV                      | 1 kHz     | 50.0                       |                    |                        | < 300 ps  |
| 500 mV                      | 1 MHz     | 50.0                       |                    |                        | < 300 ps  |
| 500 mV                      | 10 MHz    | 50.0                       |                    |                        | < 350 ps  |
| 1 V                         | 1 kHz     | 100.0                      |                    |                        | < 300 ps  |
| 1 V                         | 1 MHz     | 100.0                      |                    |                        | < 300 ps  |
| 1 V                         | 10 MHz    | 100.0                      |                    |                        | < 350 ps  |
| 2.5 V                       | 1 kHz     | 200.0                      |                    |                        | < 300 ps  |
| 2.5 V                       | 1 MHz     | 200.0                      |                    |                        | < 300 ps  |
| 2.5 V                       | 10 MHz    | 200.0                      |                    |                        | < 350 ps  |

**3-40. Edge Aberrations**

The following equipment is needed for this procedure:

- High Frequency Digital Storage Oscilloscope: Tektronix 11801 with Tektronix SD-22/26 sampling head
- N to BNC output cables provided with the Scope Calibrator (2)

Before you begin this procedure, verify that the Scope Calibrator is in the edge mode (the Edge menu is displayed), program it to output 1 V p-p @ 1 MHz, and press the soft key under TRIG to select the TRIG/1 External Trigger output. Press  to activate the output and trigger.

Set the DSO vertical to 10 mV/div and horizontal to 10 ns/div. Next, set the signal edge against the left side of the DSO display. Mentally note the signal amplitude 90 ns from the edge; use this point as the reference level. It maybe helpful to set the DSO to average 4 per reading. Now set the DSO to 1 ns/div and look at the first 10 ns of the edge signal with the rising edge at the left edge of the DSO display.

With the vertical setting, each line on the DSO represents a 1% (i.e. 10 mV) of aberration. Determine that the Scope Calibrator falls within the typical specifications shown in Table 3-17. For time greater than 10 ns, set the DSO to 10 ns/div. Verify the aberrations are within specification.

**Table 3-17. Edge Aberrations**

| Time from 50% of Rising Edge | Typical Edge Aberrations |
|------------------------------|--------------------------|
| 0 - 2 ns                     | < 32 mV (3.2%)           |
| 2 - 5 ns                     | < 22 mV (2.2%)           |
| 5 - 30 ns                    | < 12 mV (1.2%)           |
| > 30 ns                      | < 7 mV (0.7%)            |

### 3-41. Tunnel Diode Pulser Drive Amplitude Verification

This procedure uses the following equipment:

- Hewlett-Packard 3458A Digital Multimeter
- BNC(f) to Double Banana adapter
- N to BNC cable supplied with the Scope Calibrator

Set the Calibrator Mainframe to Edge. Proceed with the following steps:

1. Connect the Calibrator Mainframe's CHAN 1 connector to the HP 3458A input, using the N to BNC cable and the BNC(f) to Double Banana adapter.
2. Activate the TD Pulser output by pushing the **TDPULSE** blue softkey. The output should now be at 80 V peak-to-peak, 100 kHz, STANDBY.
3. Set the HP 3458A to DCV, NPLC = .001, LEVEL 1, TRIG LEVEL, and the DELAY to .00012 for measuring the topline and DELAY to .00007 for measuring the baseline. Manually range lock the HP 3458A to the 100 V dc range.
4. Change the Calibrator Mainframe output frequency to 10 kHz. Push the operate key, and use the HP 3458A to measure the topline and baseline.
5. The peak-to-peak value is the difference between the topline and baseline. Record these values in Table 3-18, and compare against the listed tolerance.

Table 3-18. Tunnel Diode Pulser Verification

| Nominal Value<br>(V p-p) | Frequency<br>(Hz) | Measured Value<br>(V p-p) | Deviation<br>(V p-p) | 1-Year Spec.<br>(V p-p) |
|--------------------------|-------------------|---------------------------|----------------------|-------------------------|
| 11                       | 100               |                           |                      | 0.2202                  |
| 11                       | 10000             |                           |                      | 0.2202                  |
| 55                       | 100               |                           |                      | 1.1002                  |
| 55                       | 10000             |                           |                      | 1.1002                  |
| 100                      | 100               |                           |                      | 2.0002                  |
| 100                      | 10000             |                           |                      | 2.0002                  |

### 3-42. Leveled Sine Wave Amplitude Verification

This procedure uses the following equipment:

- 5790A AC Measurement Standard
- BNC(f) to Double Banana Plug adapter
- 50  $\Omega$  feedthrough termination
- N to BNC cable supplied with the Scope Calibrator

Set the Calibrator Mainframe to the Levsine menu. Press **OPR** **STBY** on the Calibrator Mainframe to activate the output. Then follow these steps to verify the leveled sine wave amplitude.

1. Connect the N to BNC cable to the Calibrator Mainframe's CHAN 1 connector. Connect the other end of the N to BNC cable to the 50  $\Omega$  feedthrough termination then to the 5790A INPUT 2 using the BNC(f) to Double Banana adapter.
2. Set the 5790A to AUTORANGE, digital filter mode to FAST, restart fine, and Hi Res on.
3. Program the Calibrator Mainframe to output the voltage listed in Table 3-19.



4. Allow the 5790A reading to stabilize, then record the 5790A's rms reading for each voltage listed in Table 3-19.
5. Multiply the rms reading by the conversion factor of 2.8284 to convert it to the peak-to-peak value.
6. Multiply the peak-to-peak value by  $(0.5 * (50 + R_{load}) / R_{load})$ , where  $R_{load}$  = the actual feedthrough termination resistance, to correct for the resistance error. Compare result to the tolerance column.

**Table 3-19. Leveled Sine Wave Amplitude Verification**

| Calibrator Mainframe Output (@ 50 kHz) | 5790A Reading (V rms) | 5790A Reading x 2.8284 (V p-p) | V p-p value x Correction | Tolerance (V p-p) |
|--|-----------------------|--------------------------------|--------------------------|-------------------|
| 5.0 mV                                 |                       |                                |                          | 400 μV            |
| 7.5 mV                                 |                       |                                |                          | 450 μV            |
| 9.9 mV                                 |                       |                                |                          | 498 μV            |
| 10.0 mV                                |                       |                                |                          | 500 μV            |
| 25.0 mV                                |                       |                                |                          | 800 μV            |
| 39.0 mV                                |                       |                                |                          | 1.08 mV           |
| 40.0 mV                                |                       |                                |                          | 1.10 mV           |
| 70.0 mV                                |                       |                                |                          | 1.70 mV           |
| 99.0 mV                                |                       |                                |                          | 2.28 mV           |
| 100.0 mV                               |                       |                                |                          | 2.30 mV           |
| 250.0 mV                               |                       |                                |                          | 5.30 mV           |
| 399.0 mV                               |                       |                                |                          | 8.28 mV           |
| 0.4 V                                  |                       |                                |                          | 8.3 mV            |
| 0.8 V                                  |                       |                                |                          | 16.3 mV           |
| 1.2 V                                  |                       |                                |                          | 24.3 mV           |
| 1.3 V                                  |                       |                                |                          | 26.3 V            |
| 3.4 V                                  |                       |                                |                          | 68.3 mV           |
| 5.5 V                                  |                       |                                |                          | 110.3 mV          |

**3-43. MHz Leveled Sine Wave Flatness Verification**

Leveled Sine Wave flatness verification is divided into two frequency bands: 50 kHz to 10 MHz (low frequency) and >10 MHz to 600 MHz (high frequency). The equipment setups are different for each band. Leveled Sine Wave flatness is measured relative to 50 kHz. This is determined directly in the low frequency band. The high frequency band requires a “transfer” measurement be made at 10 MHz to calculate a flatness relative to 50 kHz.

**3-44. Equipment Setup for Low Frequency Flatness**

All low frequency flatness procedures use the following equipment.

- 5790A/03 AC Measurement Standard with Wideband option
- BNC(f) to Type N(m) adapter
- N to BNC cable supplied with the Scope Calibrator

Connect the Calibrator Mainframe CHAN 1 connector to the 5790A WIDEBAND input with the BNC(f) to Type N(m) adapter. Set the 5790A to AUTORANGE, digital filter mode to FAST, restart fine, and Hi Res on.

### 3-45. *Equipment Setup for High Frequency Flatness*

All high frequency flatness procedures use the following equipment:

- Hewlett-Packard 437B Power Meter
- Hewlett-Packard 8482A and 8481D Power Sensors
- BNC(f) to Type N(f) adapter
- N to BNC cable supplied with the Calibrator Mainframe

#### *Note*

*When high frequencies at voltages below 63 mV p-p are verified, use the 8481D Power Sensor. Otherwise, use the 8482A Power Sensor.*

Connect the HP 437B Power Meter to either the 8482A or the 8481D Power Sensor. For more information on connecting the two instruments, see the power meter and power sensor operators manuals.


Connect the power meter/power sensor combination to the CHAN 1 connector on the Calibrator Mainframe.


The Hewlett-Packard 437B Power Meter must be configured by setting the parameters listed below. Zero and self-calibrate the power meter with the power sensor being used. Refer to the *Hewlett-Packard 437B Operators Manual* for details.

- PRESET
- RESOLN 3
- AUTO FILTER
- WATTS
- SENSOR TABLE 0 (default)

### 3-46. *Low Frequency Verification*

This procedure provides an example of testing low frequency flatness using a 5.5 V output. Follow the same procedure for testing other amplitudes, only compare results against the flatness specification listed in Table 3-20.

1. Program the Calibrator Mainframe for an output of 5.5 V @ 500 kHz. Press  on the Calibrator Mainframe to activate the output.
2. Allow the 5790A reading to stabilize. The 5790A should display approximately 1.94 V rms. Enter the 5790A reading in Column A of Table 3-20.
3. Enter 50 kHz into the Calibrator Mainframe. Allow the 5790A reading to stabilize, then enter the 5790A reading in Column B of Table 3-20.
4. Enter the next frequency listed in Table 3-20. Allow the 5790A reading to stabilize, then enter the reading into Column A of the table.
5. Enter 50 kHz into the Calibrator Mainframe. Allow the 5790A reading to stabilize, then enter the 5790A reading in Column B of Table 3-20.
6. Repeat steps 4 and 5 for all of frequencies listed in Table 3-20. Continue until you have completed Columns A and B.

7. When you have completed Columns A and B, press  to remove the Calibrator Mainframe's output. Complete Table 3-20 by performing the calculations for column C. Compare Column C to the specifications listed in the final column.

**Table 3-20. Low Frequency Flatness Verification at 5.5 V**

| Calibrator Mainframe Frequency   | A | B<br>50 kHz | C | Calibrator Mainframe Flatness Specification (%) |
|--|---|-------------|---|---|
| 500 kHz  |   |             |   | ±1.50   |
| 1 MHz  |   |             |   | ±1.50   |
| 2 MHz  |   |             |   | ±1.50   |
| 5 MHz  |   |             |   | ±1.50   |
| 10 MHz   |   |             |   | ±1.50   |
| Complete Columns A-C as follows:<br><br>A    Enter 5790A Reading (mV) for the present frequency.<br>B    Enter 5790A Reading (mV) for 50 kHz.<br>C    Compute and enter the Calibrator Mainframe Flatness Deviation (%): $100 * ((\text{Column A entry}) - (\text{Column B entry})) / (\text{Column B entry})$ |   |             |   |   |

**3-47. High Frequency Verification**

This procedure provides an example of testing high frequency flatness using a 5 mV to 5.5 V output. Follow the same procedure for testing other amplitudes, only compare results against the flatness specification listed in Table 3-21. For this voltage range, you will use the model HP 8482A power sensor.



1. Program the Calibrator Mainframe for an output of 5 mV @ 30 MHz. Press  on the Calibrator Mainframe to activate the output.
2. Allow the power meter reading to stabilize. The power meter should display approximately 75 mW. Enter the power meter's reading in Column A of Table 3-21.
3. Enter 10 MHz into the Calibrator Mainframe. Allow the power meter reading to stabilize, then enter the power meter's reading in Column B of Table 3-21.
4. Enter the next frequency listed in Table 3-21. Allow the power meter's reading to stabilize, then enter the reading into Column A of the table.
5. Enter 10 MHz into the Calibrator Mainframe. Allow the power meter reading to stabilize, then enter the power meter's reading in Column B of Table 3-21.
6. Repeat steps 4 and 5 for all of frequencies listed in Table 3-21. Continue until you have completed Columns A and B.
7. When you have completed Columns A and B, press  to remove the Calibrator Mainframe's output. Complete Table 3-21 by performing the calculations for each column. Compare Column G to the specifications listed in the final column.

Table 3-21. High Frequency Flatness Verification

| Amplitude (V)                    | Calibrator Mainframe Freq. (MHz)  | A | B 50 kHz | C | D | E | Calibrator Mainframe Flatness Spec. (%) |
|----------------------------------|---|---|----------|---|---|---|---|
| 0.005                            | 50 MHz  |   |          |   |   |   | ±3.50                                   |
|                                  | 100 MHz   |   |          |   |   |   | ±3.50                                   |
|                                  | 150 MHz   |   |          |   |   |   | ±4.00                                   |
|                                  | 200 MHz   |   |          |   |   |   | ±4.00                                   |
|                                  | 250 MHz   |   |          |   |   |   | ±4.00                                   |
|                                  | 300 MHz   |   |          |   |   |   | ±4.00                                   |
|                                  | 350 MHz   |   |          |   |   |   | ±5.50                                   |
|                                  | 400 MHz   |   |          |   |   |   | ±5.50                                   |
|                                  | 450 MHz   |   |          |   |   |   | ±5.50                                   |
|                                  | 500 MHz   |   |          |   |   |   | ±5.50                                   |
|                                  | 550 MHz   |   |          |   |   |   | ±6.00                                   |
|                                  | 600 MHz   |   |          |   |   |   | ±6.00                                   |
| 0.0075                           | 50 MHz  |   |          |   |   |   | ±2.83                                   |
|                                  | 100 MHz   |   |          |   |   |   | ±2.83                                   |
|                                  | 150 MHz   |   |          |   |   |   | ±3.33                                   |
|                                  | 200 MHz   |   |          |   |   |   | ±3.33                                   |
|                                  | 250 MHz   |   |          |   |   |   | ±3.33                                   |
|                                  | 300 MHz   |   |          |   |   |   | ±3.33                                   |
|                                  | 350 MHz   |   |          |   |   |   | ±4.83                                   |
|                                  | 400 MHz   |   |          |   |   |   | ±4.83                                   |
|                                  | 450 MHz   |   |          |   |   |   | ±4.83                                   |
|                                  | 500 MHz   |   |          |   |   |   | ±4.83                                   |
|                                  | 550 MHz   |   |          |   |   |   | ±5.33                                   |
|                                  | 600 MHz   |   |          |   |   |   | ±5.33                                   |
| Complete Columns A-E as follows: |   |   |          |   |   |   |   |
| A                                | Enter the 437B present frequency Reading (W).   |   |          |   |   |   |   |
| B                                | Enter the 437B 50 kHz Reading (W).  |   |          |   |   |   |   |
| C                                | Apply power sensor correction factor for present frequency (W): CF * (Column A entry)   |   |          |   |   |   |   |
| D                                | Apply power sensor correction factor for 50 kHz (W): CF * (Column B entry)  |   |          |   |   |   |   |
| E                                | Compute and enter Error relative to 50 kHz plus floor (%): $100 * [(\text{sqrt}(\text{Column B}/\text{Column D entry}) - 1) \pm 100 * (100\mu\text{V}/\text{nominal voltage})]$ . |   |          |   |   |   |   |

**Table 3-21. High Frequency Flatness Verification (cont.)**

| Amplitude (V)                    | Calibrator Mainframe Freq. (MHz)  | A | B 50 kHz | C | D | E | Calibrator Mainframe Flatness Spec. (%) |
|----------------------------------|---|---|----------|---|---|---|---|
| 0.0099                           | 50 MHz  |   |          |   |   |   | ±2.51                                   |
|                                  | 100 MHz   |   |          |   |   |   | ±2.51                                   |
|                                  | 150 MHz   |   |          |   |   |   | ±3.01                                   |
|                                  | 200 MHz   |   |          |   |   |   | ±3.01                                   |
|                                  | 250 MHz   |   |          |   |   |   | ±3.01                                   |
|                                  | 300 MHz   |   |          |   |   |   | ±3.01                                   |
|                                  | 350 MHz   |   |          |   |   |   | ±4.51                                   |
|                                  | 400 MHz   |   |          |   |   |   | ±4.51                                   |
|                                  | 450 MHz   |   |          |   |   |   | ±4.51                                   |
|                                  | 500 MHz   |   |          |   |   |   | ±4.51                                   |
|                                  | 550 MHz   |   |          |   |   |   | ±5.01                                   |
|                                  | 600 MHz   |   |          |   |   |   | ±5.01                                   |
| 0.01                             | 50 MHz  |   |          |   |   |   | ±2.50                                   |
|                                  | 100 MHz   |   |          |   |   |   | ±2.50                                   |
|                                  | 150 MHz   |   |          |   |   |   | ±3.00                                   |
|                                  | 200 MHz   |   |          |   |   |   | ±3.00                                   |
|                                  | 250 MHz   |   |          |   |   |   | ±3.00                                   |
|                                  | 300 MHz   |   |          |   |   |   | ±3.00                                   |
|                                  | 350 MHz   |   |          |   |   |   | ±4.50                                   |
|                                  | 400 MHz   |   |          |   |   |   | ±4.50                                   |
|                                  | 450 MHz   |   |          |   |   |   | ±4.50                                   |
|                                  | 500 MHz   |   |          |   |   |   | ±4.50                                   |
|                                  | 550 MHz   |   |          |   |   |   | ±5.00                                   |
|                                  | 600 MHz   |   |          |   |   |   | ±5.00                                   |
| Complete Columns A-E as follows: |   |   |          |   |   |   |   |
| A                                | Enter the 437B present frequency Reading (W).   |   |          |   |   |   |   |
| B                                | Enter the 437B 50 kHz Reading (W).  |   |          |   |   |   |   |
| C                                | Apply power sensor correction factor for present frequency (W): $CF * (\text{Column A entry})$  |   |          |   |   |   |   |
| D                                | Apply power sensor correction factor for 50 kHz (W): $CF * (\text{Column B entry})$   |   |          |   |   |   |   |
| E                                | Compute and enter Error relative to 50 kHz plus floor (%): $100 * [(\text{sqrt}(\text{Column B/Column D entry}) - 1) \pm 100 * (100\mu\text{V/nominal voltage})]$ . |   |          |   |   |   |   |

Table 3-21. High Frequency Flatness Verification (cont.)

| Amplitude (V)   | Calibrator Mainframe Freq. (MHz) | A | B 50 kHz | C | D | E | Calibrator Mainframe Flatness Spec. (%) |
|---|----------------------------------|---|----------|---|---|---|---|
| 0.025   | 50 MHz                           |   |          |   |   |   | ±1.90                                   |
|   | 100 MHz                          |   |          |   |   |   | ±1.90                                   |
|   | 150 MHz                          |   |          |   |   |   | ±2.40                                   |
|   | 200 MHz                          |   |          |   |   |   | ±2.40                                   |
|   | 250 MHz                          |   |          |   |   |   | ±2.40                                   |
|   | 300 MHz                          |   |          |   |   |   | ±2.40                                   |
|   | 350 MHz                          |   |          |   |   |   | ±3.90                                   |
|   | 400 MHz                          |   |          |   |   |   | ±3.90                                   |
|   | 450 MHz                          |   |          |   |   |   | ±3.90                                   |
|   | 500 MHz                          |   |          |   |   |   | ±3.90                                   |
|   | 550 MHz                          |   |          |   |   |   | ±4.40                                   |
|   | 600 MHz                          |   |          |   |   |   | ±4.40                                   |
| 0.039   | 50 MHz                           |   |          |   |   |   | ±1.75                                   |
|   | 100 MHz                          |   |          |   |   |   | ±1.75                                   |
|   | 150 MHz                          |   |          |   |   |   | ±2.26                                   |
|   | 200 MHz                          |   |          |   |   |   | ±2.26                                   |
|   | 250 MHz                          |   |          |   |   |   | ±2.26                                   |
|   | 300 MHz                          |   |          |   |   |   | ±2.26                                   |
|   | 350 MHz                          |   |          |   |   |   | ±3.75                                   |
|   | 400 MHz                          |   |          |   |   |   | ±3.75                                   |
|   | 450 MHz                          |   |          |   |   |   | ±3.75                                   |
|   | 500 MHz                          |   |          |   |   |   | ±3.75                                   |
|   | 550 MHz                          |   |          |   |   |   | ±4.26                                   |
|   | 600 MHz                          |   |          |   |   |   | ±4.26                                   |
| <p>Complete Columns A-E as follows:</p> <p>A            Enter the 437B present frequency Reading (W).</p> <p>B            Enter the 437B 50 kHz Reading (W).</p> <p>C            Apply power sensor correction factor for present frequency (W): <math>CF * (\text{Column A entry})</math></p> <p>D            Apply power sensor correction factor for 50 kHz (W): <math>CF * (\text{Column B entry})</math></p> <p>E            Compute and enter Error relative to 50 kHz plus floor (%): <math>100 * [(\text{sqrt}(\text{Column B}/\text{Column D entry}) - 1) \pm 100 * (100\mu\text{V}/\text{nominal voltage})]</math>.</p> |                                  |   |          |   |   |   |   |

**Table 3-21. High Frequency Flatness Verification (cont.)**

| Amplitude (V)   | Calibrator Mainframe Freq. (MHz) | A | B 50 kHz | C | D | E | Calibrator Mainframe Flatness Spec. (%) |
|---|----------------------------------|---|----------|---|---|---|---|
| 0.04  | 50 MHz                           |   |          |   |   |   | ±1.75                                   |
|   | 100 MHz                          |   |          |   |   |   | ±1.75                                   |
|   | 150 MHz                          |   |          |   |   |   | ±2.25                                   |
|   | 200 MHz                          |   |          |   |   |   | ±2.25                                   |
|   | 250 MHz                          |   |          |   |   |   | ±2.25                                   |
|   | 300 MHz                          |   |          |   |   |   | ±2.25                                   |
|   | 350 MHz                          |   |          |   |   |   | ±3.75                                   |
|   | 400 MHz                          |   |          |   |   |   | ±3.75                                   |
|   | 450 MHz                          |   |          |   |   |   | ±3.75                                   |
|   | 500 MHz                          |   |          |   |   |   | ±3.75                                   |
|   | 550 MHz                          |   |          |   |   |   | ±4.25                                   |
|   | 600 MHz                          |   |          |   |   |   | ±4.25                                   |
| 0.07  | 50 MHz                           |   |          |   |   |   | ±1.64                                   |
|   | 100 MHz                          |   |          |   |   |   | ±1.64                                   |
|   | 150 MHz                          |   |          |   |   |   | ±2.14                                   |
|   | 200 MHz                          |   |          |   |   |   | ±2.14                                   |
|   | 250 MHz                          |   |          |   |   |   | ±2.14                                   |
|   | 300 MHz                          |   |          |   |   |   | ±2.14                                   |
|   | 350 MHz                          |   |          |   |   |   | ±3.64                                   |
|   | 400 MHz                          |   |          |   |   |   | ±3.64                                   |
|   | 450 MHz                          |   |          |   |   |   | ±3.64                                   |
|   | 500 MHz                          |   |          |   |   |   | ±3.64                                   |
|   | 550 MHz                          |   |          |   |   |   | ±4.14                                   |
|   | 600 MHz                          |   |          |   |   |   | ±4.14                                   |
| <p>Complete Columns A-E as follows:</p> <p>A            Enter the 437B present frequency Reading (W).</p> <p>B            Enter the 437B 50 kHz Reading (W).</p> <p>C            Apply power sensor correction factor for present frequency (W): <math>CF * (\text{Column A entry})</math></p> <p>D            Apply power sensor correction factor for 50 kHz (W): <math>CF * (\text{Column B entry})</math></p> <p>E            Compute and enter Error relative to 50 kHz plus floor (%): <math>100 * [(\text{sqrt}(\text{Column B/Column D entry}) - 1) \pm 100 * (100\mu\text{V/nominal voltage})]</math>.</p> |                                  |   |          |   |   |   |   |

Table 3-21. High Frequency Flatness Verification (cont.)

| Amplitude (V)   | Calibrator Mainframe Freq. (MHz) | A | B 50 kHz | C | D | E | Calibrator Mainframe Flatness Spec. (%) |
|---|----------------------------------|---|----------|---|---|---|---|
| 0.099   | 50 MHz                           |   |          |   |   |   | ±1.60                                   |
|   | 100 MHz                          |   |          |   |   |   | ±1.60                                   |
|   | 150 MHz                          |   |          |   |   |   | ±2.10                                   |
|   | 200 MHz                          |   |          |   |   |   | ±2.10                                   |
|   | 250 MHz                          |   |          |   |   |   | ±2.10                                   |
|   | 300 MHz                          |   |          |   |   |   | ±2.10                                   |
|   | 350 MHz                          |   |          |   |   |   | ±3.60                                   |
|   | 400 MHz                          |   |          |   |   |   | ±3.60                                   |
|   | 450 MHz                          |   |          |   |   |   | ±3.60                                   |
|   | 500 MHz                          |   |          |   |   |   | ±3.60                                   |
|   | 550 MHz                          |   |          |   |   |   | ±4.10                                   |
|   | 600 MHz                          |   |          |   |   |   | ±4.10                                   |
| 0.100   | 50 MHz                           |   |          |   |   |   | ±1.60                                   |
|   | 100 MHz                          |   |          |   |   |   | ±1.60                                   |
|   | 150 MHz                          |   |          |   |   |   | ±2.10                                   |
|   | 200 MHz                          |   |          |   |   |   | ±2.10                                   |
|   | 250 MHz                          |   |          |   |   |   | ±2.10                                   |
|   | 300 MHz                          |   |          |   |   |   | ±2.10                                   |
|   | 350 MHz                          |   |          |   |   |   | ±3.60                                   |
|   | 400 MHz                          |   |          |   |   |   | ±3.60                                   |
|   | 450 MHz                          |   |          |   |   |   | ±3.60                                   |
|   | 500 MHz                          |   |          |   |   |   | ±3.60                                   |
|   | 550 MHz                          |   |          |   |   |   | ±4.10                                   |
|   | 600 MHz                          |   |          |   |   |   | ±4.10                                   |
| <p>Complete Columns A-E as follows:</p> <p>A            Enter the 437B present frequency Reading (W).</p> <p>B            Enter the 437B 50 kHz Reading (W).</p> <p>C            Apply power sensor correction factor for present frequency (W): <math>CF * (\text{Column A entry})</math></p> <p>D            Apply power sensor correction factor for 50 kHz (W): <math>CF * (\text{Column B entry})</math></p> <p>E            Compute and enter Error relative to 50 kHz plus floor (%): <math>100 * [(\text{sqrt}(\text{Column B/Column D entry}) - 1) \pm 100 * (100\mu\text{V/nominal voltage})]</math>.</p> |                                  |   |          |   |   |   |   |



**Table 3-21. High Frequency Flatness Verification (cont.)**

| Amplitude (V)   | Calibrator Mainframe Freq. (MHz) | A | B 50 kHz | C | D | E | Calibrator Mainframe Flatness Spec. (%) |
|---|----------------------------------|---|----------|---|---|---|---|
| 0.25  | 50 MHz                           |   |          |   |   |   | ±1.54                                   |
|   | 100 MHz                          |   |          |   |   |   | ±1.54                                   |
|   | 150 MHz                          |   |          |   |   |   | ±2.04                                   |
|   | 200 MHz                          |   |          |   |   |   | ±2.04                                   |
|   | 250 MHz                          |   |          |   |   |   | ±2.04                                   |
|   | 300 MHz                          |   |          |   |   |   | ±2.04                                   |
|   | 350 MHz                          |   |          |   |   |   | ±3.54                                   |
|   | 400 MHz                          |   |          |   |   |   | ±3.54                                   |
|   | 450 MHz                          |   |          |   |   |   | ±3.54                                   |
|   | 500 MHz                          |   |          |   |   |   | ±3.54                                   |
|   | 550 MHz                          |   |          |   |   |   | ±4.04                                   |
|   | 600 MHz                          |   |          |   |   |   | ±4.04                                   |
| 0.399   | 50 MHz                           |   |          |   |   |   | ±1.52                                   |
|   | 100 MHz                          |   |          |   |   |   | ±1.52                                   |
|   | 150 MHz                          |   |          |   |   |   | ±2.02                                   |
|   | 200 MHz                          |   |          |   |   |   | ±2.02                                   |
|   | 250 MHz                          |   |          |   |   |   | ±2.02                                   |
|   | 300 MHz                          |   |          |   |   |   | ±2.02                                   |
|   | 350 MHz                          |   |          |   |   |   | ±3.52                                   |
|   | 400 MHz                          |   |          |   |   |   | ±3.52                                   |
|   | 450 MHz                          |   |          |   |   |   | ±3.52                                   |
|   | 500 MHz                          |   |          |   |   |   | ±3.52                                   |
|   | 550 MHz                          |   |          |   |   |   | ±4.02                                   |
|   | 600 MHz                          |   |          |   |   |   | ±4.02                                   |
| <p>Complete Columns A-E as follows:</p> <p>A            Enter the 437B present frequency Reading (W).</p> <p>B            Enter the 437B 50 kHz Reading (W).</p> <p>C            Apply power sensor correction factor for present frequency (W): <math>CF * (\text{Column A entry})</math></p> <p>D            Apply power sensor correction factor for 50 kHz (W): <math>CF * (\text{Column B entry})</math></p> <p>E            Compute and enter Error relative to 50 kHz plus floor (%): <math>100 * [(\text{sqrt}(\text{Column B/Column D entry} - 1) \pm 100 * (100\mu\text{V/nominal voltage}))]</math>.</p> |                                  |   |          |   |   |   |   |

Table 3-21. High Frequency Flatness Verification (cont.)

| Amplitude (V)   | Calibrator Mainframe Freq. (MHz) | A | B 50 kHz | C | D | E     | Calibrator Mainframe Flatness Spec. (%) |
|---|----------------------------------|---|----------|---|---|-------|---|
| 0.4   | 50 MHz                           |   |          |   |   |       | ±1.52                                   |
|   | 100 MHz                          |   |          |   |   |       | ±1.52                                   |
|   | 150 MHz                          |   |          |   |   |       | ±2.02                                   |
|   | 200 MHz                          |   |          |   |   |       | ±2.02                                   |
|   | 250 MHz                          |   |          |   |   |       | ±2.02                                   |
|   | 300 MHz                          |   |          |   |   |       | ±2.02                                   |
|   | 350 MHz                          |   |          |   |   |       | ±3.52                                   |
|   | 400 MHz                          |   |          |   |   |       | ±3.52                                   |
|   | 450 MHz                          |   |          |   |   |       | ±3.52                                   |
|   | 500 MHz                          |   |          |   |   |       | ±3.52                                   |
|   | 550 MHz                          |   |          |   |   |       | ±4.02                                   |
| 600 MHz   |                                  |   |          |   |   | ±4.02 |   |
| 0.8   | 50 MHz                           |   |          |   |   |       | ±1.51                                   |
|   | 100 MHz                          |   |          |   |   |       | ±1.51                                   |
|   | 150 MHz                          |   |          |   |   |       | ±2.01                                   |
|   | 200 MHz                          |   |          |   |   |       | ±2.01                                   |
|   | 250 MHz                          |   |          |   |   |       | ±2.01                                   |
|   | 300 MHz                          |   |          |   |   |       | ±2.01                                   |
|   | 350 MHz                          |   |          |   |   |       | ±3.51                                   |
|   | 400 MHz                          |   |          |   |   |       | ±3.51                                   |
|   | 450 MHz                          |   |          |   |   |       | ±3.51                                   |
|   | 500 MHz                          |   |          |   |   |       | ±3.51                                   |
|   | 550 MHz                          |   |          |   |   |       | ±4.01                                   |
| 600 MHz   |                                  |   |          |   |   | ±4.01 |   |
| <p>Complete Columns A-E as follows:</p> <p>A            Enter the 437B present frequency Reading (W).</p> <p>B            Enter the 437B 50 kHz Reading (W).</p> <p>C            Apply power sensor correction factor for present frequency (W): <math>CF * (\text{Column A entry})</math></p> <p>D            Apply power sensor correction factor for 50 kHz (W): <math>CF * (\text{Column B entry})</math></p> <p>E            Compute and enter Error relative to 50 kHz plus floor (%): <math>100 * [(\text{sqrt}(\text{Column B/Column D entry}) - 1) \pm 100 * (100\mu\text{V/nominal voltage})]</math>.</p> |                                  |   |          |   |   |       |   |

**Table 3-21. High Frequency Flatness Verification (cont.)**

| Amplitude (V)   | Calibrator Mainframe Freq. (MHz) | A | B 50 kHz | C | D | E     | Calibrator Mainframe Flatness Spec. (%) |
|---|----------------------------------|---|----------|---|---|-------|---|
| 1.2   | 50 MHz                           |   |          |   |   |       | ±1.51                                   |
|   | 100 MHz                          |   |          |   |   |       | ±1.51                                   |
|   | 150 MHz                          |   |          |   |   |       | ±2.01                                   |
|   | 200 MHz                          |   |          |   |   |       | ±2.01                                   |
|   | 250 MHz                          |   |          |   |   |       | ±2.01                                   |
|   | 300 MHz                          |   |          |   |   |       | ±2.01                                   |
|   | 350 MHz                          |   |          |   |   |       | ±3.51                                   |
|   | 400 MHz                          |   |          |   |   |       | ±3.51                                   |
|   | 450 MHz                          |   |          |   |   |       | ±3.51                                   |
|   | 500 MHz                          |   |          |   |   |       | ±3.51                                   |
|   | 550 MHz                          |   |          |   |   |       | ±4.01                                   |
| 600 MHz   |                                  |   |          |   |   | ±4.01 |   |
| 1.3   | 50 MHz                           |   |          |   |   |       | ±1.51                                   |
|   | 100 MHz                          |   |          |   |   |       | ±1.51                                   |
|   | 150 MHz                          |   |          |   |   |       | ±2.01                                   |
|   | 200 MHz                          |   |          |   |   |       | ±2.01                                   |
|   | 250 MHz                          |   |          |   |   |       | ±2.01                                   |
|   | 300 MHz                          |   |          |   |   |       | ±2.01                                   |
|   | 350 MHz                          |   |          |   |   |       | ±3.51                                   |
|   | 400 MHz                          |   |          |   |   |       | ±3.51                                   |
|   | 450 MHz                          |   |          |   |   |       | ±3.51                                   |
|   | 500 MHz                          |   |          |   |   |       | ±3.51                                   |
|   | 550 MHz                          |   |          |   |   |       | ±4.01                                   |
| 600 MHz   |                                  |   |          |   |   | ±4.01 |   |
| <p>Complete Columns A-E as follows:</p> <p>A            Enter the 437B present frequency Reading (W).</p> <p>B            Enter the 437B 50 kHz Reading (W).</p> <p>C            Apply power sensor correction factor for present frequency (W): <math>CF * (\text{Column A entry})</math></p> <p>D            Apply power sensor correction factor for 50 kHz (W): <math>CF * (\text{Column B entry})</math></p> <p>E            Compute and enter Error relative to 50 kHz plus floor (%): <math>100 * [(\text{sqrt}(\text{Column B/Column D entry}) - 1) \pm 100 * (100\mu\text{V/nominal voltage})]</math>.</p> |                                  |   |          |   |   |       |   |

Table 3-21. High Frequency Flatness Verification (cont.)

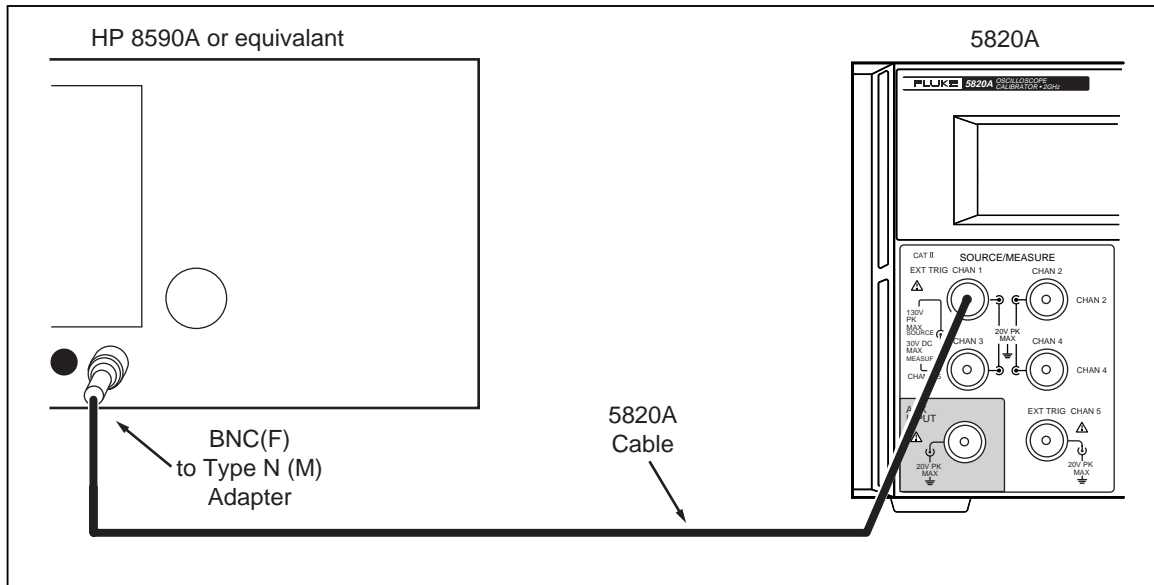
| Amplitude (V)                    | Calibrator Mainframe Freq. (MHz)  | A | B 50 kHz | C | D | E     | Calibrator Mainframe Flatness Spec. (%) |
|----------------------------------|---|---|----------|---|---|-------|---|
| 3.4                              | 50 MHz  |   |          |   |   |       | ±1.50                                   |
|                                  | 100 MHz   |   |          |   |   |       | ±1.50                                   |
|                                  | 150 MHz   |   |          |   |   |       | ±2.00                                   |
|                                  | 200 MHz   |   |          |   |   |       | ±2.00                                   |
|                                  | 250 MHz   |   |          |   |   |       | ±2.00                                   |
|                                  | 300 MHz   |   |          |   |   |       | ±2.00                                   |
|                                  | 350 MHz   |   |          |   |   |       | ±3.50                                   |
|                                  | 400 MHz   |   |          |   |   |       | ±3.50                                   |
|                                  | 450 MHz   |   |          |   |   |       | ±3.50                                   |
|                                  | 500 MHz   |   |          |   |   |       | ±3.50                                   |
|                                  | 550 MHz   |   |          |   |   |       | ±4.00                                   |
| 600 MHz                          |   |   |          |   |   | ±4.00 |   |
| 5.5                              | 50 MHz  |   |          |   |   |       | ±1.50                                   |
|                                  | 100 MHz   |   |          |   |   |       | ±1.50                                   |
|                                  | 150 MHz   |   |          |   |   |       | ±2.00                                   |
|                                  | 200 MHz   |   |          |   |   |       | ±2.00                                   |
|                                  | 250 MHz   |   |          |   |   |       | ±2.00                                   |
|                                  | 300 MHz   |   |          |   |   |       | ±2.00                                   |
|                                  | 350 MHz   |   |          |   |   |       | ±3.50                                   |
|                                  | 400 MHz   |   |          |   |   |       | ±3.50                                   |
|                                  | 450 MHz   |   |          |   |   |       | ±3.50                                   |
|                                  | 500 MHz   |   |          |   |   |       | ±3.50                                   |
|                                  | 550 MHz   |   |          |   |   |       | ±4.00                                   |
| 600 MHz                          |   |   |          |   |   | ±4.00 |   |
| Complete Columns A-E as follows: |   |   |          |   |   |       |   |
| A                                | Enter the 437B present frequency Reading (W).   |   |          |   |   |       |   |
| B                                | Enter the 437B 50 kHz Reading (W).  |   |          |   |   |       |   |
| C                                | Apply power sensor correction factor for present frequency (W): $CF * (\text{Column A entry})$  |   |          |   |   |       |   |
| D                                | Apply power sensor correction factor for 50 kHz (W): $CF * (\text{Column B entry})$   |   |          |   |   |       |   |
| E                                | Compute and enter Error relative to 50 kHz plus floor (%): $100 * [(\text{sqrt}(\text{Column B/Column D entry}) - 1) \pm 100 * (100\mu\text{V/nominal voltage})]$ . |   |          |   |   |       |   |

**3-48. < 600 MHz Leveled Sine Harmonic Verification**

This procedure uses the following equipment:

- Hewlett-Packard 8590A (or better) Spectrum Analyzer
- BNC(f) to Type N(m) adapter
- N to BNC cable supplied with the Scope Calibrator

See Figure 3-7 for the proper equipment connections.



yu059f.eps

**Figure 3-7. Setup for Leveled Sine Wave Harmonics Verification**

Set the Calibrator Mainframe to the Levsine menu. Follow these steps to verify the leveled sine wave harmonics.

1. Using the N to BNC cable and BNC(f) to Type N(m) adapter, connect the CHAN 1 connector on the Calibrator Mainframe to the HP 8590A.
2. Program the Calibrator Mainframe to 5.5 V p-p at each frequency listed in Table 3-22. Press **OPR** **STBY** on the Calibrator Mainframe to activate the output.
3. Set HP 8590A start frequency to the Calibrator Mainframe output frequency. Set HP 8590A stop frequency to 10 times the Calibrator Mainframe output frequency. Set the HP 8590A reference level at +19 dBm.
4. Record the harmonic level reading for each frequency and harmonic listed in Table 3-22. For harmonics 3, 4, and 5, record the highest harmonic level of the three measured. Harmonics should be below the levels listed in the tolerance column of Table 3-22.

Table 3-22. Leveled Sine Wave Harmonics Verification


| Calibrator Mainframe Output Frequency (@ 5.5 V p-p) | Harmonic | HP 8590A Reading (dB) | Tolerance |
|---|----------|-----------------------|-----------|
| 50 kHz  | 2        |                       | -33 dB    |
| 50 kHz  | 3, 4, 5  |                       | -38 dB    |
| 100 kHz   | 2        |                       | -33 dB    |
| 100 kHz   | 3, 4, 5  |                       | -38 dB    |
| 200 kHz   | 2        |                       | -33 dB    |
| 200 kHz   | 3, 4, 5  |                       | -38 dB    |
| 400 kHz   | 2        |                       | -33 dB    |
| 400 kHz   | 3, 4, 5  |                       | -38 dB    |
| 800 kHz   | 2        |                       | -33 dB    |
| 800 kHz   | 3, 4, 5  |                       | -38 dB    |
| 1 MHz   | 2        |                       | -33 dB    |
| 1 MHz   | 3, 4, 5  |                       | -38 dB    |
| 2 MHz   | 2        |                       | -33 dB    |
| 2 MHz   | 3, 4, 5  |                       | -38 dB    |
| 4 MHz   | 2        |                       | -33 dB    |
| 4 MHz   | 3, 4, 5  |                       | -38 dB    |
| 8 MHz   | 2        |                       | -33 dB    |
| 8 MHz   | 3, 4, 5  |                       | -38 dB    |
| 10 MHz  | 2        |                       | -33 dB    |
| 10 MHz  | 3, 4, 5  |                       | -38 dB    |
| 20 MHz  | 2        |                       | -33 dB    |
| 20 MHz  | 3, 4, 5  |                       | -38 dB    |
| 40 MHz  | 2        |                       | -33 dB    |
| 40 MHz  | 3, 4, 5  |                       | -38 dB    |
| 80 MHz  | 2        |                       | -33 dB    |
| 80 MHz  | 3, 4, 5  |                       | -38 dB    |
| 100 MHz   | 2        |                       | -33 dB    |
| 100 MHz   | 3, 4, 5  |                       | -38 dB    |
| 200 MHz   | 2        |                       | -33 dB    |
| 200 MHz   | 3, 4, 5  |                       | -38 dB    |
| 400 MHz   | 2        |                       | -33 dB    |
| 400 MHz   | 3, 4, 5  |                       | -38 dB    |
| 600 MHz   | 2        |                       | -33 dB    |
| 600 MHz   | 3, 4, 5  |                       | -38 dB    |

### 3-49. Time Marker Verification

This procedure uses the following equipment:

- PM 6680 Frequency Counter with a prescaler for the Channel C input (Option PM 9621, PM 9624, or PM 9625) and ovenized timebase (Option PM 9690 or PM 9691)
- BNC(f) to Type N(m) adapter
- N to BNC cable supplied with the Scope Calibrator

Set the PM 6680's FUNCTION to measure frequency with auto trigger, measurement time set to 1 second or longer, and 50  $\Omega$  impedance.

Set the Calibrator Mainframe to Marker mode. Press  on the Calibrator Mainframe to activate the output. Then follow these steps to for each period listed in Table 3-23.

1. Program the Calibrator Mainframe to the output as listed in Table 3-23.
2. Using the N to BNC cable, connect the CHAN 1 connector on the Calibrator Mainframe to the PM 6680 at the channel indicated in Table 3-23. You will need the BNC-N adapter for the connection to Channel C.
3. Set the filter on the PM 6680 as indicated in the table. Allow the PM 6680 reading to stabilize, then record the PM 6680 reading for each frequency listed for the Calibrator Mainframe.
4. Invert the PM 6680's frequency reading to derive the period. For example, a reading of 1.000006345 kHz has a period of:  

$$1/1.000006345 \text{ kHz} = 0.999993655 \text{ ms.}$$

Record the period in the table and compare to the tolerance column.

**Table 3-23. Marker Generator Verification**

| Period<br>(s)        | Measured Value<br>(s) | Deviation<br>(s) | 1-Year Spec.<br>(s)   |
|----------------------|-----------------------|------------------|-----------------------|
| 5                    |                       |                  | $1.4 \times 10^{-4}$  |
| 2                    |                       |                  | $2.5 \times 10^{-5}$  |
| 0.05                 |                       |                  | $1.4 \times 10^{-7}$  |
| 0.02                 |                       |                  | $2.0 \times 10^{-8}$  |
| 0.01                 |                       |                  | $1.0 \times 10^{-8}$  |
| $1.0 \times 10^{-7}$ |                       |                  | $1.0 \times 10^{-13}$ |
| $5.0 \times 10^{-8}$ |                       |                  | $5.0 \times 10^{-14}$ |
| $3.5 \times 10^{-8}$ |                       |                  | $3.5 \times 10^{-14}$ |
| $2.0 \times 10^{-8}$ |                       |                  | $2.0 \times 10^{-14}$ |
| $1.0 \times 10^{-8}$ |                       |                  | $1.0 \times 10^{-14}$ |
| $5.0 \times 10^{-9}$ |                       |                  | $5.0 \times 10^{-15}$ |
| $2.0 \times 10^{-9}$ |                       |                  | $2.0 \times 10^{-15}$ |

### 3-50. Wave Generator Verification

This procedure uses the following equipment:

- 5790A AC Measurement Standard
- BNC(f) to Double Banana adapter
- 50  $\Omega$  feedthrough termination
- N to BNC cable supplied with the Calibrator Mainframe

See Figure 3-8 for the proper equipment connections.

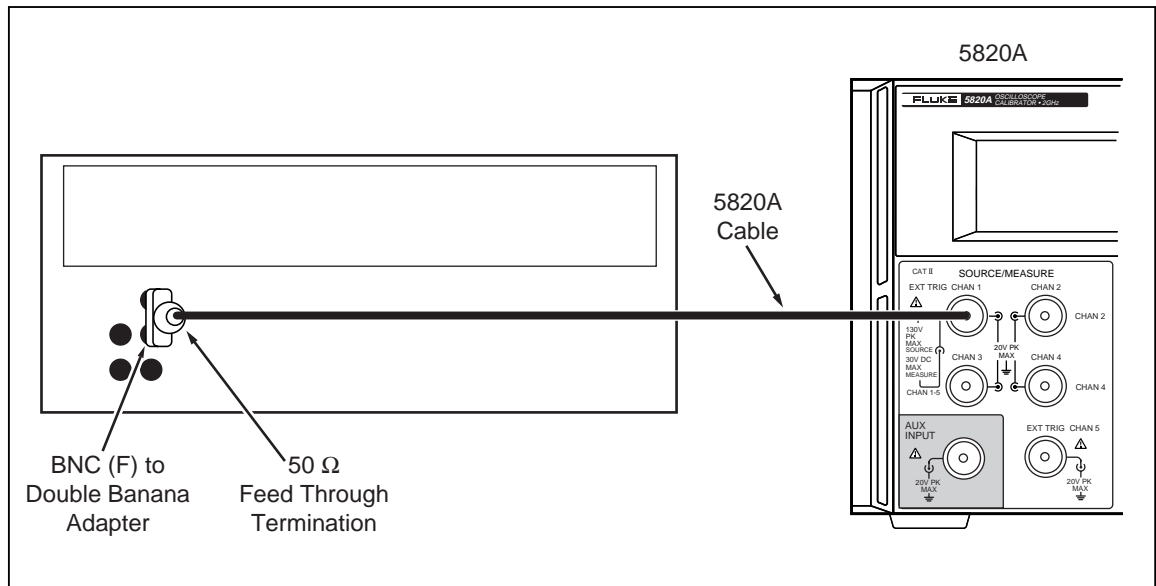


Figure 3-8. Setup for Wave Generator Function

Set the Calibrator Mainframe to the Wavegen menu. Press **OPR** **STBY** on the Calibrator Mainframe to activate the output. Set the offset to 0 mV, and the frequency to 1 kHz. Then follow these steps to verify the wave generator function.

### 3-51. Verification at 1 M $\Omega$

Set the Calibrator Mainframe impedance to 1 M $\Omega$  (The blue softkey under **SCOPE Z** toggles the impedance between 50  $\Omega$  and 1 M $\Omega$ ).

1. Connect the N to BNC cable to the Calibrator Mainframe's CHAN 1 connector. Connect the other end of the N to BNC cable to the 5790A INPUT 2 using the BNC(f) to Double Banana adapter.
2. Set the 5790A to AUTORANGE, digital filter mode to FAST, restart fine, and Hi Res on.
3. Program the Calibrator Mainframe to output the wave type and voltage listed in Table 3-24.
4. Allow the 5790A reading to stabilize, then record the 5790A rms reading for each wave type and voltage in Table 3-24.
5. Multiply the rms reading by the conversion factor listed to convert it to the peak-to-peak value. Compare result to the tolerance column.



**Table 3-24. Wave Generator Verification at 1 MΩ**

| <b>Calibrator Mainframe Wave Type</b> | <b>Calibrator Mainframe Output (@ 10 kHz)</b> | <b>5790A Reading (V rms)</b> | <b>Conversion Factor</b> | <b>5790A Reading x Conversion Factor (V p-p)</b> | <b>Tolerance (V p-p)</b> |
|---------------------------------------|---|------------------------------|--------------------------|--|--------------------------|
| square                                | 1.8 mV  |                              | 2.0000                   |  | 0.000154 V               |
| square                                | 11.9 mV                                       |                              | 2.0000                   |  | 0.000457 V               |
| square                                | 21.9 mV                                       |                              | 2.0000                   |  | 0.00075 V                |
| square                                | 22.0 mV                                       |                              | 2.0000                   |  | 0.00076 V                |
| square                                | 56.0 mV                                       |                              | 2.0000                   |  | 0.00178 V                |
| square                                | 89.9 mV                                       |                              | 2.0000                   |  | 0.002797 V               |
| square                                | 90 mV   |                              | 2.0000                   |  | 0.0028 V                 |
| square                                | 155 mV  |                              | 2.0000                   |  | 0.00475 V                |
| square                                | 219 mV  |                              | 2.0000                   |  | 0.00667 V                |
| square                                | 220 mV  |                              | 2.0000                   |  | 0.0067 V                 |
| square                                | 560 mV  |                              | 2.0000                   |  | 0.0169 V                 |
| square                                | 899 mV  |                              | 2.0000                   |  | 0.02707 V                |
| square                                | 0.90 V  |                              | 2.0000                   |  | 0.0271 V                 |
| square                                | 3.75 V  |                              | 2.0000                   |  | 0.1126 V                 |
| square                                | 6.59 V  |                              | 2.0000                   |  | 0.1978 V                 |
| square                                | 6.6 V   |                              | 2.0000                   |  | 0.1981 V                 |
| square                                | 30.8 V  |                              | 2.0000                   |  | 0.9241 V                 |
| square                                | 55.0 V  |                              | 2.0000                   |  | 1.6501 V                 |
| sine                                  | 1.8 mV  |                              | 2.8284                   |  | 0.000154 V               |
| sine                                  | 21.9 mV                                       |                              | 2.8284                   |  | 0.000757 V               |
| sine                                  | 89.9 mV                                       |                              | 2.8284                   |  | 0.002797 V               |
| sine                                  | 219 mV  |                              | 2.8284                   |  | 0.00667 V                |
| sine                                  | 899 mV  |                              | 2.8284                   |  | 0.02707 V                |
| sine                                  | 6.59 V  |                              | 2.8284                   |  | 0.1978 V                 |
| sine                                  | 55 V  |                              | 2.8284                   |  | 1.6501 V                 |
| triangle                              | 1.8 mV  |                              | 3.4641                   |  | 0.000154 V               |
| triangle                              | 21.9 mV                                       |                              | 3.4641                   |  | 0.000757 V               |
| triangle                              | 89.9 mV                                       |                              | 3.4641                   |  | 0.002797 V               |
| triangle                              | 219 mV  |                              | 3.4641                   |  | 0.00667 V                |
| triangle                              | 899 mV  |                              | 3.4641                   |  | 0.02707 V                |
| triangle                              | 6.59 V  |                              | 3.4641                   |  | 0.1978 V                 |
| triangle                              | 55 V  |                              | 3.4641                   |  | 1.6501 V                 |

### 3-52. Verification at 50 Ω

Set the Calibrator Mainframe impedance to 50 Ω (The blue softkey under **SCOPE Z** toggles the impedance between 50 Ω and 1 MΩ).

1. Connect the N to BNC cable to the Calibrator Mainframe's CHAN 1 connector. Connect the other end of the N to BNC cable to the 50 Ω feedthrough termination then to the 5790A INPUT 2 using the BNC(f) to Double Banana adapter.
2. Set the 5790A to AUTORANGE, digital filter mode to FAST, restart fine, and Hi Res on.
3. Program the Calibrator Mainframe to output the wave type and voltage listed in Table 3-25.
4. Allow the 5790A reading to stabilize, then record the 5790A rms reading for each wave type and voltage in Table 3-25.
5. Multiply the rms reading by the conversion factor listed to convert it to the peak-to-peak value.
6. Multiply the peak-to-peak value by  $(0.5 * (50 + Rload) / Rload)$ , where Rload = the actual feedthrough termination resistance, to correct for the resistance error. Compare result to the tolerance column.

Table 3-25. Wave Generator Verification at 50 Ω

| Calibrator Mainframe Wave Type | Calibrator Mainframe Output (10 kHz) | 5790A Reading (V rms) | Conversion Factor | 5790A Rdg x Conversion Factor (V p-p) | V p-p Value x correction | Tolerance (V p-p) |
|--------------------------------|--------------------------------------|-----------------------|-------------------|---------------------------------------|--------------------------|-------------------|
| square                         | 1.8 mV                               |                       | 2.0000            |                                       |                          | 0.000154 V        |
| square                         | 6.4 mV                               |                       | 2.0000            |                                       |                          | 0.000292 V        |
| square                         | 10.9 mV                              |                       | 2.0000            |                                       |                          | 0.000427 V        |
| square                         | 11.0 mV                              |                       | 2.0000            |                                       |                          | 0.00043 V         |
| square                         | 28.0 mV                              |                       | 2.0000            |                                       |                          | 0.00094 V         |
| square                         | 44.9 mV                              |                       | 2.0000            |                                       |                          | 0.001447 V        |
| square                         | 45 mV                                |                       | 2.0000            |                                       |                          | 0.00145 V         |
| square                         | 78 mV                                |                       | 2.0000            |                                       |                          | 0.00244 V         |
| square                         | 109 mV                               |                       | 2.0000            |                                       |                          | 0.00337 V         |
| square                         | 110 mV                               |                       | 2.0000            |                                       |                          | 0.0034 V          |
| square                         | 280 mV                               |                       | 2.0000            |                                       |                          | 0.0085 V          |
| square                         | 449 mV                               |                       | 2.0000            |                                       |                          | 0.01357 V         |
| square                         | 450 mV                               |                       | 2.0000            |                                       |                          | 0.0136 V          |
| square                         | 780 mV                               |                       | 2.0000            |                                       |                          | 0.0235 V          |
| square                         | 1.09 V                               |                       | 2.0000            |                                       |                          | 0.0328 V          |
| square                         | 1.10 V                               |                       | 2.0000            |                                       |                          | 0.0331 V          |
| square                         | 1.80 V                               |                       | 2.0000            |                                       |                          | 0.0541 V          |

Table 3-25. Wave Generator Verification at 50 Ω (cont.)

| Calibrator Mainframe Wave Type | Calibrator Mainframe Output (10 kHz) | 5790A Reading (V rms) | Conversion Factor | 5790A Rdg x Conversion Factor (V p-p) | V p-p Value x Correction | Tolerance (V p-p) |
|--------------------------------|--------------------------------------|-----------------------|-------------------|---------------------------------------|--------------------------|-------------------|
| square                         | 2.50 V                               |                       | 2.0000            |                                       |                          | 0.0751 V          |
| sine                           | 1.8 mV                               |                       | 2.8284            |                                       |                          | 0.000154 V        |
| sine                           | 10.9 mV                              |                       | 2.8284            |                                       |                          | 0.000427 V        |
| sine                           | 44.9 mV                              |                       | 2.8284            |                                       |                          | 0.001447 V        |
| sine                           | 109 mV                               |                       | 2.8284            |                                       |                          | 0.00337 V         |
| sine                           | 449 mV                               |                       | 2.8284            |                                       |                          | 0.01357 V         |
| sine                           | 1.09 V                               |                       | 2.8284            |                                       |                          | 0.0328 V          |
| sine                           | 2.50 V                               |                       | 2.8284            |                                       |                          | 0.0751 V          |
| triangle                       | 1.8 mV                               |                       | 3.4641            |                                       |                          | 0.000154 V        |
| triangle                       | 10.9 mV                              |                       | 3.4641            |                                       |                          | 0.000427 V        |
| triangle                       | 44.9 mV                              |                       | 3.4641            |                                       |                          | 0.001447 V        |
| triangle                       | 109 mV                               |                       | 3.4641            |                                       |                          | 0.00337 V         |
| triangle                       | 449 mV                               |                       | 3.4641            |                                       |                          | 0.01357 V         |
| triangle                       | 1.09 V                               |                       | 3.4641            |                                       |                          | 0.0328 V          |
| triangle                       | 2.50 V                               |                       | 3.4641            |                                       |                          | 0.0751 V          |

**3-53. Pulse Width Verification**

The following equipment is used to verify the pulse width:

- High Frequency Digital Storage Oscilloscope: Tektronix 11801 with Tektronix SD-22/26 sampling head
- 3 dB attenuator, SMA (m/f)
- BNC(f) to SMA adapter (2)
- N to BNC cable supplied with the Scope Calibrator (2)

Put the Calibrator into standby. Connect the N to BNC cable supplied with the Scope Calibrator to the Calibrator Mainframe’s CHAN 1 connector. Connect the other end of the N to BNC cable to one BNC(f) to SMA(m) adapter then to the DSO’s sampling head through the 3-dB attenuator.

Using the second BNC(f) to SMA(m) adapter and N to BNC cable, connect the Calibrator Mainframe’s EXT TRIG (channel 5) connector to the 11801’s Trigger Input. On the Calibrator keypad, select **MORE MODES**. On the display, press the soft key under Pulse. Press the soft key under TRIG to select the TRIG/1 External Trigger output. Press **OPR STBY** on the Calibrator to activate the output.

Auto set the Digital Scope. Then set the Digital Scope to these starting values:

Main Time Base position (initial)    2 ns/div  
Vertical scale                                200 mV/div

Trigger source = ext; level = 200 mV; ext atten = x10;  
 slope = +; mode = auto  
 Measurement Function positive width

1. Program the Calibrator Mainframe to output the pulse width and period at 1.5 V as listed in Table 3-26.
2. Change the horizontal scale of the DSO so that you can view one positive pulse width. Record the width measurement made by the DSO. Compare to the tolerance column of Table 3-26.
3. Change the pulse amplitude and repeat the measurements for an amplitude of 0.15 V. You will need to change the vertical scale of the DSO.

**Table 3-26. Pulse Generator Verification: Pulse Width**

| Nominal Value (V p-p) | Pulse Width (s)        | Period (s)             | Measured Value (s) | Deviation (s) | 1-Year Spec. (s)      |
|-----------------------|------------------------|------------------------|--------------------|---------------|-----------------------|
| 1.5                   | $1.0 \times 10^{-9}$   | $200.0 \times 10^{-9}$ |                    |               | $250 \times 10^{-12}$ |
| 1.5                   | $9.9 \times 10^{-9}$   | $200.0 \times 10^{-9}$ |                    |               | $700 \times 10^{-12}$ |
| 1.5                   | $79.9 \times 10^{-9}$  | $1.000 \times 10^{-6}$ |                    |               | $4.2 \times 10^{-9}$  |
| 1.5                   | $500.0 \times 10^{-9}$ | $10.00 \times 10^{-6}$ |                    |               | $25.2 \times 10^{-9}$ |
| 0.150                 | $1.0 \times 10^{-9}$   | $200.0 \times 10^{-9}$ |                    |               | $250 \times 10^{-12}$ |
| 0.150                 | $9.9 \times 10^{-9}$   | $200.0 \times 10^{-9}$ |                    |               | $700 \times 10^{-12}$ |
| 0.150                 | $79.9 \times 10^{-9}$  | $1.000 \times 10^{-6}$ |                    |               | $4.2 \times 10^{-9}$  |
| 0.150                 | $500.0 \times 10^{-9}$ | $10.00 \times 10^{-6}$ |                    |               | $25.2 \times 10^{-9}$ |

**3-54. Pulse Skew Calibration and Verification**

The following equipment is used to Calibrate and verify Pulse Skew:

- High Frequency Digital Storage Oscilloscope: Tektronix 11801 with Tektronix SD-22/26 sampling head
- SMA T m-f-m connector
- 3 dB attenuator, SMA (m/f)
- BNC(f) to SMA adapter (2)
- 0.5 m SMA (m) - SMA (m) cable
- N to BNC cable supplied with the Scope Calibrator (2)

The skew function was introduced in December 1998. It is available only in Scope Calibrators shipped since that time. Skew calibration and verification is normally performed as part of the pulse width calibration and verification procedure.

For these procedures, skew is measured from 30% of the trigger signal amplitude to 30% of pulse amplitude. As an example, the trigger output is ~1.0 V into 50 Ω, if the pulse amplitude is 1.5 V, the skew would be measured from 450 mV point on the pulse to 300 mV on the trigger.

Put the Calibrator into standby. Connect the N to BNC cable supplied with the Scope Calibrator to the Calibrator Mainframe's CHAN 1 connector. Connect the other end of



### 3-57. Pulse Period Verification

This procedure uses the following equipment:

- PM 6680 Frequency Counter with an ovenized timebase (Option PM 9690 or PM 9691)
- N to BNC cable supplied with the Scope Calibrator

Set the Calibrator Mainframe to the Pulse menu. Press **OPR** **STBY** on the Calibrator Mainframe to activate the output. Then follow these steps to verify the Pulse period.

1. Set the PM 6680's FUNCTION to measure period on channel A with auto trigger, DC couple, 50  $\Omega$  impedance, and filter off.
2. Using the N to BNC cable, connect the CHAN 1 connector on the Calibrator Mainframe to PM 6680 channel A.
3. Program the Calibrator Mainframe to output the pulse width and period (at 1.5 V) as listed in Table 3-28.
4. Allow the PM 6680 reading to stabilize, then record the PM 6680 reading for each period listed for the Calibrator Mainframe.

Table 3-28. Pulse Generator Verification: Period

| Nominal Value (V p-p) | Pulse Width (s)      | Period (s)           | Measured Value (s) | Deviation (s) | 1-Year Spec. (s)     |
|-----------------------|----------------------|----------------------|--------------------|---------------|----------------------|
| 1.5                   | $5.0 \times 10^{-9}$ | $200 \times 10^{-9}$ |                    |               | $66 \times 10^{-15}$ |
| 1.5                   | $500 \times 10^{-9}$ | 0.01                 |                    |               | $3.3 \times 10^{-9}$ |
| 1.5                   | $500 \times 10^{-9}$ | 0.02                 |                    |               | $6.6 \times 10^{-9}$ |

### 3-58. MeasZ Resistance Verification

The MeasZ resistance function is verified by measuring resistors of known values. The measurement value is then compared to the resistor actual value.

The resistors must make a solid connection to a BNC(f) to enable a connection to the end of the N to BNC cable supplied with the Scope Calibrator. The resistance values must be known at this BNC(f) connector. Fluke uses an HP 3458A DMM to make a 4-wire ohms measurement at the BNC(f) connector to determine the actual resistance values.

This procedure uses the following equipment:

- Resistors of known values: 1.5 M $\Omega$ , 1 M $\Omega$ , 60  $\Omega$ , 50  $\Omega$ , 40  $\Omega$  nominal
- adapters to connect resistors to BNC(f) connector
- N to BNC cable supplied with the Scope Calibrator

Set the Calibrator Mainframe to the MeasZ menu. Follow these steps to verify the MeasZ resistance function.

1. Set the Calibrator Mainframe MeasZ resistance range as indicated in Table 3-26. (The blue softkey under **MEASURE** toggles the MeasZ ranges).
2. Using the N to BNC cable, connect the CHAN 1 connector to the BNC(f) connector attached to the nominal resistance values indicated in Table 3-26. The 600 K $\Omega$  nominal value can be achieved by connecting the 1.5 M $\Omega$  and 1 M $\Omega$  resistors in parallel.

3. Allow the Calibrator Mainframe reading to stabilize, then record the Calibrator Mainframe resistance reading for each nominal value listed in Table 3-26. Compare the Calibrator Mainframe resistance readings to the actual resistance values and the tolerance column of Table 3-26.

**Table 3-26. MeasZ Resistance Verification**

| Calibrator Mainframe MeasZ Range | Nominal Resistance Value | Calibrator Mainframe Resistance Reading | Actual Resistance Value | Tolerance |
|----------------------------------|--------------------------|---|-------------------------|-----------|
| res 50 Ω                         | 40 Ω                     |   |                         | 0.04 Ω    |
| res 50 Ω                         | 50 Ω                     |   |                         | 0.05 Ω    |
| res 50 Ω                         | 60 Ω                     |   |                         | 0.06 Ω    |
| res 1 MΩ                         | 600 kΩ                   |   |                         | 600 Ω     |
| res 1 MΩ                         | 1 MΩ                     |   |                         | 1 kΩ      |
| res 1 MΩ                         | 1.5 MΩ                   |   |                         | 1.5 kΩ    |

### **3-59. MeasZ Capacitance Verification**

The MeasZ capacitance function is verified by measuring capacitors of known values. The measurement value is then compared to the capacitor actual value.

The capacitors must make a solid connection to a BNC(f) to enable a connection to the end of the N to BNC cable supplied with the Scope Calibrator. Due to the small capacitance values, care must be taken to know the actual capacitance at this BNC(f) connector. The capacitance values must be determined at a 10 MHz oscillator frequency. Fluke uses an HP 4192A Impedance Analyzer at 10 MHz to determine the actual capacitance values.

This procedure uses the following equipment:

- Adapters and capacitors to achieve 5 pF, 29 pF, 49 pF nominal values at the end of BNC(f) connector
- N to BNC cable supplied with the Scope Calibrator

Set the Calibrator Mainframe to the MeasZ menu. Follow these steps to verify the MeasZ capacitance function.

1. Set the Calibrator Mainframe MeasZ capacitance range to **cap**. (The blue softkey under **MEASURE** toggles the MeasZ ranges).
2. Connect the N to BNC cable to the Calibrator Mainframe CHAN 1 connector, but do not connect any thing to the end of this cable.
3. Allow the Calibrator Mainframe reading to stabilize, then press the **SET OFFSET** blue softkey to zero the capacitance reading.
4. Connect the end of the N to BNC cable to the BNC(f) connector attached to the nominal capacitor values indicated in Table 3-27.
5. Allow the Calibrator Mainframe reading to stabilize, then record the Calibrator Mainframe capacitance reading for each nominal value listed in Table 3-27. Compare the Calibrator Mainframe capacitance readings to the actual capacitance values and the tolerance column of Table 3-30.

Table 3-27. MeasZ Capacitance Verification

| Nominal Capacitance Value | Calibrator Mainframe Capacitance Reading | Actual Capacitance Value | Tolerance |
|---------------------------|--|--------------------------|-----------|
| 5 pF                      |  |                          | 0.75 pF   |
| 29 pF                     |  |                          | 1.95 pF   |
| 49 pF                     |  |                          | 2.95 pF   |

**3-60. Overload Function Verification**

This procedure uses the following equipment:

- 50 Ω feedthrough termination
- N to BNC cable supplied with the Calibrator Mainframe

See Figure 3-9 for the proper equipment connections.

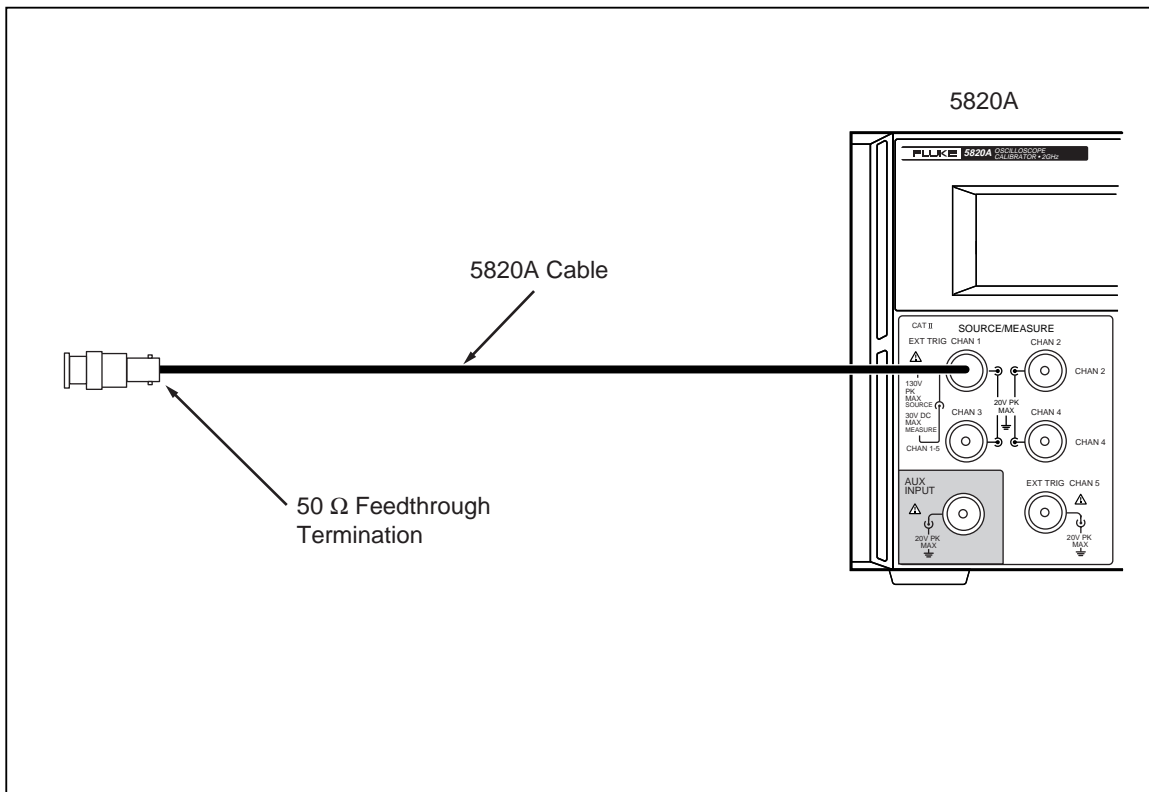


Figure 3-9. Setup for Overload Function Verification

Set the Calibrator Mainframe to the Overload menu. Connect the N to BNC cable to the Calibrator Mainframe CHAN 1 connector. Then follow these steps to verify the overload function.

1. Connect the 50 Ω feedthrough termination to the end of the N to BNC cable.
2. Program the Calibrator Mainframe output for 5.000 V, dc (**OUT VAL** blue softkey), and time limit = 60 s (**T LIMIT** blue softkey).
3. Press **OPR STBY** on the Calibrator Mainframe to activate the output and verify that the **OPR** display timer increments.



4. Remove the 50  $\Omega$  feedthrough termination before 60 seconds and verify that Calibrator Mainframe goes to **STBY**.
5. Reconnect the 50  $\Omega$  feedthrough termination to the end of the N to BNC cable.
6. Program the Calibrator Mainframe output for 5.000 V, AC (**OUT VAL** blue softkey).
7. Press   on the Calibrator Mainframe to activate the output and verify that the **OPR** display timer increments.
8. Remove the 50  $\Omega$  feedthrough termination before 60 seconds and verify that Calibrator Mainframe goes to **STBY**.

### **3-61. Hardware Adjustments**

Hardware adjustments must be made to the leveled sine and edge functions each time the 5820A is repaired. In addition to the adjustment procedures, this section provides lists of the required equipment and some recommendations on models that have the capabilities required by these procedures. Equivalent models can be substituted if necessary.

#### **3-62. Equipment Required**

The following equipment is necessary for performing the hardware adjustments described in this section. The models listed are recommended for providing accurate results.

- Standard adjustment tool for adjusting the pots and trimmer caps
- Extender Card
- Oscilloscope Mainframe and Sampling Head (Tektronix 11801 with SD-22/26 or Tektronix TDS 820 with 8 GHz bandwidth)
- 10 dB Attenuator (Weinschel 9-10 (SMA), or Weinschel 18W-10, or equivalent)
- Cable provided with 5820A
- Spectrum Analyzer (Hewlett-Packard 8590A)

#### **3-63. Adjusting the Leveled Sine Wave Function**

There are two adjustment procedures that need to be made for the leveled sine wave function. The first procedure adjusts the balance out of the LO VCO so that the signal is balanced between the two VCOs. The second procedure adjusts the harmonics.

#### **3-64. Equipment Setup**

This procedure uses the spectrum analyzer. Before you begin this procedure, verify that the Calibrator Mainframe is in leveled sine wave mode (the Levsine menu is displayed), and program it to output 5.5 V p-p @ 600 MHz. Press   to activate the output.

Refer to Figure 3-7 for setup connections and connect the Calibrator Mainframe to the Spectrum Analyzer. Adjust the Spectrum Analyzer so that it displays one peak across its horizontal center line. The far right of the peak is fixed at the far right of the center line, as shown below.

#### **3-65. Adjusting the Leveled Sine Wave VCO Balance**

Once you have completed the setup described above, perform the following procedure to adjust the VCO balance for the leveled sine wave function.

1. Program the Calibrator Mainframe for an output of 5.5 V @ 600 MHz.
2. Set the Spectrum Analyzer to the parameters listed below:

**Spectrum Analyzer Setup**

|                      |         |
|----------------------|---------|
| Start Frequency      | 10 MHz  |
| Stop Frequency       | 800 MHz |
| Resolution Bandwidth | 30 kHz  |
| Video Bandwidth      | 3 kHz   |
| Reference Level      | 20 dBm  |

The Spectrum Analyzer will display a spur at 153 MHz. Refer to Figure 3-10 to identify the spur.

3. You need to adjust the wave until the spur is at a minimum. To do this, slowly rotate R1 (shown in Figure 3-10) counterclockwise until the spur is at a minimum. As you adjust it, the spur will move down the waveform, towards the right. As soon as the spur is minimized, stop rotating R1. If you rotate it too far, the spur will reappear.

Once you have turned R1 to the point at which the spur is at a minimum, the signal is balanced between the VCOs, and you have completed the adjustment.

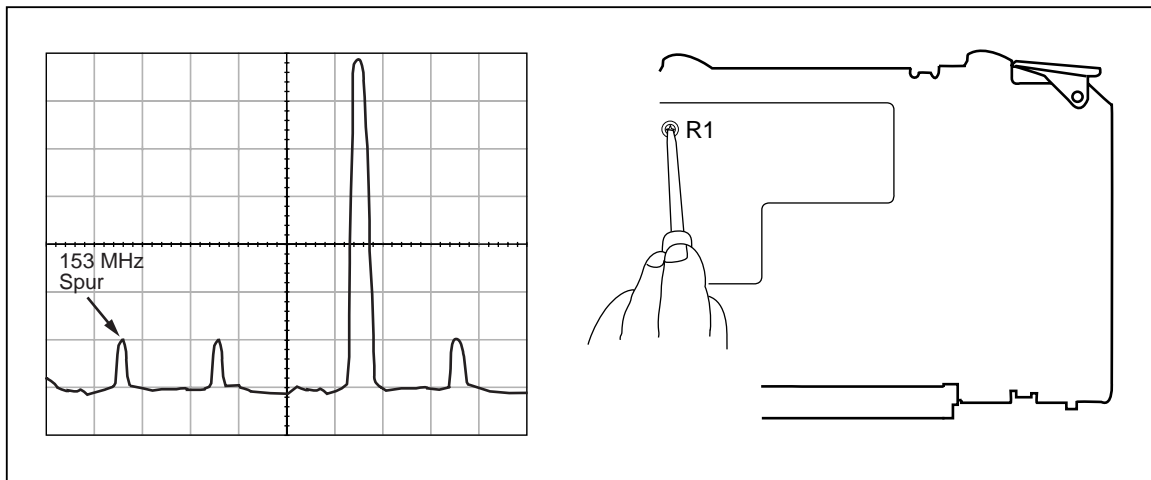


Figure 3-10. Adjusting the Leveled Sine Wave Balance

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**3-66. Adjusting the Leveled Sine Wave Harmonics**

The following procedure adjusts the harmonics for the leveled sine wave function.

*Note*

*This procedure should only be used for adjusting the leveled sine wave harmonics. Do not use this procedure as a verification test. The specifications in this procedure are not valid for verification.*

1. Set the Spectrum Analyzer to the parameters listed below:

**Spectrum Analyzer Setup**

|                 |         |
|-----------------|---------|
| Start Frequency | 50 MHz  |
| Stop Frequency  | 500 MHz |

|                      |        |
|----------------------|--------|
| Resolution Bandwidth | 3 MHz  |
| Video Bandwidth      | 3 kHz  |
| Reference Level      | 20 dBm |

- Use your Spectrum Analyzer's Peak Search function to find the desired reference signal. The Analyzer should show the fundamental, and second and third harmonics. The harmonics need to be adjusted so that the second harmonic is at 33 dBc and third harmonic should typically be at 38 dBc as shown in Figure 3-11.
- To adjust the harmonics, adjust R8, as shown in Figure 3-11 until the peaks of the second and third harmonic are at the correct dB level. You may find that you can place the second harmonic at 33 dBc but the third harmonic is not at 38 dBc. If this is the case, continue adjusting R8. The second harmonic will fluctuate, but there is a point at which both harmonics will be at the correct decibel level.

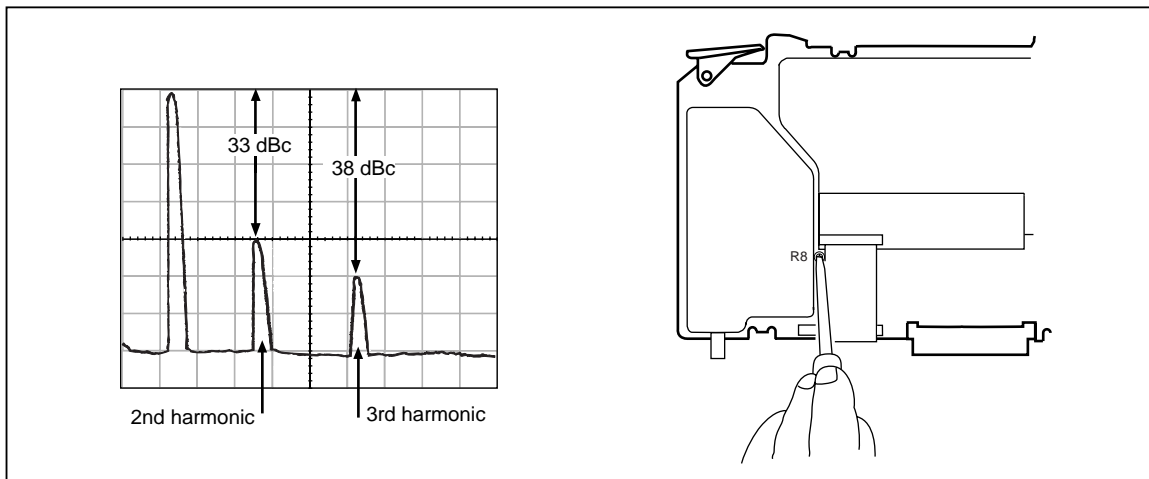


Figure 3-11. Adjusting the Levelled Sine Wave Harmonics

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### 3-67. Adjusting the Aberrations for the Edge Function

Adjustments need to be made after repair to the edge function to adjust the edge aberrations.

#### Note


*To verify the edge aberrations back to national standards, you should send your Calibrator Mainframe to Fluke, or other facility that has established traceability for aberrations. Fluke, for example, has a reference pulse that is sent to the National Institute of Standards and Technology (NIST) for characterization. This information is then transferred to high speed sampling heads, which are used to adjust and verify the 5820A.*

### 3-68. Equipment Setup

The following equipment is needed for this procedure:

- Oscilloscope: Tektronix 11801 with SD22/26 input module or Tektronix TDS 820 with 8 GHz bandwidth.
- 10 dB Attenuator: Weinschel 9-10 (SMA) or Weinschel 18W-10 or equivalent

- Output cable provided with the 5820A

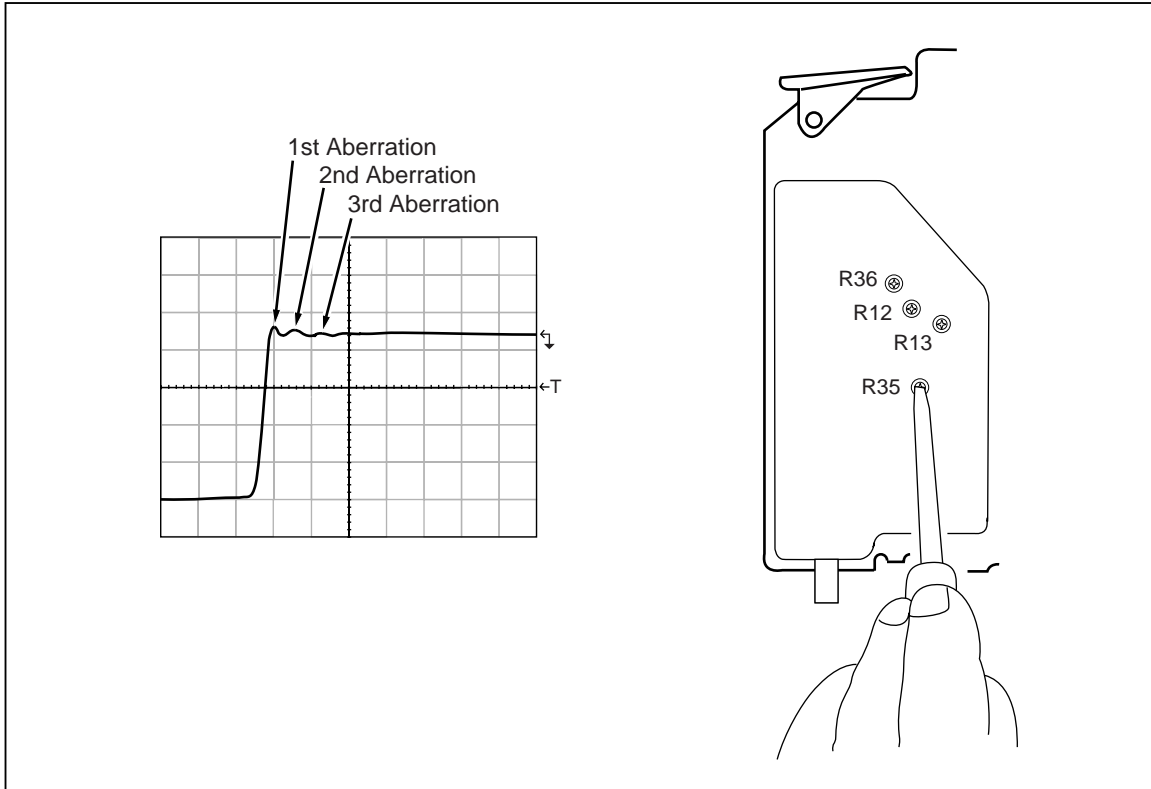
Before you begin this procedure, verify that the 5820A is in the edge mode (the Edge menu is displayed), and program it to output 1 V p-p @ 1 MHz. Press  to activate the output.

Refer to Figure 3-6 for the proper setup connections and connect the Calibrator Mainframe to the oscilloscope. Set the oscilloscope vertical to 10 mV/div and horizontal to 1 ns/div. Set the oscilloscope to look at the 90% point of the edge signal; use this point as the reference level. Set the oscilloscope to look at the first 10 ns of the edge signal with the rising edge at the left edge of the oscilloscope display.

### **3-69. Adjusting the Edge Aberrations**

Refer to Figure 3-12 while making the following adjustments:

1. Adjust A90R13 to set the edge signal at the right edge of oscilloscope display, at 10 ns, to the reference level set above.
2. Adjust A90R36 so the first overshoot is the same amplitude as the next highest aberration.
3. Adjust A90R35 so that the second and third overshoot aberrations are the same amplitude as the first aberration.
4. Adjust A90R12 to set the edge signal occurring between 2 ns and 10 ns to the reference level set above.
5. Readjust A90R36 and A90R35 to obtain equal amplitudes for the first, second, and third aberrations.
6. Adjust A90R13 to set the edge signal occurring between 0 ns and 2 ns to the reference point set above. Center any aberrations so the peaks are equal above and below the reference level.
7. Readjust A90R12 if necessary to keep the edge signal occurring between 2 ns and 10 ns at the reference level.
8. Readjust A90R13 if necessary to keep the edge signal occurring between 0 ns and 2 ns at the reference level.
9. Set the UUT output to 250 mV and the oscilloscope vertical to 2 mV/div. Check the aberrations.
10. Connect the 10 dB attenuator to the oscilloscope input. Connect the UUT to the attenuator and program the UUT output to 2.5 V.
11. Set the oscilloscope vertical to 5 mV/div. Check the aberrations.
12. Check for rise time < 300 ps at 250 mV, 1 V, and 2.5 V outputs.



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**Figure 3-12. Adjusting Edge Aberrations**



# **Chapter 4**

## **Maintenance**

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## 4-1. Introduction

This chapter explains how to perform routine maintenance to keep a normally operating 5820A Calibrator in service. These tasks include:

- Replacing the fuse
- Cleaning the air filter
- Cleaning the external surfaces

## 4-2. Replacing the Line Fuse

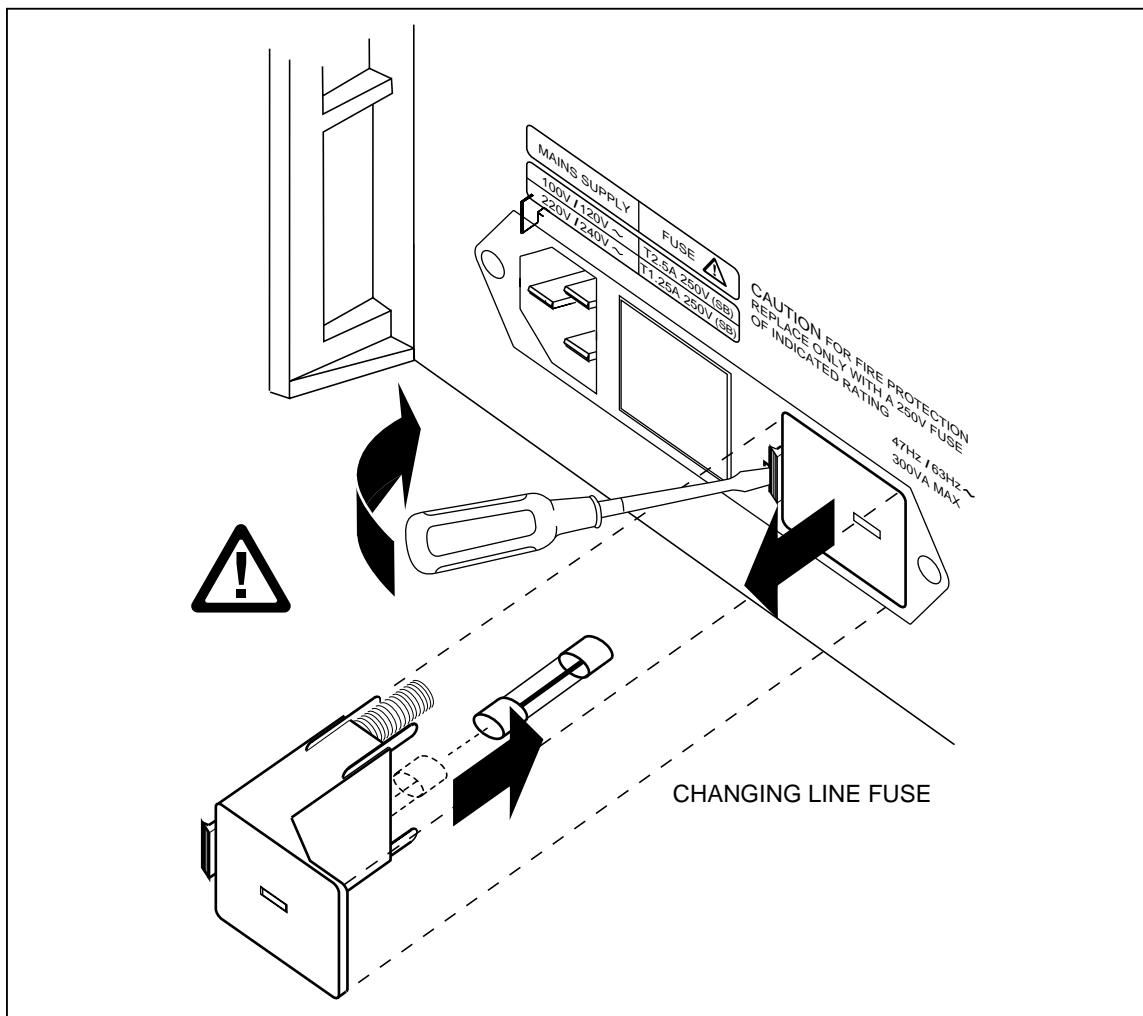
The line power fuse is accessible on the rear panel. The fuse rating label above the ac power input module shows the correct replacement fuse for each line voltage setting. Table 4-1 lists the fuse part numbers for each line voltage setting.

To check or replace the fuse, refer to Figure 4-1 and proceed as follows:

1. **Disconnect line power.**
2. The line power fuse and line voltage switch are located in a compartment on the right end of the ac input module. To open the compartment and remove the fuse, insert the blade of a standard screwdriver to the left of the tab located at the left side of the compartment cover.
3. Pry the tab out of the slot and the compartment cover will pop part way out.
4. Remove the compartment cover with your fingers.
5. The fuse comes out with the compartment cover and can be easily replaced.
6. To reinstall the fuse, push the compartment cover back into the compartment until the tab locks with the ac input module.

**Table 4-1. Replacement Fuses**

| Part Number  | Fuse Description        | Line Voltage Setting |
|--|-------------------------|----------------------|
| ⚠ 109181   | 2A/250V SB (Time Delay) | 100 V or 120 V       |
| ⚠ 109272   | 1A/250V SB (Time Delay) | 200 V or 240 V       |
| ⚠ To ensure safety, use exact replacement fuse only. |                         |                      |



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Figure 4-1. Accessing the Fuse

### 4-3. **Cleaning the Air Filter**

#### **⚠ ⚠ Warning**

To avoid risk of injury, never operate or power the 5820A calibrator without the fan filter in place.

#### **⚠ Caution**

To avoid possible damage caused by overheating, keep the area around the fan unrestricted. If the air intake becomes restricted, the intake air will be too warm, or the filter will become clogged.

The air filter must be removed and cleaned every 30 days or more frequently if the calibrator is operated in a dusty environment. The air filter is accessible from the rear panel of the calibrator.

To clean the air filter, refer to Figure 4-2 and proceed as follows:

1. **Disconnect line power.**
2. Remove the filter element.
  - a. Grasp the top and bottom of the air filter frame.
  - b. Squeeze the edges of the frame towards each other to disengage the filter tabs from the slots in the calibrator.
  - c. Pull the filter frame straight out from the calibrator.
3. Clean the filter element.
  - a. Wash the filter element in soapy water.
  - b. Rinse the filter element thoroughly.
  - c. Shake out the excess water, then allow the filter element to dry thoroughly before reinstalling it.
4. Reinstall the filter element by performing the filter removal steps in reverse order.

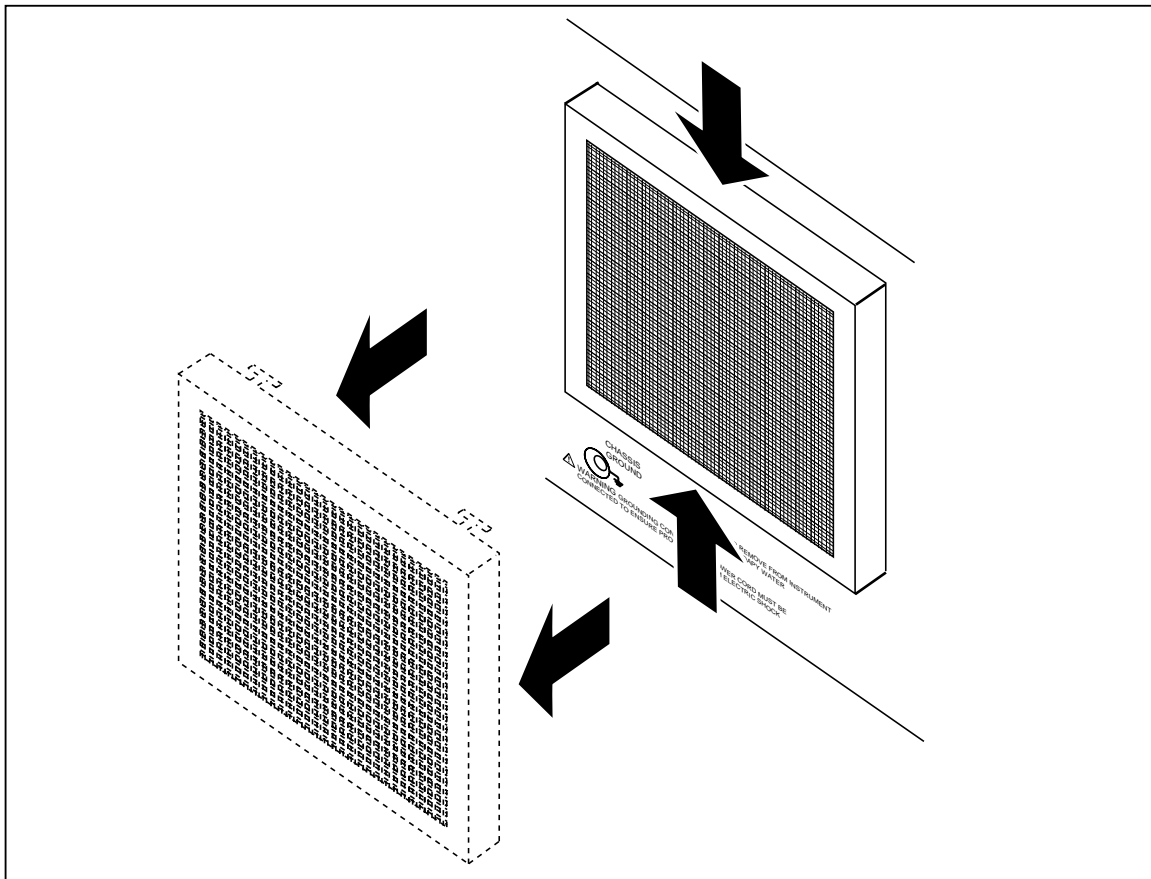


Figure 4-2. Accessing the Air Filter

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#### **4-4. General Cleaning**

For general cleaning, wipe the case, front panel keys, and lens using a soft cloth slightly dampened with water or a non-abrasive mild cleaning solution that does not harm plastics.

##### **⚠ Caution**

**To prevent damage, do not use aromatic hydrocarbons or chlorinated solvents for cleaning. They can damage the plastic materials used in the calibrator.**

#### **4-5. Service Information**

The warranty for the original purchaser of each Model 5820A Calibrator is 1 year beginning on the date received. The warranty is located at the front of this manual.

##### *Note*

*If sending the 5820A in for servicing, be sure to send all BNC cables back with the unit.*

## **Chapter 5**

# **Options**

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## 5-1. Introduction

The following describes additional options to the standard 5820A Calibrator.

## 5-2. 5820A-5 Option

The 5820A-5 option allows you to calibrate up to five oscilloscope channels simultaneously without changing cables. This allows you to perform fast, automated calibrations with documented procedures and results while freeing the operator to complete other work. All signals, except for current, are routed through this switch system. This option is discussed throughout the manual where appropriate. The specifications for 5820A calibrators with the 5820A-5 Option are the same as for units without this option.

### Note

*If the 5820A is equipped with the 5-channel option, the Mainframe will indicate when to move to the next channel.*

## 5-3. GHz Module

The GHz option extends leveled sine from 600 MHz to 2.1 GHz and adds a 150 ps, 250 mV fast edge signal. The GHz Module offers extended specifications for many of the 5820A Oscilloscope Calibrator functions. See the GHz Option Specifications section later in this chapter.

## 5-4. GHz Option Specifications

Inclusion of the GHz option modifies several of the Calibrator's specifications. The following specification tables supersede those with the similar titles in Chapter 1.

- Fast Edge Specifications
- Leveled Sine Wave Specifications (>600 MHz)
- Time Marker Specifications

## 5-5. Fast Edge Specifications

Table 5-1. Fast Edge Specifications

| Edge Characteristics into 50 $\Omega$   |                | 1-Year Absolute Uncertainty,<br>tcal $\pm 5$ $^{\circ}$ C |
|---|----------------|---|
| <b>Amplitude</b>  |                |   |
| Range (p-p)   | 250 mV         |   |
| Adjustment Range  | none           |   |
| <b>Other Edge Characteristics</b>   |                |   |
| Frequency Range [1]   | 1 kHz to 1 MHz | $\pm$ (0.33 ppm of setting)                               |
| Rise Time   | +0/-50 ps      |   |
| [1] All readings are referenced to a Tek11801 with an SD26 module or a Tek820 oscilloscope with a 8-GHz bandwidth option. |                |   |

## 5-6. Leveled Sine Wave (> 600 MHz ) Specifications

### Note

To ensure applied frequencies above 600 MHz meet factory specifications, the user **MUST** use the special 10 MHz reference that is installed in the high frequency section of the 5820A. To use this reference frequency, follow these instructions:

1. In the Lev Sine mode, press the MORE OPTIONS blue softkey. The menu will change.
2. Push the SET TO R 10MHz blue softkey.

If there is no GHz Option loaded into the 5820A, then the SET TO R 10MHz menu option is not present.

Table 5-2. Leveled Sine Wave Specifications (>600 MHz)

| Leveled Sine Wave  | Frequency Range                          |                           |                           |                           |
|--|--|---------------------------|---------------------------|---------------------------|
|  | 10 MHz<br>(reference)                    | 600 MHz to<br>1.1 GHz     | 1.1 GHz to<br>1.6 GHz     | 1.6 GHz to<br>2.1 GHz     |
| <b>Amplitude Characteristics</b>   |  |                           |                           |                           |
| Range (p-p)  | 5 mV to 3.5 V                            |                           |                           |                           |
| Resolution   | < 100 mV: 3 digits<br>≥ 100 mV: 4 digits |                           |                           |                           |
| Adjustment Range   | continuously adjustable                  |                           |                           |                           |
| 1-Year Absolute Uncertainty, tcal ± 5 °C   | ± (2% of output + 300 μV)                | ± (7% of output + 300 μV) | ± (7% of output + 300 μV) | ± (8% of output + 300 μV) |
| Flatness (relative to 10 MHz) [1]  | not applicable                           | ± (5% of output + 100 μV) | ± (5% of output + 100 μV) | ± (6% of output + 100 μV) |
| Short-term Amplitude Stability   | ≤ 1% [2]                                 |                           |                           |                           |
| <b>Frequency Characteristics</b>   |  |                           |                           |                           |
| Resolution   | 100 kHz                                  |                           |                           |                           |
| 1-Year Absolute Uncertainty, tcal ± 5 °C   | ± 0.33 ppm                               |                           |                           |                           |
| <b>Distortion Characteristics</b>  |  |                           |                           |                           |
| 2nd Harmonic   | ≤ -33dBc                                 |                           |                           |                           |
| 3rd and Higher Harmonics   | ≤ -38 dBc                                |                           |                           |                           |
| [1] As measured near Oscilloscope bandwidth frequency.   |  |                           |                           |                           |
| [2] Within one hour after reference amplitude setting, provided temperature varies no more than ± 5°C. |  |                           |                           |                           |



**5-7. Time Marker Specifications****Table 5-3. Time Marker Specifications**

| Time Marker into 50 $\Omega$                               | 2 ns to 500 ps  |
|--|---|
| Wave Shape   | sine  |
| Typical Output Level                                       | > 1V p-p  |
| Typical Jitter (p-p)                                       | < 1 ppm   |
| Sequence   | 5-2-1 from 5 s to 2 ns (e.g., 500 ms, 200 ms, 100 ms) |
| Period Resolution  | 4 digits  |
| 1-Year Absolute Uncertainty, $t_{cal} \pm 5^\circ\text{C}$ | $\pm 0.33$ ppm  |

**5-8. Theory of Operation**

The GHz Module consists of two portions, the A93 Main Board and the A92 Piggy Board. A93 contains the power supply filtering and all of the control circuitry used to control the module. This board contains the high frequency VCO used to generate leveled sine signals to 2.1 GHz. The main board also routes the signals from A55 to A92. Refer to Figure 5-1 for a block diagram of the GHz Module.

A 10 MHz reference clock is provided by the A55 module from its internal crystal/external reference circuit. The reference clock is routed through the mother board to the VCO circuit on main. Harmonics from the synthesized VCO circuit are removed by a switched filter system..

A92 contains the high frequency attenuator/switching relays, the fast edge circuit, the leveled sine power amplifier and all of the high frequency connectors. The attenuator/switching relays replace the A90 board used on A55. In fact, when the GHz module is installed, A90 is replaced with the A91 board. The A91 contains the < 300 ps edge circuitry but does not provide any attenuation.

The fast edge circuit uses a tunnel diode to generate a < 150 ps, 250 mV, square wave. This is a single amplitude signal. The period/frequency is controlled by the trigger signal from A55. A special high frequency switch is used to switch between other signals and the fast edge signal.

The leveled sine signal is derived from A93 but the power amplifier and coupling circuits are on this board. There is a high frequency switch used to select between the signals on A55 and this leveled sine signal. A cable is used to route the output signal to the high frequency switches on the front panel.

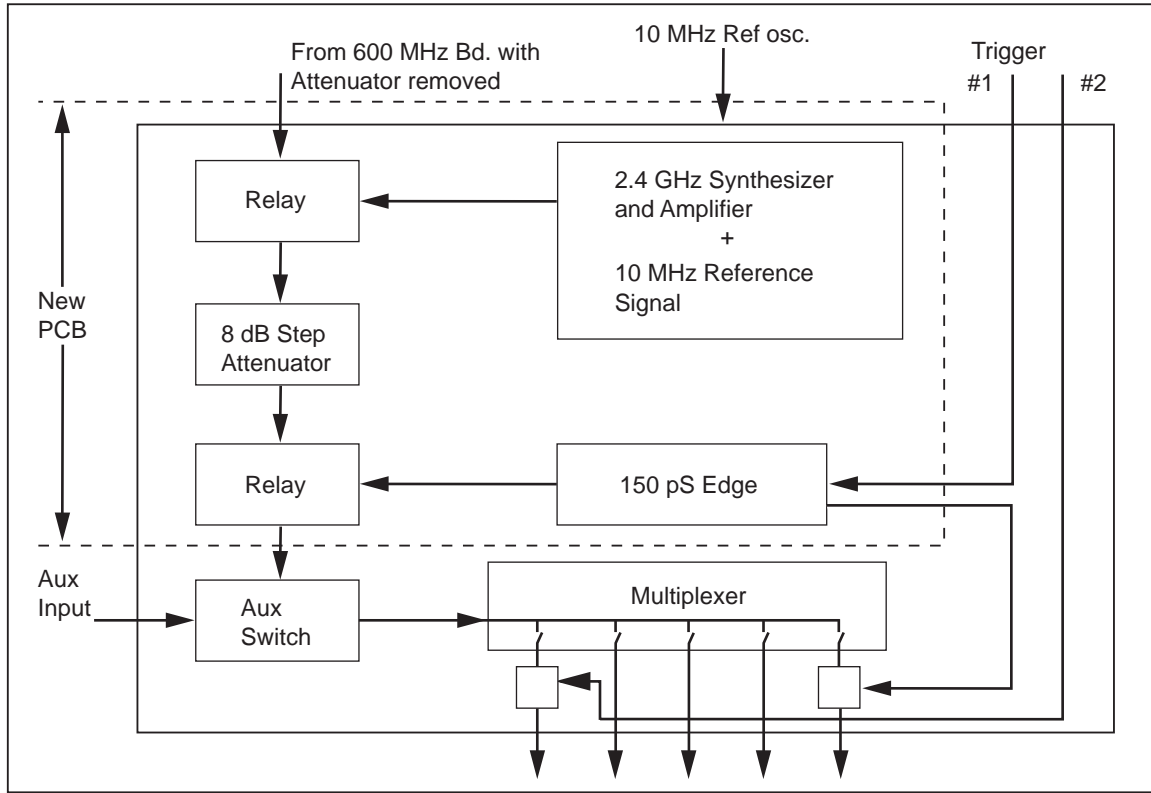


Figure 5-1. GHz Block Diagram

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### 5-9. Fast Edge Adjustment for the GHz Module

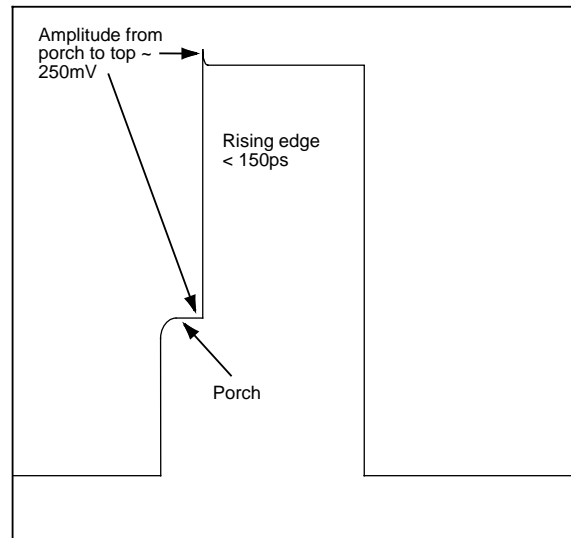
The GHz module consists of two boards, A93 and A92. The fast edge is generated on A92. There are two adjustments for the fast edge:

- R175 adjusts the edge trigger level.
- R188 adjusts the amplitude of the porch signal on which the fast edge signal rides.

While R175 can be adjusted through a hole in the machined cover, adjusting R188 requires that the A92 cover be removed.

Before the module is taken apart, the fast edge should be checked against the specifications when viewed through a scope set to 1 ns/division. If no signal above the porch appears, try adjusting R175. Failure of the edge to appear above the porch may indicate that R188 also needs adjustment.

A typical fast edge waveform looks like Figure 5-2. Notice how the fast edge signal rides on top of a porch signal.



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**Figure 5-2. Fast Edge Full Wave Form**

The fast edge testing procedure uses the following equipment:

- A Tektronix TDS 820 with 8 GHz bandwidth option or a Tektronix 11801 with an SD 26 module
- 3 ½ DMM.
- It is suggested that an extender card be used during adjustment.

Use the following steps to test and adjust the circuits on A92:

1. Remove the GHz module and remove the machined cover over the A92 module.
2. Before the adjustment, check that the resistance measured across the tunnel diode (CR21) is between 2  $\Omega$  and 5  $\Omega$ . If this measurement is less than 2  $\Omega$  or more than 5  $\Omega$ , the tunnel diode may be damaged.
3. Install the GHz module on the extender board.
4. Connect the trigger signal from A55 to the trigger input, J2 - SMB, on the A92 board.
5. Connect a scope to the GHz signal output connector, J4 -SMA.
6. Apply power. No other cables need to be attached.
7. Set the 5820A edge function to "fast edge on" via the front panel.
8. Adjust the oscilloscope vertical offset so that the porch level is centered in the display screen. See Figure 5-3.

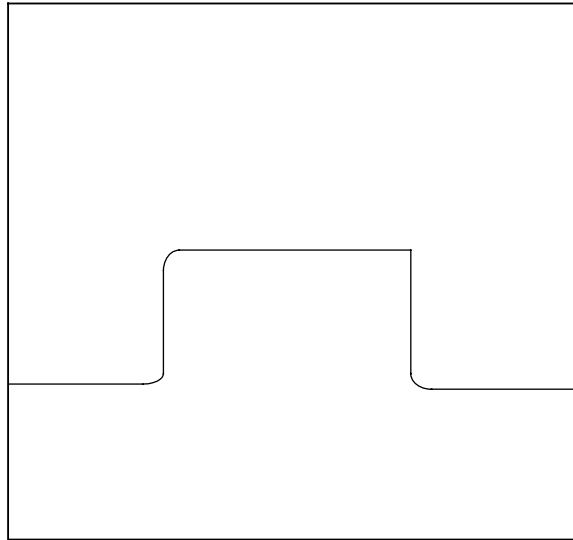


Figure 5-3. Porch

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9. Adjust R175 so that a porch-waveform can be observed (refer to Figure 5-3).
10. Adjust the oscilloscope vertical setup to be 5 mV/Div.
11. Adjust R188 to make the bullet waveform shown in Figure 5-4. Its amplitude should not be less than 7 mV.

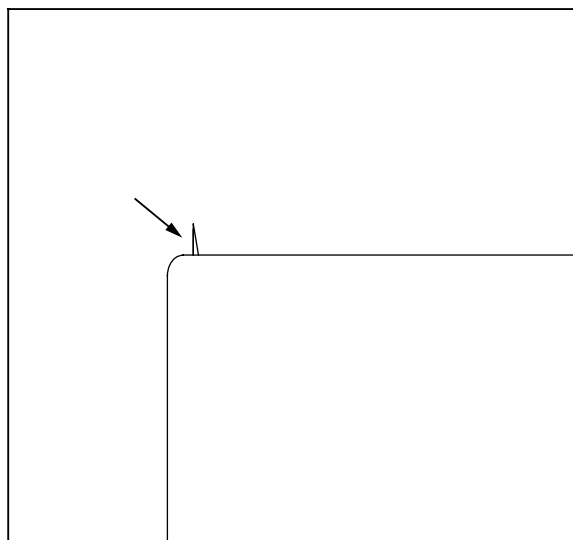
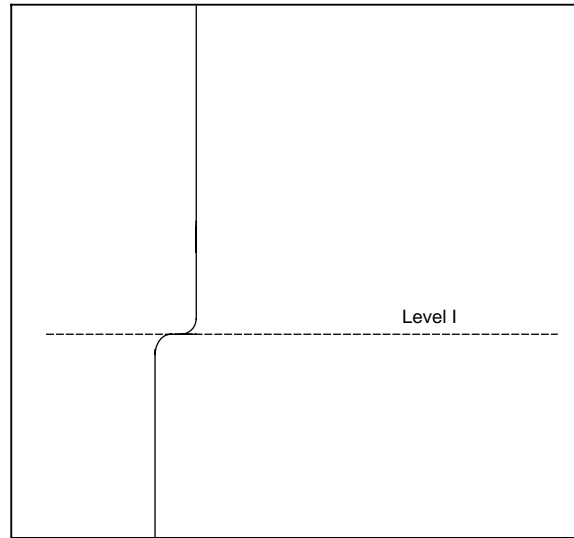


Figure 5-4. Bullet on the Porch

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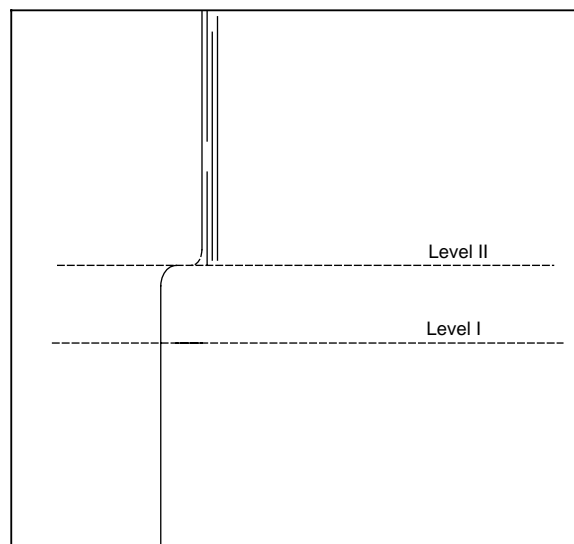
12. Adjust R175 to raise the porch level to the height at which fast edge is stable (refer to figure 5-5).
13. Use a cursor on the scope to mark this porch level (Level I).
14. By adjusting R175, continue to raise the porch level to the height at which the fast edge waveform is unstable.
15. Use a cursor on the scope to mark this porch level (Level II). A typical voltage difference between Level I and Level II is 20 mV. (Refer to Figure 5-6).



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**Figure 5-5. Critically Triggered Edge at Porch Height Level I**

16. Adjust R175 to reduce the porch level, setting it in the middle of Level I and Level II.
17. Adjust the vertical/horizontal settings of the oscilloscope so that an entire fast edge waveform can be viewed. It should look like the waveform in Figure 5-2.



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**Figure 5-6. Critically Distorted Edge at Porch Height Level II**

18. Verify that the edge rise time is  $< 150$  ps at the cable-end and that the amplitude from the porch to the top of the edge is  $\sim 250$  mV.

### **5-10. GHz Leveled Sine Wave Frequency Verification**

This procedure uses the following equipment:

- PM 6680 Frequency Counter with a prescaler for the Channel C input (Option PM 9621, PM 9624, or PM 9625) and ovenized timebase (Option PM 9690 or PM 9691)

- BNC(f) to Type N(m) adapter
- N to BNC cable supplied with the Scope Calibrator

Set the Calibrator Mainframe to the Levsine menu. Follow these steps to verify the leveled sine wave amplitude.

1. Set the PM 6680's FUNCTION to measure frequency with auto trigger, measurement time set to 1 second or longer, and 50  $\Omega$  impedance.
2. Using the N to BNC cable, connect the CHAN 1 connector on the Calibrator Mainframe to the PM 6680 at the channel indicated in Table 5-4. You will need the BNC-N adapter for the connection to Channel C.
3. Set the filter on the PM 6680 as indicated in the table.
4. Program the Calibrator Mainframe to output as listed in Table 5-4. Press **OPR STBY** on the Calibrator Mainframe to activate the output.
5. Allow the PM 6680 reading to stabilize, then record the PM 6680 reading for each frequency listed in Table 5-4.

### 5-11. GHz Leveled Sine Wave Harmonics Verification

This procedure uses the following equipment:

- Hewlett-Packard 8592L Spectrum Analyzer
- BNC(f) to Type N(m) adapter
- N to BNC cable supplied with the Scope Calibrator

See Figure 5-7 for the proper connections.

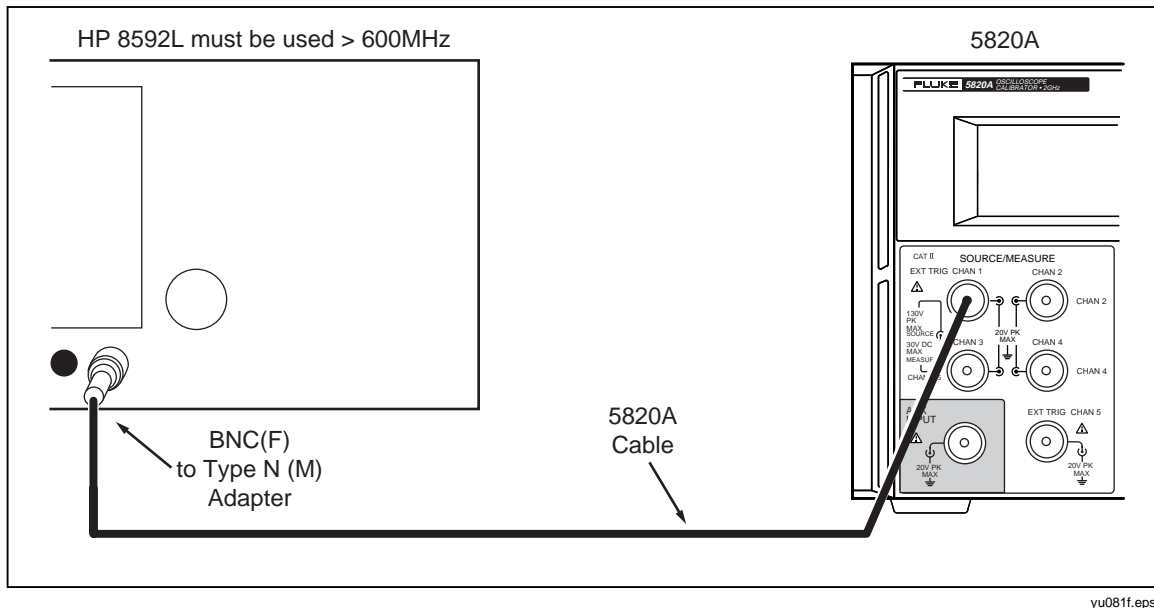


Figure 5-7. Setup for Leveled Sine Wave Harmonics Verification

Set the Calibrator Mainframe to the Levsine menu. Follow these steps to verify the leveled sine wave harmonics.

1. Using the N to BNC cable and BNC(f) to Type N(m) adapter, connect the CHAN 1 connector on the Calibrator Mainframe to the HP 8592L.

2. Program the Calibrator Mainframe to 3.5 V p-p at each frequency listed in Table 5-6. Press **OPR** **STBY** on the Calibrator Mainframe to activate the output.
3. Set HP 8592L start frequency to the Calibrator Mainframe output frequency. Set HP 8592L stop frequency to 10 times the Calibrator Mainframe output frequency. Set the HP 8592L reference level at +19 dBm.
4. Record the harmonic level reading for each frequency and harmonic listed in Table 5-6. For harmonics 3, 4, and 5, record the highest harmonic level of the three measured. Harmonics should be below the levels listed in the Deviation column of Table 5-6.

## 5-12. Verification Tables

Table 5-4 through Table 5-7 are to be used to verify channels 2-5. The verification test points are provided here as a guide when verification to one-year specifications is desired. For more information on verification, see Chapter 3.

**Table 5-4. GHz Leveled Sine Wave Frequency Verification (Channels 1, 2, and 5)**

| Calibrator Mainframe Frequency | PM 6680 Settings | PM 6680 Reading | Tolerance   |        |
|--------------------------------|------------------|-----------------|-------------|--------|
| (Output @ 3.5 V p-p)           | Channel          | Filter          | (Frequency) | ± (Hz) |
| 10 MHz                         | A                | Off             |             | 3.3    |
| 601 MHz                        | C                | Off             |             | 198.3  |
| 1000 MHz                       | C                | Off             |             | 330    |
| 1500 MHz                       | C                | Off             |             | 495    |
| 2000 MHz                       | C                | Off             |             | 660    |
| 2100 MHz                       | C                | Off             |             | 693    |

**Table 5-5. Fast Edge Rise Time for Channels 1, 2, and 5**

| Channel | Function | Measurement | Amplitude | Frequency | Measured Value | Deviation | Spec (s) |
|---------|----------|-------------|-----------|-----------|----------------|-----------|----------|
| 1-5     | edge     | rise time   | 0.25      | 1000000   |                |           | 150 ps   |

**Table 5-6. GHz Leveled Sine Wave Harmonics Verification (Channels 1, 2, and 5)**

| <b>Harmonic</b> | <b>Nominal Value<br/>(V p-p)</b> | <b>Frequency</b> | <b>Measured<br/>Value (dB)</b> | <b>Deviation<br/>(dB)</b> | <b>1-Year Spec.<br/>(dB)</b> |
|-----------------|----------------------------------|------------------|--------------------------------|---------------------------|------------------------------|
| 2nd harmonic    | 0.0399                           | 10,000,000       |                                |                           | -33                          |
| 3rd+ harmonic   | 0.0399                           | 10,000,000       |                                |                           | -38                          |
| 2nd harmonic    | 0.099                            | 10,000,000       |                                |                           | -33                          |
| 3rd+ harmonic   | 0.099                            | 10,000,000       |                                |                           | -38                          |
| 2nd harmonic    | 0.399                            | 10,000,000       |                                |                           | -33                          |
| 3rd+ harmonic   | 0.399                            | 10,000,000       |                                |                           | -38                          |
| 2nd harmonic    | 1.2                              | 10,000,000       |                                |                           | -33                          |
| 3rd+ harmonic   | 1.2                              | 10,000,000       |                                |                           | -38                          |
| 2nd harmonic    | 3.5                              | 10,000,000       |                                |                           | -33                          |
| 3rd+ harmonic   | 3.5                              | 10,000,000       |                                |                           | -38                          |
| 2nd harmonic    | 3.5                              | 625,000,000      |                                |                           | -33                          |
| 3rd+ harmonic   | 3.5                              | 625,000,000      |                                |                           | -38                          |
| 2nd harmonic    | 3.5                              | 655,000,000      |                                |                           | -33                          |
| 3rd+ harmonic   | 3.5                              | 655,000,000      |                                |                           | -38                          |
| 2nd harmonic    | 3.5                              | 725,000,000      |                                |                           | -33                          |
| 3rd+ harmonic   | 3.5                              | 725,000,000      |                                |                           | -38                          |
| 2nd harmonic    | 3.5                              | 795,000,000      |                                |                           | -33                          |
| 3rd+ harmonic   | 3.5                              | 795,000,000      |                                |                           | -38                          |
| 2nd harmonic    | 3.5                              | 865,000,000      |                                |                           | -33                          |
| 3rd+ harmonic   | 3.5                              | 865,000,000      |                                |                           | -38                          |
| 2nd harmonic    | 3.5                              | 900,000,000      |                                |                           | -33                          |
| 3rd+ harmonic   | 3.5                              | 900,000,000      |                                |                           | -38                          |
| 2nd harmonic    | 3.5                              | 935,000,000      |                                |                           | -33                          |
| 3rd+ harmonic   | 3.5                              | 935,000,000      |                                |                           | -38                          |



Table 5-6. GHz Leveled Sinewave Verification: Harmonics (Channels 1, 2, and 5) (cont.)

| Harmonic      | Nominal Value<br>(V p-p) | Frequency     | Measured<br>Value (dB) | Deviation<br>(dB) | 1-Year Spec.<br>(dB) |
|---------------|--------------------------|---------------|------------------------|-------------------|----------------------|
| 2nd harmonic  | 3.5                      | 1,000,000,000 |                        |                   | -33                  |
| 3rd+ harmonic | 3.5                      | 1,000,000,000 |                        |                   | -38                  |
| 2nd harmonic  | 3.5                      | 1,075,000,000 |                        |                   | -33                  |
| 3rd+ harmonic | 3.5                      | 1,075,000,000 |                        |                   | -38                  |
| 2nd harmonic  | 3.5                      | 1,145,000,000 |                        |                   | -33                  |
| 3rd+ harmonic | 3.5                      | 1,145,000,000 |                        |                   | -38                  |
| 2nd harmonic  | 3.5                      | 1,250,000,000 |                        |                   | -33                  |
| 3rd+ harmonic | 3.5                      | 1,250,000,000 |                        |                   | -38                  |
| 2nd harmonic  | 3.5                      | 1,285,000,000 |                        |                   | -33                  |
| 3rd+ harmonic | 3.5                      | 1,285,000,000 |                        |                   | -38                  |
| 2nd harmonic  | 3.5                      | 1,375,000,000 |                        |                   | -33                  |
| 3rd+ harmonic | 3.5                      | 1,375,000,000 |                        |                   | -38                  |
| 2nd harmonic  | 3.5                      | 1,425,000,000 |                        |                   | -33                  |
| 3rd+ harmonic | 3.5                      | 1,425,000,000 |                        |                   | -38                  |
| 2nd harmonic  | 3.5                      | 1,475,000,000 |                        |                   | -33                  |
| 3rd+ harmonic | 3.5                      | 1,475,000,000 |                        |                   | -38                  |
| 2nd harmonic  | 3.5                      | 1,500,000,000 |                        |                   | -33                  |
| 3rd+ harmonic | 3.5                      | 1,500,000,000 |                        |                   | -38                  |
| 2nd harmonic  | 3.5                      | 1,525,000,000 |                        |                   | -33                  |
| 3rd+ harmonic | 3.5                      | 1,525,000,000 |                        |                   | -38                  |
| 2nd harmonic  | 3.5                      | 1,600,000,000 |                        |                   | -33                  |
| 3rd+ harmonic | 3.5                      | 1,600,000,000 |                        |                   | -38                  |
| 2nd harmonic  | 3.5                      | 1,650,000,000 |                        |                   | -33                  |
| 3rd+ harmonic | 3.5                      | 1,650,000,000 |                        |                   | -38                  |
| 2nd harmonic  | 3.5                      | 1,750,000,000 |                        |                   | -33                  |
| 3rd+ harmonic | 3.5                      | 1,750,000,000 |                        |                   | -38                  |
| 2nd harmonic  | 3.5                      | 1,850,000,000 |                        |                   | -33                  |
| 3rd+ harmonic | 3.5                      | 1,850,000,000 |                        |                   | -38                  |
| 2nd harmonic  | 3.5                      | 1,930,000,000 |                        |                   | -33                  |
| 3rd+ harmonic | 3.5                      | 1,930,000,000 |                        |                   | -38                  |
| 2nd harmonic  | 3.5                      | 1,980,000,000 |                        |                   | -33                  |
| 3rd+ harmonic | 3.5                      | 1,980,000,000 |                        |                   | -38                  |
| 2nd harmonic  | 3.5                      | 2,030,000,000 |                        |                   | -33                  |
| 3rd+ harmonic | 3.5                      | 2,030,000,000 |                        |                   | -38                  |
| 2nd harmonic  | 3.5                      | 2,080,000,000 |                        |                   | -33                  |
| 3rd+ harmonic | 3.5                      | 2,080,000,000 |                        |                   | -38                  |

Table 5-7. GHz Leveled Sinewave Verification: Flatness (Channels 1, 2, and 5)

| Calibrator Mainframe Freq. (MHz) | A   | B<br>10 MHz | C | D | E | Calibrator Mainframe Flatness Spec. (%) |
|----------------------------------|---|-------------|---|---|---|---|
| <b>3.5Vpp</b>                    |   |             |   |   |   |   |
| 625,000,000                      |   |             |   |   |   | ± 5.0                                   |
| 725,000,000                      |   |             |   |   |   | ± 5.0                                   |
| 900,000,000                      |   |             |   |   |   | ± 5.0                                   |
| 1,125,000,000                    |   |             |   |   |   | ± 5.0                                   |
| 1,250,000,000                    |   |             |   |   |   | ± 5.0                                   |
| 1,325,000,000                    |   |             |   |   |   | ± 5.0                                   |
| 1,375,000,000                    |   |             |   |   |   | ± 5.0                                   |
| 1,425,000,000                    |   |             |   |   |   | ± 5.0                                   |
| 1,475,000,000                    |   |             |   |   |   | ± 5.0                                   |
| 1,525,000,000                    |   |             |   |   |   | ± 5.0                                   |
| 1,575,000,000                    |   |             |   |   |   | ± 5.0                                   |
| 1,650,000,000                    |   |             |   |   |   | ± 6.0                                   |
| 1,750,000,000                    |   |             |   |   |   | ± 6.0                                   |
| 1,850,000,000                    |   |             |   |   |   | ± 6.0                                   |
| 1,925,000,000                    |   |             |   |   |   | ± 6.0                                   |
| 1,975,000,000                    |   |             |   |   |   | ± 6.0                                   |
| 2,025,000,000                    |   |             |   |   |   | ± 6.0                                   |
| 2,075,000,000                    |   |             |   |   |   | ± 6.0                                   |
| <b>1.3 Vpp</b>                   |   |             |   |   |   |   |
| 625,000,000                      |   |             |   |   |   | ± 5.0                                   |
| 725,000,000                      |   |             |   |   |   | ± 5.0                                   |
| 900,000,000                      |   |             |   |   |   | ± 5.0                                   |
| 1,125,000,000                    |   |             |   |   |   | ± 5.0                                   |
| 1,250,000,000                    |   |             |   |   |   | ± 5.0                                   |
| 1,325,000,000                    |   |             |   |   |   | ± 5.0                                   |
| 1,375,000,000                    |   |             |   |   |   | ± 5.0                                   |
| 1,425,000,000                    |   |             |   |   |   | ± 5.0                                   |
| 1,475,000,000                    |   |             |   |   |   | ± 5.0                                   |
| Complete Columns A-E as follows: |   |             |   |   |   |   |
| A                                | Enter the 437B present frequency Reading (W).   |             |   |   |   |   |
| B                                | Enter the 437B 10 MHz Reading (W).  |             |   |   |   |   |
| C                                | Apply power sensor correction factor for present frequency (W): $CF * (\text{Column A entry})$  |             |   |   |   |   |
| D                                | Apply power sensor correction factor for 10 MHz (W): $CF * (\text{Column B entry})$   |             |   |   |   |   |
| E                                | Compute and enter error relative to 50 kHz plus floor (%): $100 * [(\sqrt{\text{Column C/Column D entry}} - 1) \pm 100 * (100\mu\text{V/nominal voltage})]$ . |             |   |   |   |   |

Table 5-7. Leveled Sinewave Verification: Flatness (Channels 1, 2, and 5) (cont.)

| Calibrator Mainframe Freq. (MHz) | A | B 10 MHz | C | D | E | Calibrator Mainframe Flatness Spec. (%) |
|----------------------------------|---|----------|---|---|---|---|
| 1,525,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,575,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,650,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,750,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,850,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,925,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,975,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 2,025,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 2,075,000,000                    |   |          |   |   |   | ± 6.0                                   |
| <b>1.2 Vpp</b>                   |   |          |   |   |   |   |
| 625,000,000                      |   |          |   |   |   | ± 5.0                                   |
| 725,000,000                      |   |          |   |   |   | ± 5.0                                   |
| 900,000,000                      |   |          |   |   |   | ± 5.0                                   |
| 1,125,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,250,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,325,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,375,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,425,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,475,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,525,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,575,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,650,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,750,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,850,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,925,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,975,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 2,025,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 2,075,000,000                    |   |          |   |   |   | ± 6.0                                   |
| <b>0.800 Vpp</b>                 |   |          |   |   |   |   |
| 625,000,000                      |   |          |   |   |   | ± 5.0                                   |
| 725,000,000                      |   |          |   |   |   | ± 5.0                                   |
| 900,000,000                      |   |          |   |   |   | ± 5.0                                   |

Table 5-7. Leveled Sinewave Verification: Flatness (Channels 1, 2, and 5) (cont.)

| Calibrator Mainframe Freq. (MHz) | A | B 10 MHz | C | D | E | Calibrator Mainframe Flatness Spec. (%) |
|----------------------------------|---|----------|---|---|---|---|
| 1,125,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,250,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,325,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,375,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,425,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,475,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,525,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,575,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,650,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,750,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,850,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,925,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,975,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 2,025,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 2,075,000,000                    |   |          |   |   |   | ± 6.0                                   |
| <b>0.400 Vpp</b>                 |   |          |   |   |   |   |
| 625,000,000                      |   |          |   |   |   | ± 5.0                                   |
| 725,000,000                      |   |          |   |   |   | ± 5.0                                   |
| 900,000,000                      |   |          |   |   |   | ± 5.0                                   |
| 1,125,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,250,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,325,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,375,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,425,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,475,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,525,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,575,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,650,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,750,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,850,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,925,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,975,000,000                    |   |          |   |   |   | ± 6.0                                   |

Table 5-7. Leveled Sinewave Verification: Flatness (Channels 1, 2, and 5) (cont.)

| Calibrator Mainframe Freq. (MHz) | A | B 10 MHz | C | D | E | Calibrator Mainframe Flatness Spec. (%) |
|----------------------------------|---|----------|---|---|---|---|
| 2,025,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 2,075,000,000                    |   |          |   |   |   | ± 6.0                                   |
| <b>0.250 Vpp</b>                 |   |          |   |   |   |   |
| 625,000,000                      |   |          |   |   |   | ± 5.0                                   |
| 725,000,000                      |   |          |   |   |   | ± 5.0                                   |
| 900,000,000                      |   |          |   |   |   | ± 5.0                                   |
| 1,125,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,250,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,325,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,375,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,425,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,475,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,525,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,575,000,000                    |   |          |   |   |   | ± 5.0                                   |
| 1,650,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,750,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,850,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,925,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,975,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 2,025,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 2,075,000,000                    |   |          |   |   |   | ± 6.0                                   |
| <b>0.100 Vpp</b>                 |   |          |   |   |   |   |
| 625,000,000                      |   |          |   |   |   | ± 5.1                                   |
| 725,000,000                      |   |          |   |   |   | ± 5.1                                   |
| 900,000,000                      |   |          |   |   |   | ± 5.1                                   |
| 1,125,000,000                    |   |          |   |   |   | ± 5.1                                   |
| 1,250,000,000                    |   |          |   |   |   | ± 5.1                                   |
| 1,325,000,000                    |   |          |   |   |   | ± 5.1                                   |
| 1,375,000,000                    |   |          |   |   |   | ± 5.1                                   |
| 1,425,000,000                    |   |          |   |   |   | ± 5.1                                   |
| 1,475,000,000                    |   |          |   |   |   | ± 5.1                                   |
| 1,525,000,000                    |   |          |   |   |   | ± 5.1                                   |

Table 5-7. Leveled Sinewave Verification: Flatness (Channels 1, 2, and 5) (cont.)

| Calibrator Mainframe Freq. (MHz) | A | B 10 MHz | C | D | E | Calibrator Mainframe Flatness Spec. (%) |
|----------------------------------|---|----------|---|---|---|---|
| 1,575,000,000                    |   |          |   |   |   | ± 5.1                                   |
| 1,650,000,000                    |   |          |   |   |   | ± 6.1                                   |
| 1,750,000,000                    |   |          |   |   |   | ± 6.1                                   |
| 1,850,000,000                    |   |          |   |   |   | ± 6.1                                   |
| 1,925,000,000                    |   |          |   |   |   | ± 6.1                                   |
| 1,975,000,000                    |   |          |   |   |   | ± 6.1                                   |
| 2,025,000,000                    |   |          |   |   |   | ± 6.1                                   |
| 2,075,000,000                    |   |          |   |   |   | ± 6.1                                   |
| <b>0.070 Vpp</b>                 |   |          |   |   |   |   |
| 625,000,000                      |   |          |   |   |   | ± 5.1                                   |
| 725,000,000                      |   |          |   |   |   | ± 5.1                                   |
| 900,000,000                      |   |          |   |   |   | ± 5.1                                   |
| 1,125,000,000                    |   |          |   |   |   | ± 5.1                                   |
| 1,250,000,000                    |   |          |   |   |   | ± 5.1                                   |
| 1,325,000,000                    |   |          |   |   |   | ± 5.1                                   |
| 1,375,000,000                    |   |          |   |   |   | ± 5.1                                   |
| 1,425,000,000                    |   |          |   |   |   | ± 5.1                                   |
| 1,475,000,000                    |   |          |   |   |   | ± 5.1                                   |
| 1,525,000,000                    |   |          |   |   |   | ± 5.1                                   |
| 1,575,000,000                    |   |          |   |   |   | ± 5.1                                   |
| 1,650,000,000                    |   |          |   |   |   | ± 6.1                                   |
| 1,750,000,000                    |   |          |   |   |   | ± 6.1                                   |
| 1,850,000,000                    |   |          |   |   |   | ± 6.1                                   |
| 1,925,000,000                    |   |          |   |   |   | ± 6.1                                   |
| 1,975,000,000                    |   |          |   |   |   | ± 6.1                                   |
| 2,025,000,000                    |   |          |   |   |   | ± 6.1                                   |
| 2,075,000,000                    |   |          |   |   |   | ± 6.1                                   |
| <b>0.040 Vpp</b>                 |   |          |   |   |   |   |
| 625,000,000                      |   |          |   |   |   | ± 5.25                                  |
| 725,000,000                      |   |          |   |   |   | ± 5.25                                  |
| 900,000,000                      |   |          |   |   |   | ± 5.25                                  |
| 1,125,000,000                    |   |          |   |   |   | ± 5.25                                  |

Table 5-7. Leveled Sinewave Verification: Flatness (Channels 1, 2, and 5) (cont.)

| Calibrator Mainframe Freq. (MHz) | A | B<br>10 MHz | C | D | E | Calibrator Mainframe Flatness Spec. (%) |
|----------------------------------|---|-------------|---|---|---|---|
| 1,250,000,000                    |   |             |   |   |   | ± 5.25                                  |
| 1,325,000,000                    |   |             |   |   |   | ± 5.25                                  |
| 1,375,000,000                    |   |             |   |   |   | ± 5.25                                  |
| 1,425,000,000                    |   |             |   |   |   | ± 5.25                                  |
| 1,475,000,000                    |   |             |   |   |   | ± 5.25                                  |
| 1,525,000,000                    |   |             |   |   |   | ± 5.25                                  |
| 1,575,000,000                    |   |             |   |   |   | ± 5.25                                  |
| 1,650,000,000                    |   |             |   |   |   | ± 6.25                                  |
| 1,750,000,000                    |   |             |   |   |   | ± 6.25                                  |
| 1,850,000,000                    |   |             |   |   |   | ± 6.25                                  |
| 1,925,000,000                    |   |             |   |   |   | ± 6.25                                  |
| 1,975,000,000                    |   |             |   |   |   | ± 6.25                                  |
| 2,025,000,000                    |   |             |   |   |   | ± 6.25                                  |
| 2,075,000,000                    |   |             |   |   |   | ± 6.25                                  |
| <b>0.025 Vpp</b>                 |   |             |   |   |   |   |
| 625,000,000                      |   |             |   |   |   | ± 5.4                                   |
| 725,000,000                      |   |             |   |   |   | ± 5.4                                   |
| 900,000,000                      |   |             |   |   |   | ± 5.4                                   |
| 1,125,000,000                    |   |             |   |   |   | ± 5.4                                   |
| 1,250,000,000                    |   |             |   |   |   | ± 5.4                                   |
| 1,325,000,000                    |   |             |   |   |   | ± 5.4                                   |
| 1,375,000,000                    |   |             |   |   |   | ± 5.4                                   |
| 1,425,000,000                    |   |             |   |   |   | ± 5.4                                   |
| 1,475,000,000                    |   |             |   |   |   | ± 5.4                                   |
| 1,525,000,000                    |   |             |   |   |   | ± 5.4                                   |
| 1,575,000,000                    |   |             |   |   |   | ± 5.4                                   |
| 1,650,000,000                    |   |             |   |   |   | ± 6.4                                   |
| 1,750,000,000                    |   |             |   |   |   | ± 6.4                                   |
| 1,850,000,000                    |   |             |   |   |   | ± 6.4                                   |
| 1,925,000,000                    |   |             |   |   |   | ± 6.4                                   |
| 1,975,000,000                    |   |             |   |   |   | ± 6.4                                   |
| 2,025,000,000                    |   |             |   |   |   | ± 6.4                                   |

Table 5-7. Leveled Sinewave Verification: Flatness (Channels 1, 2, and 5) (cont.)

| Calibrator Mainframe Freq. (MHz) | A | B 10 MHz | C | D | E | Calibrator Mainframe Flatness Spec. (%) |
|----------------------------------|---|----------|---|---|---|---|
| 2,075,000,000                    |   |          |   |   |   | ± 6.4                                   |
| <b>0.010 Vpp</b>                 |   |          |   |   |   |   |
| 625,000,000                      |   |          |   |   |   | ± 6.0                                   |
| 725,000,000                      |   |          |   |   |   | ± 6.0                                   |
| 900,000,000                      |   |          |   |   |   | ± 6.0                                   |
| 1,125,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,250,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,325,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,375,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,425,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,475,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,525,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,575,000,000                    |   |          |   |   |   | ± 6.0                                   |
| 1,650,000,000                    |   |          |   |   |   | ± 7.0                                   |
| 1,750,000,000                    |   |          |   |   |   | ± 7.0                                   |
| 1,850,000,000                    |   |          |   |   |   | ± 7.0                                   |
| 1,925,000,000                    |   |          |   |   |   | ± 7.0                                   |
| 1,975,000,000                    |   |          |   |   |   | ± 7.0                                   |
| 2,025,000,000                    |   |          |   |   |   | ± 7.0                                   |
| 2,075,000,000                    |   |          |   |   |   | ± 7.0                                   |
| <b>0.005 Vpp</b>                 |   |          |   |   |   |   |
| 625,000,000                      |   |          |   |   |   | ± 7.0                                   |
| 725,000,000                      |   |          |   |   |   | ± 7.0                                   |
| 900,000,000                      |   |          |   |   |   | ± 7.0                                   |
| 1,125,000,000                    |   |          |   |   |   | ± 7.0                                   |
| 1,250,000,000                    |   |          |   |   |   | ± 7.0                                   |
| 1,325,000,000                    |   |          |   |   |   | ± 7.0                                   |
| 1,375,000,000                    |   |          |   |   |   | ± 7.0                                   |
| 1,425,000,000                    |   |          |   |   |   | ± 7.0                                   |
| 1,475,000,000                    |   |          |   |   |   | ± 7.0                                   |
| 1,525,000,000                    |   |          |   |   |   | ± 7.0                                   |
| 1,575,000,000                    |   |          |   |   |   | ± 7.0                                   |



**Table 5-7. Leveled Sinewave Verification: Flatness (Channels 1, 2, and 5) (cont.)**

| Calibrator Mainframe Freq. (MHz)  | A | B<br>10 MHz | C | D | E | Calibrator Mainframe Flatness Spec. (%) |
|---|---|-------------|---|---|---|---|
| 1,650,000,000   |   |             |   |   |   | ± 8.0                                   |
| 1,750,000,000   |   |             |   |   |   | ± 8.0                                   |
| 1,850,000,000   |   |             |   |   |   | ± 8.0                                   |
| 1,925,000,000   |   |             |   |   |   | ± 8.0                                   |
| 1,975,000,000   |   |             |   |   |   | ± 8.0                                   |
| 2,025,000,000   |   |             |   |   |   | ± 8.0                                   |
| 2,075,000,000   |   |             |   |   |   | ± 8.0                                   |
| <p>Complete Columns A-E as follows:</p> <p>A     Enter the 437B or equivalent present frequency Reading (W).</p> <p>B     Enter the 437B or equivalent 10 MHz Reading (W).</p> <p>C     Apply power sensor correction factor for present frequency (W): <math>CF * (\text{Column A entry})</math></p> <p>D     Apply power sensor correction factor for 10 MHz (W): <math>CF * (\text{Column B entry})</math></p> <p>E     Compute and enter Error relative to 10 MHz (%): <math>100 * (\text{sqrt}(\text{Column C entry}) - \text{sqrt}(\text{Column D entry})) / \text{sqrt}(\text{Column D entry}) \pm 100 * (100\mu\text{V}/\text{nominal voltage})</math>.</p> |   |             |   |   |   |   |

### 5-13. Verification Tables for Channels 2-5

The following Verification Tables are to be used to verify channels 2-5 for other functions. The verification test points are provided here as a guide when verification to one-year specifications is desired.

#### 5-14. Leveled Sine Flatness (< 600 MHz)

**Table 5-8. Leveled Sine Flatness (5.5 V) (Channel 2)**

| Channel | Function | Measurement | Amplitude | Frequency | Measured Value | Deviation | Spec (vp-p) |
|---------|----------|-------------|-----------|-----------|----------------|-----------|-------------|
| 2       | levsine  | flatness    | 5.5       | 1000000   |                |           | 0.0826      |
| 2       | levsine  | flatness    | 5.5       | 10000000  |                |           | 0.0826      |
| 2       | levsine  | flatness    | 5.5       | 30000000  |                |           | 0.0826      |
| 2       | levsine  | flatness    | 5.5       | 70000000  |                |           | 0.0826      |
| 2       | levsine  | flatness    | 5.5       | 120000000 |                |           | 0.1101      |
| 2       | levsine  | flatness    | 5.5       | 290000000 |                |           | 0.1101      |
| 2       | levsine  | flatness    | 5.5       | 360000000 |                |           | 0.1926      |
| 2       | levsine  | flatness    | 5.5       | 390000000 |                |           | 0.1926      |
| 2       | levsine  | flatness    | 5.5       | 400000000 |                |           | 0.1926      |
| 2       | levsine  | flatness    | 5.5       | 480000000 |                |           | 0.1926      |
| 2       | levsine  | flatness    | 5.5       | 570000000 |                |           | 0.2201      |
| 2       | levsine  | flatness    | 5.5       | 580000000 |                |           | 0.2201      |
| 2       | levsine  | flatness    | 5.5       | 590000000 |                |           | 0.2201      |
| 2       | levsine  | flatness    | 5.5       | 600000000 |                |           | 0.2201      |

**Table 5-9. Leveled Sine Flatness (5.5 V) (Channel 3)**

| Channel | Function | Measurement | Amplitude | Frequency | Measured Value | Deviation | Spec (Vp-p) |
|---------|----------|-------------|-----------|-----------|----------------|-----------|-------------|
| 3       | levsine  | flatness    | 5.5       | 1000000   |                |           | 0.0826      |
| 3       | levsine  | flatness    | 5.5       | 10000000  |                |           | 0.0826      |
| 3       | levsine  | flatness    | 5.5       | 30000000  |                |           | 0.0826      |
| 3       | levsine  | flatness    | 5.5       | 70000000  |                |           | 0.0826      |
| 3       | levsine  | flatness    | 5.5       | 120000000 |                |           | 0.1101      |
| 3       | levsine  | flatness    | 5.5       | 290000000 |                |           | 0.1101      |
| 3       | levsine  | flatness    | 5.5       | 360000000 |                |           | 0.1926      |
| 3       | levsine  | flatness    | 5.5       | 390000000 |                |           | 0.1926      |
| 3       | levsine  | flatness    | 5.5       | 400000000 |                |           | 0.1926      |
| 3       | levsine  | flatness    | 5.5       | 480000000 |                |           | 0.1926      |
| 3       | levsine  | flatness    | 5.5       | 570000000 |                |           | 0.2201      |
| 3       | levsine  | flatness    | 5.5       | 580000000 |                |           | 0.2201      |
| 3       | levsine  | flatness    | 5.5       | 590000000 |                |           | 0.2201      |
| 3       | levsine  | flatness    | 5.5       | 600000000 |                |           | 0.2201      |

**Table 5-10. Leveled Sine Flatness (5.5 V) (Channel 4)**

| Channel | Function | Measurement | Amplitude | Frequency | Measured Value | Deviation | Spec (Vp-p) |
|---------|----------|-------------|-----------|-----------|----------------|-----------|-------------|
| 4       | levsine  | flatness    | 5.5       | 1000000   |                |           | 0.0826      |
| 4       | levsine  | flatness    | 5.5       | 10000000  |                |           | 0.0826      |
| 4       | levsine  | flatness    | 5.5       | 30000000  |                |           | 0.0826      |
| 4       | levsine  | flatness    | 5.5       | 70000000  |                |           | 0.0826      |
| 4       | levsine  | flatness    | 5.5       | 120000000 |                |           | 0.1101      |
| 4       | levsine  | flatness    | 5.5       | 290000000 |                |           | 0.1101      |
| 4       | levsine  | flatness    | 5.5       | 360000000 |                |           | 0.1926      |
| 4       | levsine  | flatness    | 5.5       | 390000000 |                |           | 0.1926      |
| 4       | levsine  | flatness    | 5.5       | 400000000 |                |           | 0.1926      |
| 4       | levsine  | flatness    | 5.5       | 480000000 |                |           | 0.1926      |
| 4       | levsine  | flatness    | 5.5       | 570000000 |                |           | 0.2201      |
| 4       | levsine  | flatness    | 5.5       | 580000000 |                |           | 0.2201      |
| 4       | levsine  | flatness    | 5.5       | 590000000 |                |           | 0.2201      |
| 4       | levsine  | flatness    | 5.5       | 600000000 |                |           | 0.2201      |

**Table 5-11. Leveled Sine Flatness (5.5 V) (Channel 5)**

| Channel | Function | Measurement | Amplitude | Frequency | Measured Value | Deviation | Spec (Vp-p) |
|---------|----------|-------------|-----------|-----------|----------------|-----------|-------------|
| 5       | levsine  | flatness    | 5.5       | 1000000   |                |           | 0.0826      |
| 5       | levsine  | flatness    | 5.5       | 10000000  |                |           | 0.0826      |
| 5       | levsine  | flatness    | 5.5       | 30000000  |                |           | 0.0826      |
| 5       | levsine  | flatness    | 5.5       | 70000000  |                |           | 0.0826      |
| 5       | levsine  | flatness    | 5.5       | 120000000 |                |           | 0.1101      |
| 5       | levsine  | flatness    | 5.5       | 290000000 |                |           | 0.1101      |
| 5       | levsine  | flatness    | 5.5       | 360000000 |                |           | 0.1926      |
| 5       | levsine  | flatness    | 5.5       | 390000000 |                |           | 0.1926      |
| 5       | levsine  | flatness    | 5.5       | 400000000 |                |           | 0.1926      |
| 5       | levsine  | flatness    | 5.5       | 480000000 |                |           | 0.1926      |
| 5       | levsine  | flatness    | 5.5       | 570000000 |                |           | 0.2201      |
| 5       | levsine  | flatness    | 5.5       | 580000000 |                |           | 0.2201      |
| 5       | levsine  | flatness    | 5.5       | 590000000 |                |           | 0.2201      |
| 5       | levsine  | flatness    | 5.5       | 600000000 |                |           | 0.2201      |

**5-15. Pulse Width****Table 5-12. Pulse Width**

| Channel | Function | Measurement | Amplitude | Width    | Period   | Measured Value | Deviation | Spec (s) |
|---------|----------|-------------|-----------|----------|----------|----------------|-----------|----------|
| 3       | pulse    | width       | 1.5       | 1.00E-09 | 2.00E-07 |                |           | 5.5E-10  |
| 3       | pulse    | width       | 1.5       | 9.90E-09 | 2.00E-07 |                |           | 1.0E-09  |
| 3       | pulse    | width       | 1.5       | 7.99E-08 | 2.00E-06 |                |           | 4.5E-09  |
| 3       | pulse    | width       | 1.5       | 5.00E-07 | 1.00E-05 |                |           | 2.6E-08  |

**5-16. Edge Rise Time Verification (Channels 2-5)**

**Table 5-13. Edge Rise Time (Channel 2)**

| Channel | Function | Measurement | Amplitude | Frequency | Measured Value | Deviation | Spec (s) |
|---------|----------|-------------|-----------|-----------|----------------|-----------|----------|
| 2       | edge     | rise time   | 0.025     | 1000000   |                |           | 3.00E-10 |
| 2       | edge     | rise time   | 1         | 1000000   |                |           | 3.00E-10 |

**Table 5-14. Edge Rise Time (Channel 3)**

| Channel | Function | Measurement | Amplitude | Frequency | Measured Value | Deviation | Spec (s) |
|---------|----------|-------------|-----------|-----------|----------------|-----------|----------|
| 3       | edge     | rise time   | 0.025     | 1000000   |                |           | 3.00E-10 |
| 3       | edge     | rise time   | 1         | 1000000   |                |           | 3.00E-10 |

**Table 5-15. Edge Rise Time (Channel 4)**

| Channel | Function | Measurement | Amplitude | Frequency | Measured Value | Deviation | Spec (s) |
|---------|----------|-------------|-----------|-----------|----------------|-----------|----------|
| 4       | edge     | rise time   | 0.025     | 1000000   |                |           | 3.00E-10 |
| 4       | edge     | rise time   | 1         | 1000000   |                |           | 3.00E-10 |

**Table 5-16. Edge Rise Time (Channel 5)**

| Channel | Function | Measurement | Amplitude | Frequency | Measured Value | Deviation | Spec (s) |
|---------|----------|-------------|-----------|-----------|----------------|-----------|----------|
| 5       | edge     | rise time   | 0.025     | 1000000   |                |           | 3.00E-10 |
| 5       | edge     | rise time   | 1         | 1000000   |                |           | 3.00E-10 |
| 5       | edge     | rise time   | 2.5       | 1000000   |                |           | 3.00E-10 |
| 5       | edge     | rise time   | 2.5       | 10000000  |                |           | 3.50E-10 |

**5-17. Pulse Skew****Table 5-17. Pulse Skew**

| Channel | Function | Measurement | Skew      | Width    | Period   | Measured Value | Deviation | Spec (s) |
|---------|----------|-------------|-----------|----------|----------|----------------|-----------|----------|
| 1       | pulse    | skew        | -1.00E-08 | 1.00E-08 | 2.00E-07 |                |           | 5.00E-10 |
| 1       | pulse    | skew        | -5.00E-09 | 1.00E-08 | 2.00E-07 |                |           | 5.00E-10 |
| 1       | pulse    | skew        | 1.50E-08  | 1.00E-08 | 2.00E-07 |                |           | 5.00E-10 |
| 1       | pulse    | skew        | 3.00E-08  | 1.00E-08 | 2.00E-07 |                |           | 5.00E-10 |
| 3       | pulse    | skew        | -1.00E-08 | 1.00E-08 | 2.00E-07 |                |           | 5.00E-10 |
| 3       | pulse    | skew        | -5.00E-09 | 1.00E-08 | 2.00E-07 |                |           | 5.00E-10 |
| 3       | pulse    | skew        | 1.50E-08  | 1.00E-08 | 2.00E-07 |                |           | 5.00E-10 |
| 3       | pulse    | skew        | 3.00E-08  | 1.00E-08 | 2.00E-07 |                |           | 5.00E-10 |

**5-18. Channel 2 DMM Input****Table 5-18. Levsine Amplitude**

| Channel | Function | Measurement | Amplitude | Frequency | Measured Value | Deviation | Spec (s) |
|---------|----------|-------------|-----------|-----------|----------------|-----------|----------|
| 2       | levsine  | amplitude   | 5.5       | 50000     |                |           | 0.1103   |

**Table 5-19. DC Voltage 1 M $\Omega$** 

| Channel | Function | Amplitude | Measured Value | Deviation | Spec (V)   |
|---------|----------|-----------|----------------|-----------|------------|
| 2       | dcvh     | 0         |                |           | 0.000025   |
| 2       | dcvh     | 0.001     |                |           | 0.00002525 |
| 2       | dcvh     | -0.001    |                |           | 0.00002525 |
| 2       | dcvh     | 130       |                |           | 0.032525   |
| 2       | dcvh     | -130      |                |           | 0.032525   |

Table 5-20. AC Voltage 1 M $\Omega$

| Channel | Function | Measurement         | Amplitude | Frequency | Measured Value | Deviation | Spec (Vp-p) |
|---------|----------|---------------------|-----------|-----------|----------------|-----------|-------------|
| 2       | acvh     | offset              | 0.001     | 1000      |                |           | 0.0000425   |
| 2       | acvh     | amplitude           | 0.001     | 1000      |                |           | 0.0000055   |
| 2       | acvh     | topline aberration  | 0.001     | 1000      |                |           | 0.000105    |
| 2       | acvh     | baseline aberration | 0.001     | 1000      |                |           | 0.000105    |
| 2       | acvh     | offset              | -0.001    | 1000      |                |           | 0.0000425   |
| 2       | acvh     | amplitude           | -0.001    | 1000      |                |           | 0.0000055   |
| 2       | acvh     | topline aberration  | -0.001    | 1000      |                |           | 0.000105    |
| 2       | acvh     | baseline aberration | -0.001    | 1000      |                |           | 0.000105    |
| 2       | acvh     | offset              | 130       | 1000      |                |           | 0.32504     |
| 2       | acvh     | amplitude           | 130       | 1000      |                |           | 0.065005    |
| 2       | acvh     | topline aberration  | 130       | 1000      |                |           | 0.6501      |
| 2       | acvh     | baseline aberration | 130       | 1000      |                |           | 0.6501      |
| 2       | acvh     | offset              | -130      | 1000      |                |           | 0.32504     |
| 2       | acvh     | amplitude           | -130      | 1000      |                |           | 0.065005    |
| 2       | acvh     | topline aberration  | -130      | 1000      |                |           | 0.6501      |
| 2       | acvh     | baseline aberration | -130      | 1000      |                |           | 0.6501      |

Table 5-21. Edge Amplitude

| Channel | Function | Measurement          | Amplitude | Frequency | Measured Value | Deviation | Spec (Vp-p) |
|---------|----------|----------------------|-----------|-----------|----------------|-----------|-------------|
| 2       | edge     | amplitude            | 2.5       | 10 kHz    |                |           | 0.0502      |
| 2       | edge     | topline aberr. 15 ns | 2.5       | 10 kHz    |                |           | 0.0145      |

**5-19. Channel 3 DMM Input****Table 5-22. Levsine Amplitude**

| Channel | Function | Measurement | Amplitude | Frequency | Measured Value | Deviation | Spec (Vp-p) |
|---------|----------|-------------|-----------|-----------|----------------|-----------|-------------|
| 3       | levsine  | amplitude   | 5.5       | 50000     |                |           | 0.1103      |

**Table 5-23. DC Voltage 1 M $\Omega$** 

| Channel | Function | Amplitude | Measured Value | Deviation | Spec (V)   |
|---------|----------|-----------|----------------|-----------|------------|
| 3       | dcvh     | 0         |                |           | 0.000025   |
| 3       | dcvh     | 0.001     |                |           | 0.00002525 |
| 3       | dcvh     | -0.001    |                |           | 0.00002525 |
| 3       | dcvh     | 130       |                |           | 0.032525   |
| 3       | dcvh     | -130      |                |           | 0.032525   |

**Table 5-24. AC Voltage 1 M $\Omega$** 

| Channel | Function | Measurement         | Amplitude | Frequency | Measured Value | Deviation | Spec (Vp-p) |
|---------|----------|---------------------|-----------|-----------|----------------|-----------|-------------|
| 3       | acvh     | offset              | 0.001     | 1000      |                |           | 0.0000425   |
| 3       | acvh     | amplitude           | 0.001     | 1000      |                |           | 0.0000055   |
| 3       | acvh     | topline aberration  | 0.001     | 1000      |                |           | 0.000105    |
| 3       | acvh     | baseline aberration | 0.001     | 1000      |                |           | 0.000105    |
| 3       | acvh     | offset              | -0.001    | 1000      |                |           | 0.0000425   |
| 3       | acvh     | amplitude           | -0.001    | 1000      |                |           | 0.0000055   |
| 3       | acvh     | topline aberration  | -0.001    | 1000      |                |           | 0.000105    |
| 3       | acvh     | baseline aberration | -0.001    | 1000      |                |           | 0.000105    |
| 3       | acvh     | offset              | 130       | 1000      |                |           | 0.32504     |
| 3       | acvh     | amplitude           | 130       | 1000      |                |           | 0.065005    |
| 3       | acvh     | topline aberration  | 130       | 1000      |                |           | 0.6501      |
| 3       | acvh     | baseline aberration | 130       | 1000      |                |           | 0.6501      |
| 3       | acvh     | offset              | -130      | 1000      |                |           | 0.32504     |
| 3       | acvh     | amplitude           | -130      | 1000      |                |           | 0.065005    |
| 3       | acvh     | topline aberration  | -130      | 1000      |                |           | 0.6501      |
| 3       | acvh     | baseline aberration | -130      | 1000      |                |           | 0.6501      |

**Table 5-25. Edge Amplitude**

| Channel | Function | Measurement         | Amplitude | Frequency | Measured Value | Deviation | Spec (Vp-p) |
|---------|----------|---------------------|-----------|-----------|----------------|-----------|-------------|
| 3       | edge     | amplitude           | 2.5       | 10 kHz    |                |           | 0.0502      |
| 3       | edge     | topline aberr 15 ns | 2.5       | 10 kHz    |                |           | 0.0145      |

**5-20. Channel 4 DMM Input**

**Table 5-26. Levsine Amplitude**

| Channel | Function | Measurement | Amplitude | Frequency | Measured Value | Deviation | Spec (Vp-p) |
|---------|----------|-------------|-----------|-----------|----------------|-----------|-------------|
| 4       | levsine  | amplitude   | 5.5       | 50000     |                |           | 0.1103      |

**Table 5-27. DC Voltage 50 Ω**

| Channel | Function | Amplitude | Measured Value | Deviation | Spec (V)   |
|---------|----------|-----------|----------------|-----------|------------|
| 4       | dcvh     | 0         |                |           | 0.000025   |
| 4       | dcvh     | 0.001     |                |           | 0.00002525 |
| 4       | dcvh     | -0.001    |                |           | 0.00002525 |
| 4       | dcvh     | 6 V       |                |           | 0.032525   |
| 4       | dcvh     | 6 V       |                |           | 0.032525   |

**Table 5-28. AC Voltage 50 Ω**

| Channel | Function | Measurement         | Amplitude | Frequency | Measured Value | Deviation | Spec (Vp-p) |
|---------|----------|---------------------|-----------|-----------|----------------|-----------|-------------|
| 4       | acvh     | offset              | 0.001     | 1000      |                |           | 0.0000425   |
| 4       | acvh     | amplitude           | 0.001     | 1000      |                |           | 0.0000055   |
| 4       | acvh     | topline aberration  | 0.001     | 1000      |                |           | 0.000105    |
| 4       | acvh     | baseline aberration | 0.001     | 1000      |                |           | 0.000105    |
| 4       | acvh     | offset              | -0.001    | 1000      |                |           | 0.0000425   |
| 4       | acvh     | amplitude           | -0.001    | 1000      |                |           | 0.0000055   |
| 4       | acvh     | topline aberration  | -0.001    | 1000      |                |           | 0.000105    |
| 4       | acvh     | baseline aberration | -0.001    | 1000      |                |           | 0.000105    |
| 4       | acvh     | offset              | 6 V       | 1000      |                |           | 0.32504     |
| 4       | acvh     | amplitude           | 6 V       | 1000      |                |           | 0.065005    |
| 4       | acvh     | topline aberration  | 6 V       | 1000      |                |           | 0.6501      |
| 4       | acvh     | baseline aberration | 6 V       | 1000      |                |           | 0.6501      |
| 4       | acvh     | offset              | 6 V       | 1000      |                |           | 0.32504     |
| 4       | acvh     | amplitude           | 6 V       | 1000      |                |           | 0.065005    |
| 4       | acvh     | topline aberration  | 6 V       | 1000      |                |           | 0.6501      |
| 4       | acvh     | baseline aberration | 6 V       | 1000      |                |           | 0.6501      |



Table 5-29. Edge Amplitude

| Channel | Function | Measurement             | Amplitude | Frequency | Measured Value | Deviation | Spec (Vp-p) |
|---------|----------|-------------------------|-----------|-----------|----------------|-----------|-------------|
| 4       | edge     | amplitude               | 2.5       | 10 kHz    |                |           | 0.0502      |
| 4       | edge     | topline aberr.<br>15 ns | 2.5       | 10 kHz    |                |           | 0.0145      |

**5-21. Channel 5 DMM Input**

Table 5-30. Levsine Amplitude

| Channel | Function | Measurement | Amplitude | Frequency | Measured Value | Deviation | Spec (Vp-p) |
|---------|----------|-------------|-----------|-----------|----------------|-----------|-------------|
| 5       | levsine  | amplitude   | 5.5       | 50000     |                |           | 0.1103      |

Table 5-31. DC Voltage 1 M $\Omega$ 

| Channel | Function | Amplitude | Measured Value | Deviation | Spec (V)   |
|---------|----------|-----------|----------------|-----------|------------|
| 5       | dcvh     | 0         |                |           | 0.000025   |
| 5       | dcvh     | 0.001     |                |           | 0.00002525 |
| 5       | dcvh     | -0.001    |                |           | 0.00002525 |
| 5       | dcvh     | 130       |                |           | 0.032525   |
| 5       | dcvh     | -130      |                |           | 0.032525   |

Table 5-32. AC Voltage 1 M $\Omega$ 

| Channel | Function | Measurement         | Amplitude | Frequency | Measured Value | Deviation | Spec (Vp-p) |
|---------|----------|---------------------|-----------|-----------|----------------|-----------|-------------|
| 5       | acvh     | offset              | 0.001     | 1000      |                |           | 0.0000425   |
| 5       | acvh     | amplitude           | 0.001     | 1000      |                |           | 0.0000055   |
| 5       | acvh     | topline aberration  | 0.001     | 1000      |                |           | 0.000105    |
| 5       | acvh     | baseline aberration | 0.001     | 1000      |                |           | 0.000105    |
| 5       | acvh     | offset              | -0.001    | 1000      |                |           | 0.0000425   |
| 5       | acvh     | amplitude           | -0.001    | 1000      |                |           | 0.0000055   |
| 5       | acvh     | topline aberration  | -0.001    | 1000      |                |           | 0.000105    |
| 5       | acvh     | baseline aberration | -0.001    | 1000      |                |           | 0.000105    |
| 5       | acvh     | offset              | 130       | 1000      |                |           | 0.32504     |
| 5       | acvh     | amplitude           | 130       | 1000      |                |           | 0.065005    |
| 5       | acvh     | topline aberration  | 130       | 1000      |                |           | 0.6501      |
| 5       | acvh     | baseline aberration | 130       | 1000      |                |           | 0.6501      |
| 5       | acvh     | offset              | -130      | 1000      |                |           | 0.32504     |
| 5       | acvh     | amplitude           | -130      | 1000      |                |           | 0.065005    |
| 5       | acvh     | topline aberration  | -130      | 1000      |                |           | 0.6501      |
| 5       | acvh     | baseline aberration | -130      | 1000      |                |           | 0.6501      |

**Table 5-33. Edge Amplitude**

| Channel | Function | Measurement        | Amplitude | Frequency | Measured Value | Deviation | Spec (Vp-p) |
|---------|----------|--------------------|-----------|-----------|----------------|-----------|-------------|
| 5       | edge     | amplitude          | 2.5       | 10 kHz    |                |           | 0.0502      |
| 5       | edge     | topline aberration | 2.5       | 10 kHz    |                |           | 0.0145      |

**5-22. Capacitance**

**Table 5-34. Capacitance (Channels 2-5)**

| Channel | Function | Measurement | Value    | Measured Value | Deviation | Cap (F)  |
|---------|----------|-------------|----------|----------------|-----------|----------|
| 2       | measz    | capacitance | 1.30E-11 |                |           | 1.15E-12 |
| 3       | measz    | capacitance | 1.30E-11 |                |           | 1.15E-12 |
| 4       | measz    | capacitance | 1.30E-11 |                |           | 1.15E-12 |
| 5       | measz    | capacitance | 1.30E-11 |                |           | 1.15E-12 |

# **Chapter 6**

## ***Replaceable Parts***

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## **6-1. Introduction**

This chapter contains a list of replaceable parts for the Fluke 5820A Oscilloscope Calibrator. Parts are listed by assembly and alphabetized by reference designator. Each assembly is accompanied by an illustration showing the location of each part and its reference designator. The parts lists give the following information:

- Reference designator.
- An indication if the part is subject to damage by static discharge.
- Description
- Fluke stock number
- Total quantity
- Any special notes (i.e., factory-selected part)

### **⚠ Caution**

**A \*** symbol indicates a device that may be damaged by static discharge.

## **6-2. How to Obtain Parts**

Electrical components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the Fluke Corporation and its authorized representatives by using the part number under the heading Fluke Stock Number. See Chapter 4 for Fluke contact information.

## **6-3. List of Replacement Parts**

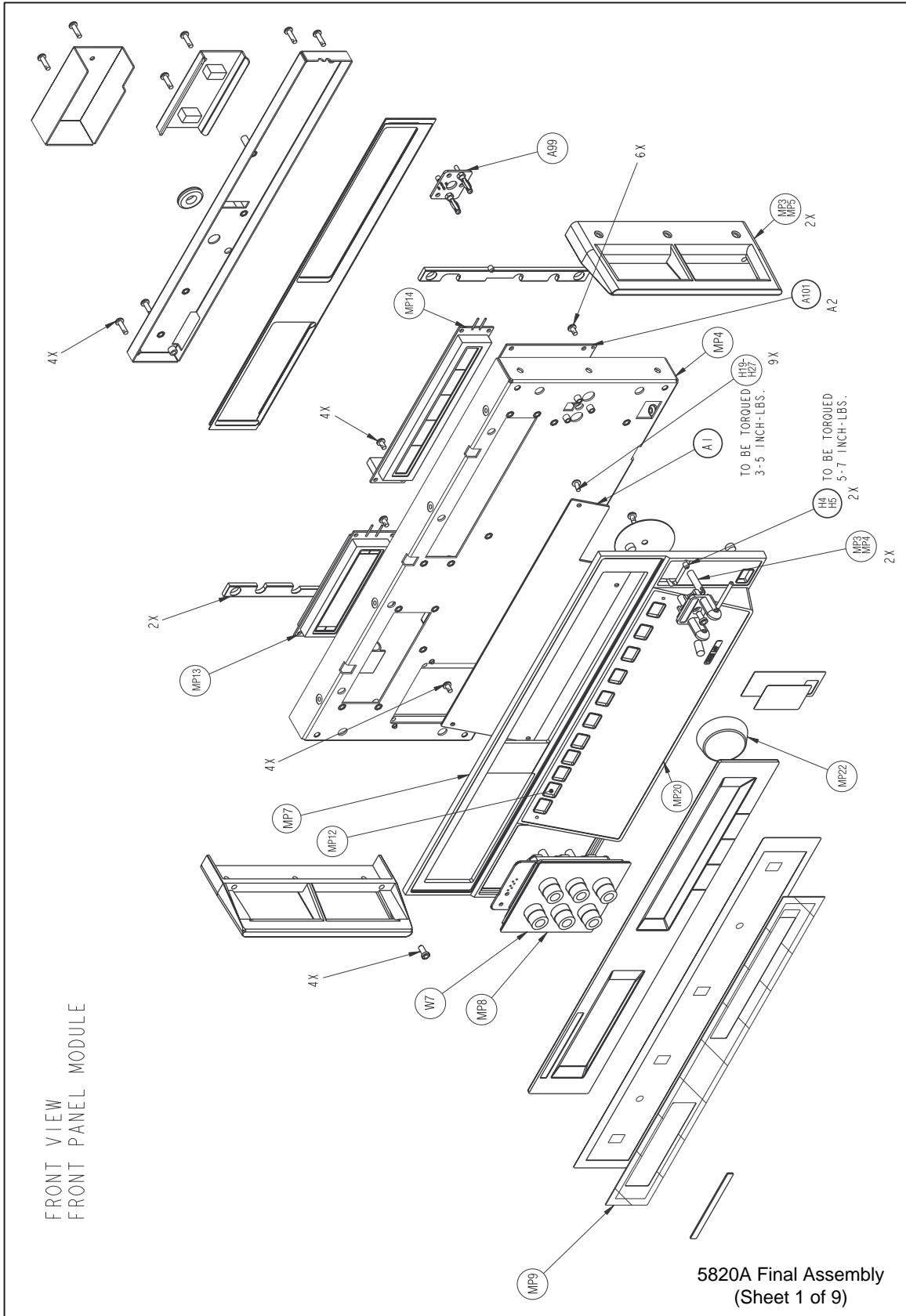
The following is a list of replacement parts for the Fluke 5820A.

Table 6-1. 5820A Manuals

| Description                               | Qty | Fluke Stock Number |
|---|-----|--------------------|
| MANUAL ADDENDUM SET, ASIA, 5820A OPERATOR | 1   | 802238             |
| MANUAL ADDENDUM SET, INTL, 5820A OPERATOR | 1   | 802170             |
| MANUAL, ENG, 5820A OPERATOR               | 1   | 802154             |

Table 6-2. Front Panel Module List of User Replaceable Parts

| Reference Designator | Description                             | Qty | Fluke Stock Number |
|----------------------|---|-----|--------------------|
| A1A1                 | PWB, KEYBOARD                           | 1   | 760868             |
| A63H19-27            | SCREW, WH, P, THD FORM, STL, 5-20, .312 | 9   | 494641             |
| A63H29               | CLAMP, CABLE, .50 ID, ADHESIVE MOUNT    | 1   | 688629             |
| A63MP2               | ASSEMBLY, FRONT PANEL                   | 1   | 673087             |
| A63MP3,<br>A63MP4    | HANDLE, INSTRUMENT, GREY #7             | 2   | 886333             |
| A63MP7               | *FRONT PANEL, GHZ                       | 1   | 673084             |
| A63MP8               | DECAL, OUTPUT BLOCK                     | 1   | 673191             |
| A63MP9               | LENS, BEZEL                             | 1   | 945246             |
| A63MP12              | KEYPAD, ELASTOMERIC                     | 1   | 1586646            |
| A63MP13              | *LCD MODULE, 16X2 CHAR, TRANSMISSIVE    | 1   | 929179             |
| A63MP14              | *LCD MODULE, 40X2 CHAR, TRANSMISSIVE    | 1   | 929182             |
| A63MP22              | KNOB, ENCODER, GREY                     | 1   | 868794             |
| A99H4,<br>A99H5      | SCREW, SET, SCKT, SS, LOCK, 8-32, .187  | 2   | 801446             |
| A99MP6               | CABLE, CURRENT LOOP                     | 1   | 673092             |
| A99A99               | PCA, LOOP, GHZ                          | 1   | 661667             |
| A99MP3,<br>A99MP4    | RECEPTABLE, LOOP                        | 2   | 662338             |



yu172f.eps

Figure 6-1. Final Assembly

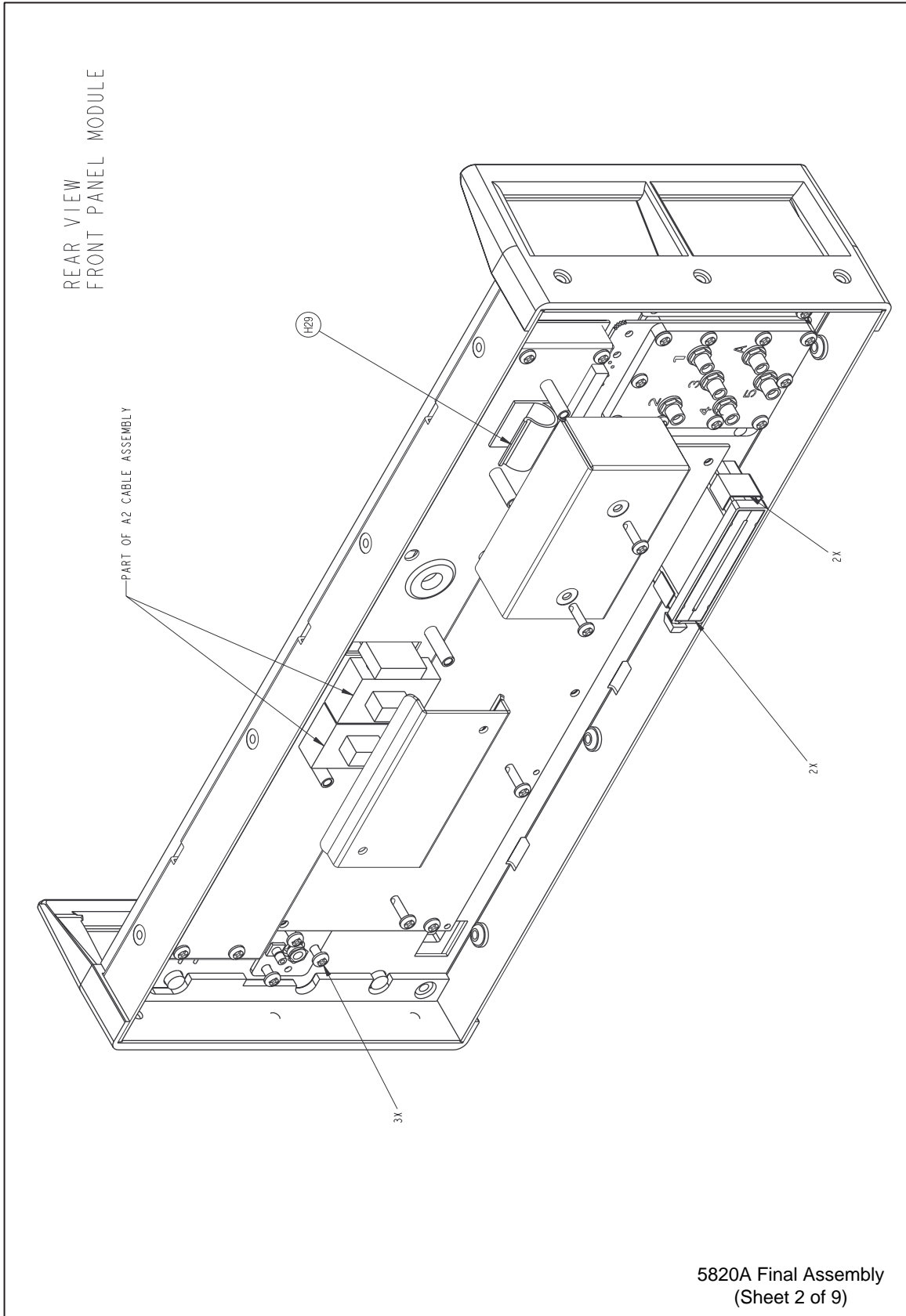
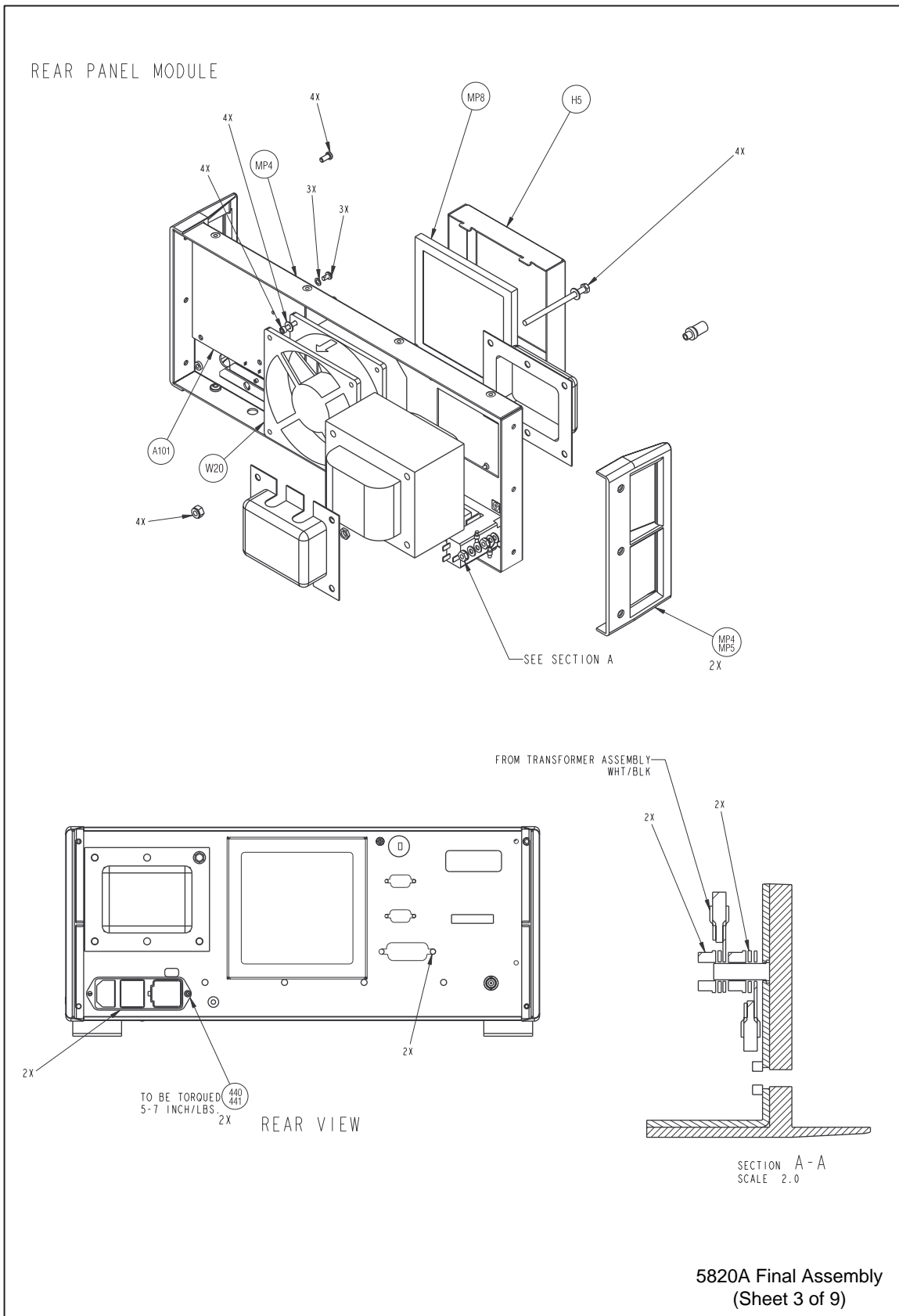


Figure 6-1. Final Assembly (cont)



**Table 6-3. Rear Panel Module List of Replaceable Parts**

| <b>Reference Designator</b> | <b>Description</b>          | <b>Qty</b> | <b>Fluke Stock Number</b> |
|-----------------------------|-----------------------------|------------|---------------------------|
| A65MP4,<br>A65MP5           | HANDLE, INSTRUMENT, GREY #7 | 2          | 886333                    |
| A65MP8                      | AIR FILTER                  | 1          | 945287                    |
| A65W20                      | FAN ASSEMBLY                | 1          | 843029                    |

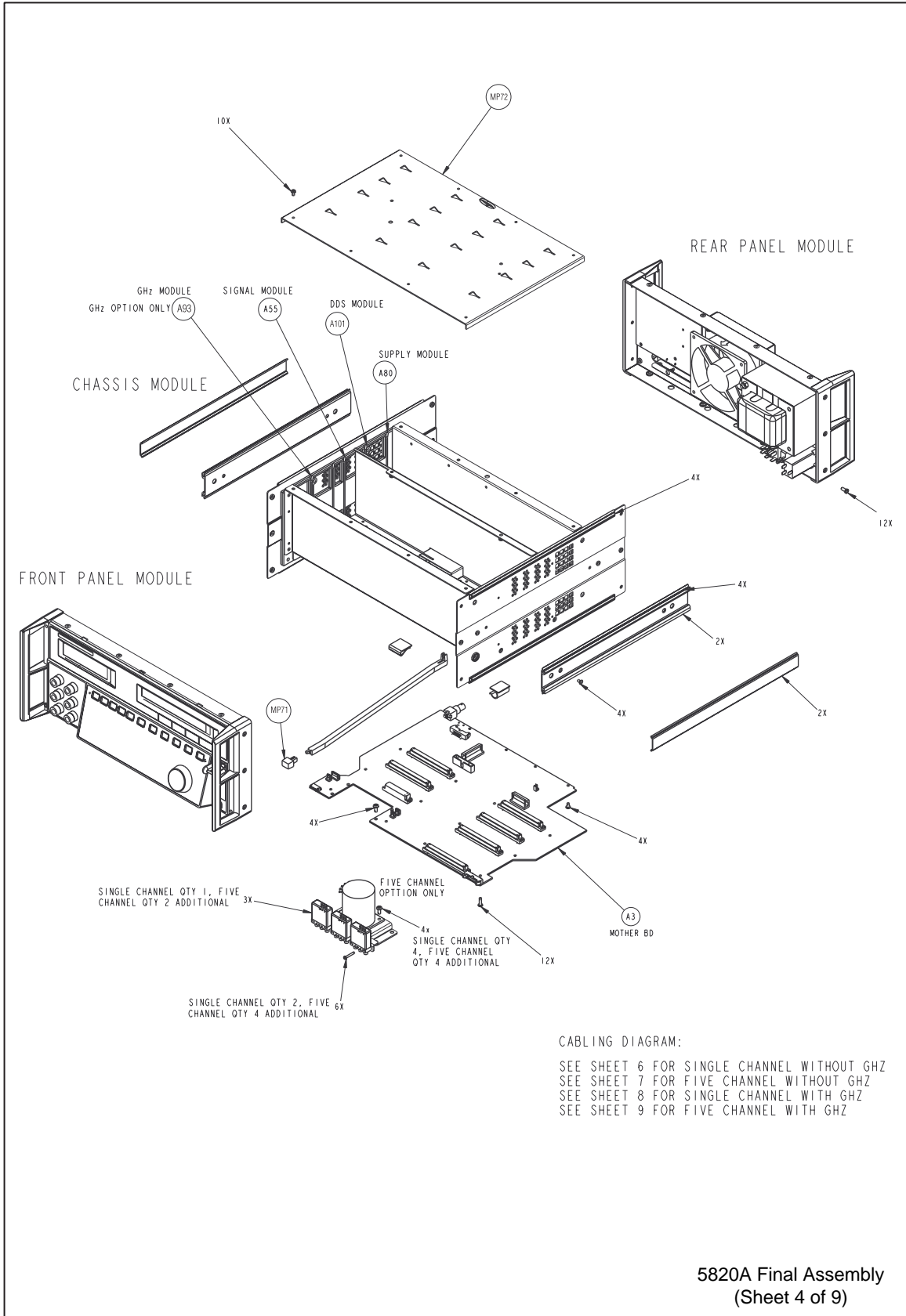


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Figure 6-1. Final Assembly (cont)

**Table 6-4. Chassis Module List of Replaceable Parts**

| Reference Designator                        | Description                              | Qty | Fluke Stock Number |
|---|--|-----|--------------------|
| A3A3  | *PCA, MOTHER, GHZ A03                    | 1   | 662221             |
| A11A101                                     | PCA, MANUAL, A2, A6, A9                  | 1   | 617198             |
| A11A101                                     | *ENCODER, 5520A-7602                     | 1   | 627232             |
| A11A101                                     | *IN-GUARD, 5520A-7606                    | 1   | 626900             |
| A11A101                                     | *OUT-GUARD, 5520A-7609                   | 1   | 626934             |
| A55A55                                      | *SIGNAL, GHZ, A55                        | 1   | 662301             |
| A55A55                                      | *SIGNAL, MHZ, A55                        | 1   | 661519             |
| A56MP9                                      | AUX CABLE, SMA RT-RT                     | 1   | 647104             |
| A57W6                                       | CABLE, TRIGGER, SINGLE                   | 1   | 661485             |
| A64H13-28,<br>A64H78-H81                    | SCREW, FHU, P. LOCK, MAG, SS, 6-32, .250 | 20  | 320093             |
| A64H29                                      | CLAMP, CABLE, .50 ID, ADHESIVE MOUNT     | 1   | 688629             |
| A64MP2                                      | COVER, INSTRUMENT TOP                    | 1   | 647146             |
| A64MP3                                      | COVER, INSTRUMENT BOTTOM                 | 1   | 627213             |
| A64MP4                                      | REAR PANEL                               | 1   | 617230             |
| A64MP14,<br>A64MP15,<br>A64MP22,<br>A64MP24 | BOTTOM FOOT, MOLDED, GREY #7             | 4   | 868786             |
| A64MP16-21                                  | PLASTIC PART, CAP, POLYETH, 5/8-24, .41  | 6   | 689320             |
| A64MP51                                     | CABLE, GHZ OUT                           | 1   | 661964             |
| A64MP54                                     | CABLE, MHZ/GHZ                           | 1   | 661998             |
| A64MP56                                     | CABLE, TRIGGER, MHZ/GHZ                  | 1   | 662228             |
| A64MP72                                     | COVER, ANALOG                            | 1   | 673126             |
| A64W1                                       | CABLE, SMA ST TO RT                      | 1   | 626025             |
| A64W7                                       | ASSY, OUTPUT BLOCK MODULE, GHZ           | 1   | 66239              |
| A80A80                                      | *PCA, VOLTAGE, A80                       | 1   | 626033             |
| A81   | *CURRENT OUTPUT, 5820A-4081              | 1   | 662304             |
| A92A93                                      | *BANDWIDTH GHZ MODULE                    | 1   | 659950             |



5820A Final Assembly  
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Figure 6-1. Final Assembly (cont)

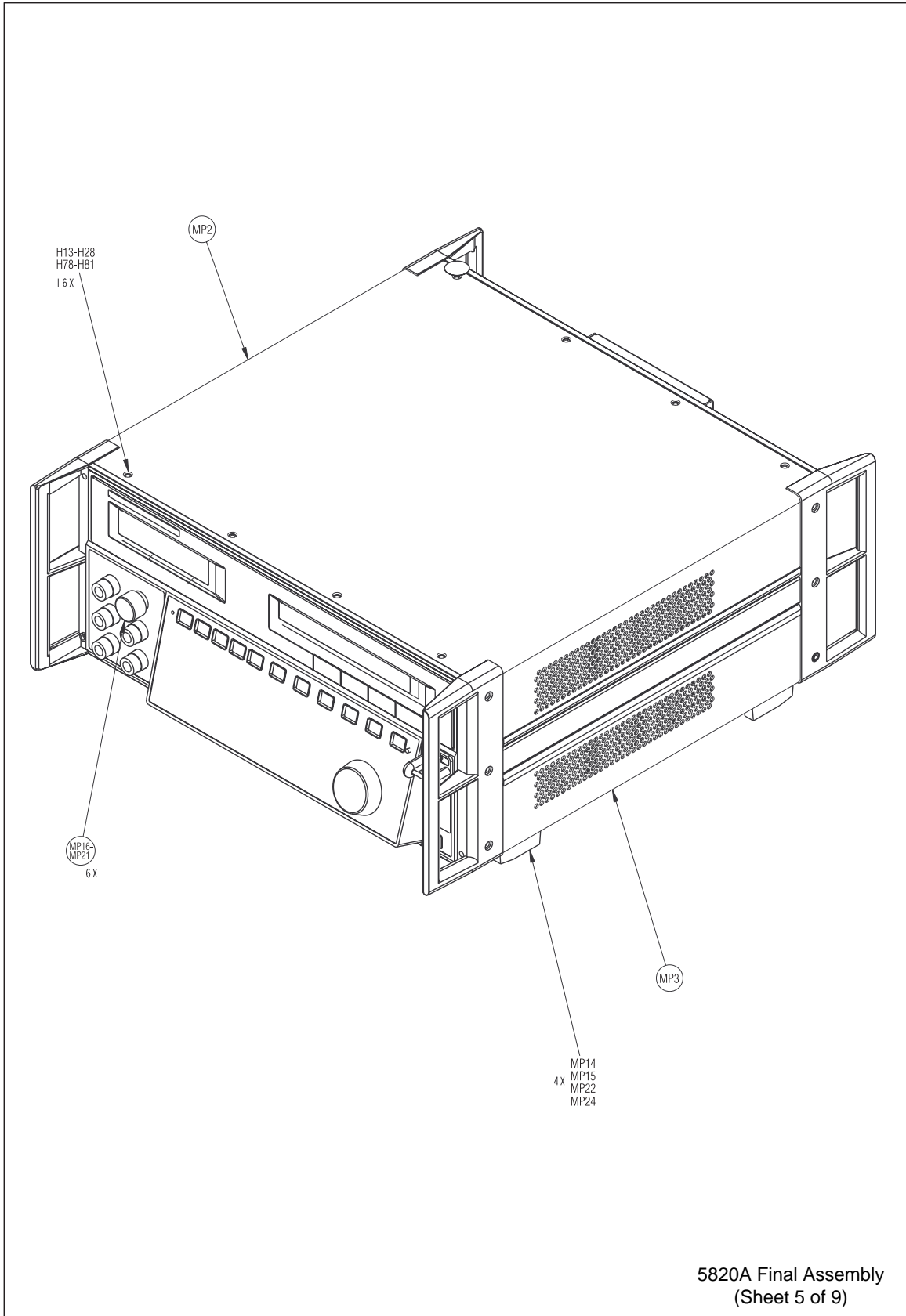


Figure 6-1. Final Assembly (cont)

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Table 6-5. Single Channel Without GHz Option List of Replaceable Parts

| Reference Designator | Description                                | Qty | Fluke Stock Number |
|----------------------|--|-----|--------------------|
| A54MP2               | ADAPTER, COAX, SMA(F), SMA(M), SMA(F), TEE | 1   | 688710             |
| A54MP8,<br>A54MP13   | CABLE, SMA RT TO RT                        | 2   | 659968             |
| A54W2-4              | CABLE, SMA ST TO RT                        | 3   | 626025             |
| A54W6                | CABLE, TRIGGER 5 CHANNEL                   | 1   | 926009             |
| A54W9-12             | CABLE, SMA ST TO RT                        | 4   | 626017             |
| A56MP9               | AUX CABLE, SMA RT-RT                       | 1   | 647104             |
| A99MP6               | CABLE, CURRENT LOOP                        | 1   | 673092             |
| A99A99               | PCA, LOOP, GHZ                             | 1   | 661667             |

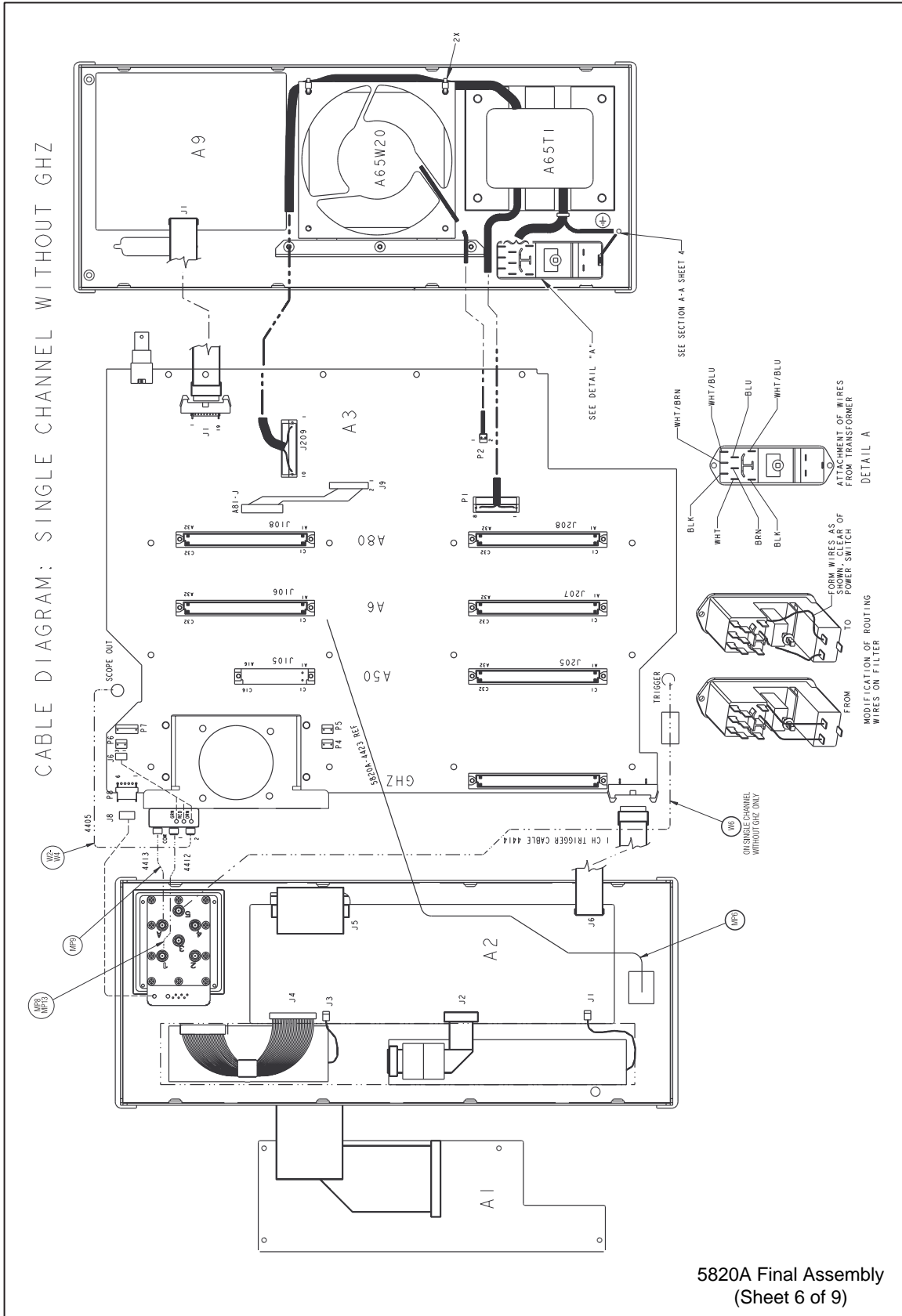


Figure 6-1. Final Assembly (cont)

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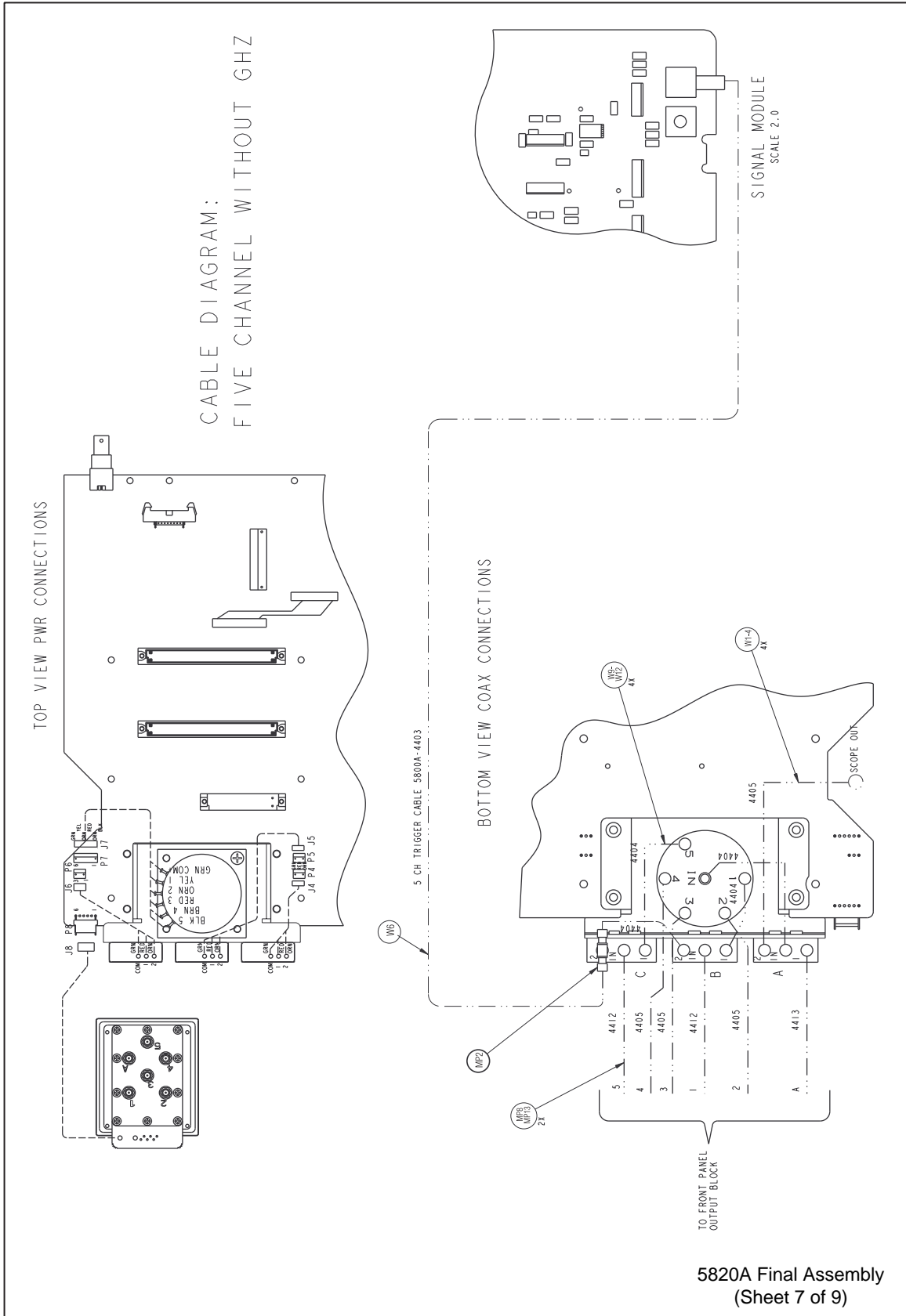


Figure 6-1. Final Assembly (cont)

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**Table 6-6. Single Channel With GHZ Option List of Replaceable Parts**

| Reference Designator | Description                                | Qty | Fluke Stock Number |
|----------------------|--|-----|--------------------|
| A54MP2               | ADAPTER, COAX, SMA(F), SMA(M), SMA(F), TEE | 1   | 688710             |
| A54MP8,<br>A54MP13   | CABLE, SMA RT TO RT                        | 2   | 659968             |
| A54W6                | CABLE, TRIGGER 5 CHANNEL                   | 1   | 926009             |
| A54W9-12             | CABLE, SMA ST TO RT                        | 4   | 626017             |
| A56MP9               | AUX CABLE, SMA RT-RT                       | 1   | 647104             |
| A64MP51              | CABLE, GHZ OUT                             | 1   | 661964             |
| A99MP6               | CABLE, CURRENT LOOP                        | 1   | 673092             |



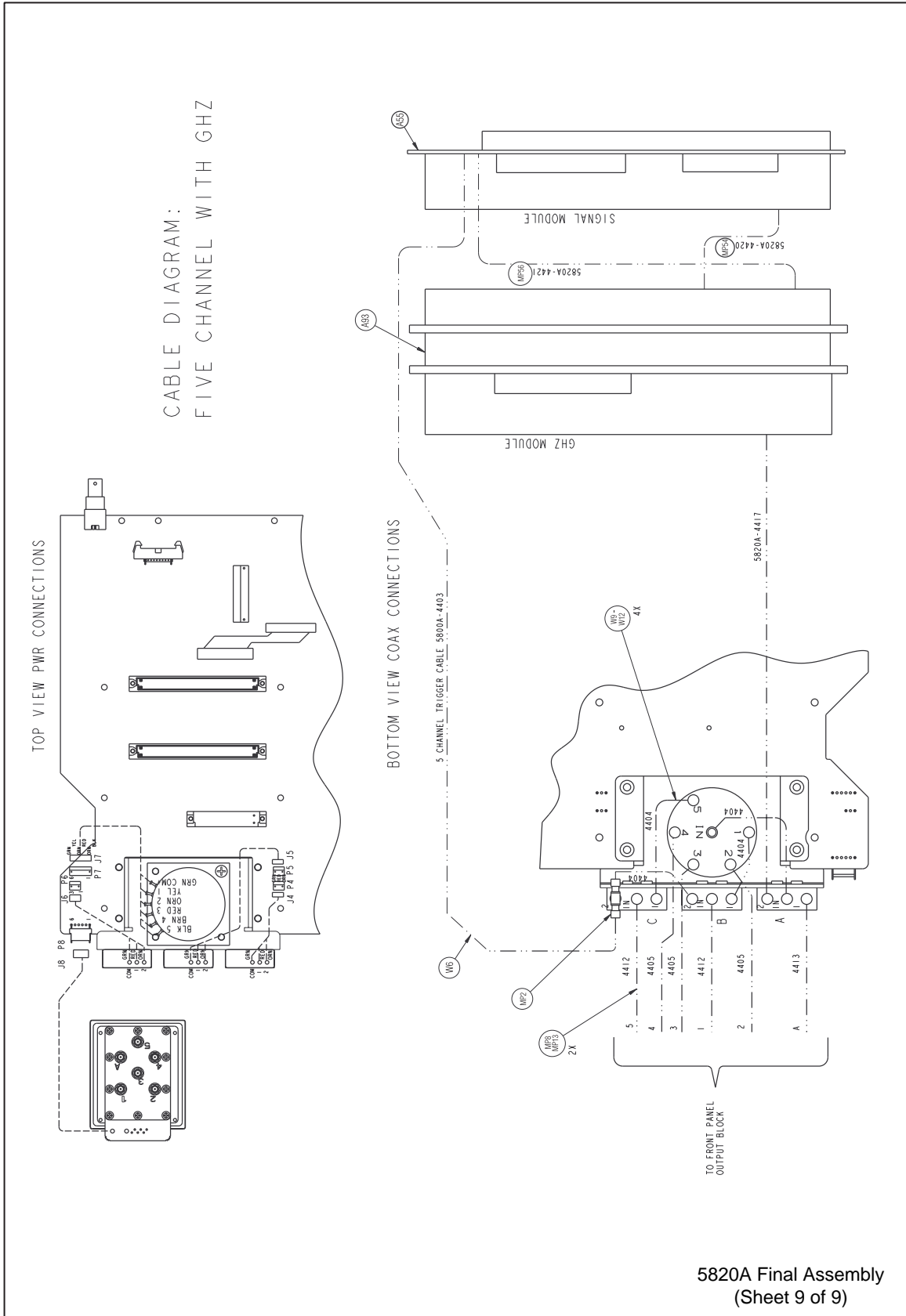


Figure 6-1. Final Assembly (cont)

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