FLUKE ®

5800A

Oscilloscope Calibrator

Service Manual

PN 689411
December 1998

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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 5800A 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 5800A Calibrator must be operated in the way specified by this manual or other documentation provided by Fluke.

Features of the 5800A Calibrator include the following:

- Automatic meter error calculation.
- MULT X and DIV ÷ 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.

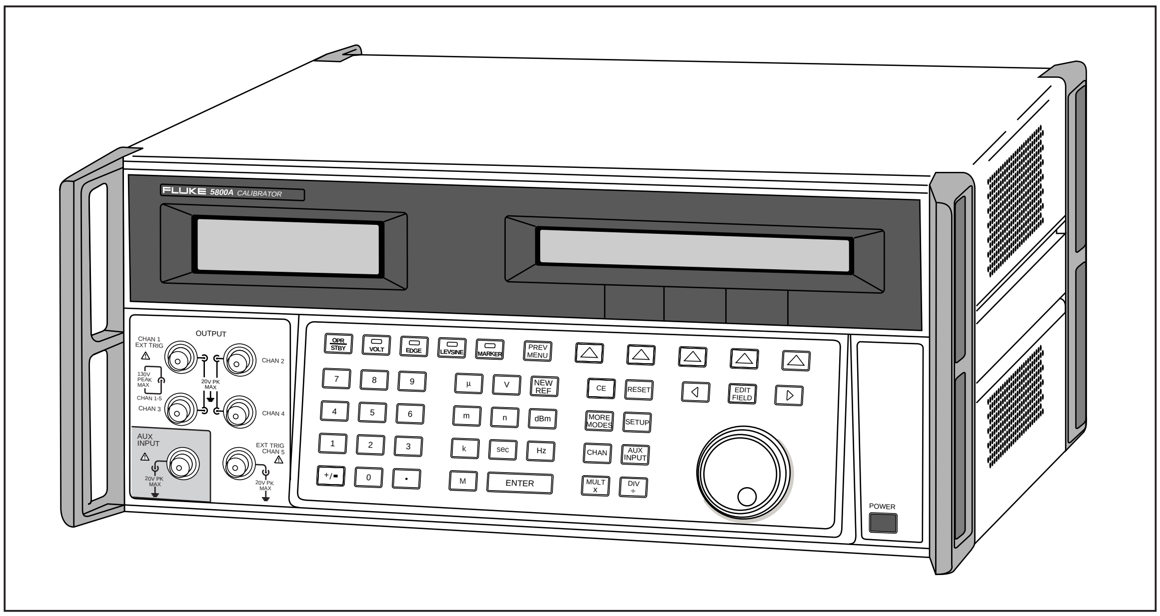

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Figure 1-1. 5800A Oscilloscope Calibrator

- 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.
- 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 5800A.
- 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. Instruction Manuals

The 5800A Manual Set provides complete information for operators and service or maintenance technicians. The set includes:

- *5800A Operators Manual* (PN 686318)
- *5800A Service Manual* (PN 689411)

The *5800A Operators Manual* ships with the instrument. The *5800A 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.

1-3. 5800A Operators Manual

The *5800A Operators Manual* provides complete information for installing the 5800A 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 *5800A 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 5800A
- Accessories
- Error Messages

1-4. 5800A Service Manual

This *5800A Service Manual* includes: product specifications, appropriate theory of operation, calibration and verification procedures, maintenance information, options, parts lists, and schematic diagrams.

1-5. Specifications

The following paragraphs describe the details for the 5800A specifications. All specifications are valid after allowing a warm-up period of 30 minutes, or twice the time the 5800A has been turned off. (For example, if the 5800A 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 tcal ± 5 °C (tcal is the ambient temperature when the 5800A was calibrated), the temperature coefficient is less than 0.1 times the 1-year specification per °C (limited to 0 °C - 50 °C).

If you ordered the GHz Option, the following specification tables are superseded by the tables with the same headings in Chapter 5:

- Volt Specifications
- Edge Specifications
- Leveled Sine Wave Specifications
- Pulse Generator Specifications
- Oscilloscope Input Capacitance Measurement Specifications

Refer to Figure 1-2 for the dimensional outline of the 5800A Calibrator.

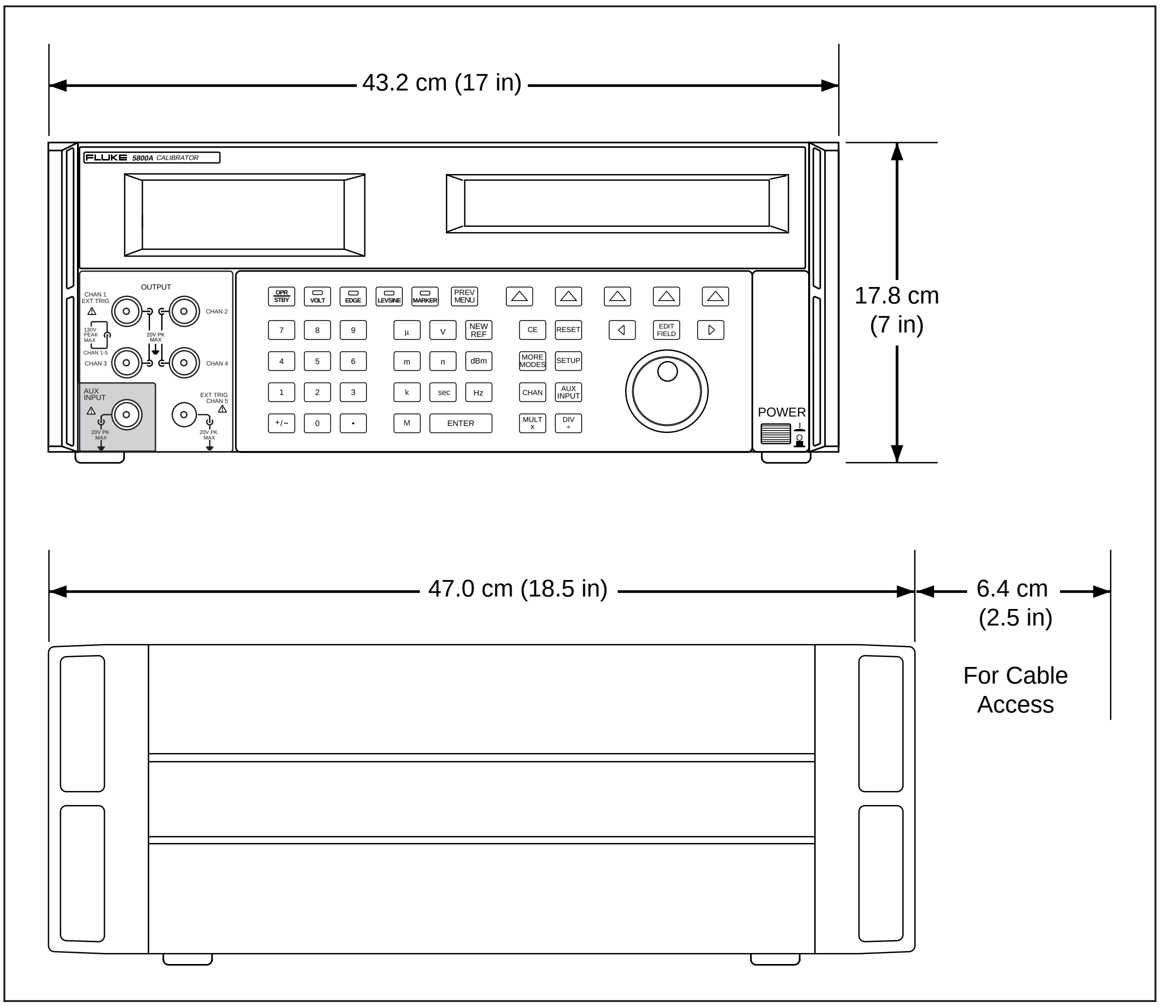

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Figure 1-2. 5800A Calibrator Dimensional Outline

1-6. General Specifications

Warmup Time	Twice the time since last warmed up, to a maximum of 30 minutes
Settling Time	5 seconds or faster for all functions and ranges
Standard Interfaces	IEEE-488 (GPIB), RS-232
Temperature Performance	Operating: 0 °C to 50 °C
	Calibration (tcal): 15 °C to 35 °C
	Storage: -20 °C to 70 °C
Electromagnetic Compatibility	Designed to operate in Standard Laboratory environments where the Electromagnetic environment is highly controlled.
Temperature Coefficient	Temperature Coefficient for temperatures outside tcal ±5 °C is 0.1X/°C of 1-year specification.
Relative Humidity	Operating: <80 % to 30 °C, <70 % to 40 °C,<40 % to 50 °C
	Storage: <95 %, noncondensing
Altitude	Operating: 3,050 m (10,000 ft) maximum Nonoperating: 12,200 m (40,000 ft) maximum
Safety	Designed to comply with IEC 1010-1 (1992-1); ANSI/ISA-S82.01-1994; CAN/CSA-C22.2 No. 1010.1-92
Analog Low Isolation	20 V
EMC	Complies with EN 61326-1
Line Power	Line Voltage (selectable): 100 V, 120 V, 220 V, 240 V
	Line Frequency: 47 to 63 Hz
	Line Voltage Variation: ±10 % about line voltage setting
Power Consumption	250 VA
Dimensions	Height, 17.8 cm (7 inches), standard rack increment, plus 1.5 cm (0.6 inch) for feet on bottom of unit; Width, 43.2 cm (17 inches), standard rack width Depth, 47.3 cm (18.6 inches) overall.
Weight	20 kg (44 pounds)

1-7. Volt 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 1-1. Volt Specifications

Amplitude Characteristics				
	DC Signal		Square Wave Signal [1]	
	50 Ω Load	**1 MΩ Load**	**50 Ω Load**	**1 MΩ Load**
Adjustment Range (continuous)	0 V to ±6.6 V	0 V to ±130 V	±1 mV to ±6.6 V p-p	±1 mV to ±130 V p-p
1-Year Absolute Uncertainty, tcal ± 5 °C	± (0.25 % of output + 40 µV)	± (0.025 % of output + 25 µV)	± (0.25 % of output + 40 µV)	± (0.05 % of output + 5 µV) [2]
Adjustment Sequence	1-2-5 (e.g., 10 mV, 20 mV, 50 mV)			
Resolution				
1 mV 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			
Square Wave Frequency Characteristics				
Range	10 Hz to 10 kHz			
1-Year Absolute Uncertainty, tcal ± 5 °C	± (1 ppm of setting)			
Typical Aberration (from 50 % of leading/trailing edge)	< (0.5 % of output + 100 µV)			
25 mV to 130 V: within 4 µs				
10 mV to 25 mV: within 8 µs				
1 mV to 10 mV: within 14 µs				
[1] Positive or negative, zero-referenced square wave.				
[2] Above 1 kHz, ± (0.25 % of output + 40 µV).				

1-8. Edge 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 1-2. Edge Specifications

Edge Characteristics into 50 Ω Load		1-Year Absolute Uncertainty, tcal ± 5 °C
Rise Time	250 ps [1]	± 50 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 kHz to 10 MHz	± (1 ppm of setting)
Typical Jitter, edge to trigger	< 5 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 15 ns	< (1 % of output + 2 mV)
	after 15 ns	< (0.5 % of output + 2 mV)
Typical Duty Cycle	45 % to 55 %	

[1] Frequency range above 2 MHz has rise time specification < 300 ps typical.

[2] Below 250 mV, the leading edge aberrations are typical. All readings are referenced to a Tek TDS820 8 GHz scope or a Tek 11801 mainframe with an SD26 or SD22 option.

1-9. Leveled Sine Wave 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 1-3. Leveled Sine Wave Specifications

Leveled Sine Wave Characteristics into 50 Ω	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
Amplitude Characteristics					
Range (p-p)	5 mV to 5.5 V				
Resolution	< 100 mV: 3 digits ≥ 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]				
Frequency Characteristics					
Resolution	10 kHz				
1-Year Absolute Uncertainty, tcal ± 5 °C	± 1 ppm				
Distortion Characteristics [3]					
2nd Harmonic	≤ -33 dBc				
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. [3] Harmonics above 500 MHz are typical.					

1-10. 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 1-4. Time Marker Specifications

Time Marker into 50 Ω	5 s to 50 ms	20 ms to 100 ns	50 ns to 20 ns	10 ns	5 ns to 2 ns
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]	± 1 ppm	± 1 ppm	± 1 ppm	± 1 ppm

[1] Typical rise time of square wave and 20%-pulse (20 % duty cycle pulse) is < 1.5 ns.
[2] With 10 MHz external reference selected, the uncertainty becomes that of the external clock plus 5 µHz.
[3] Time marker uncertainty is ±50 ppm when measured off of cardinal points:
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

1-11. Wave Generator Specifications

Table 1-5. Wave Generator Specifications

Wave Generator Characteristics	Square Wave and Sine Wave into 50 Ω or 1 MΩ	Triangle Wave into 50 Ω or 1 MΩ
Amplitude		
Range	into 1 MΩ: 1.8 mV to 55 V p-p into 50 Ω: 1.8 mV to 2.5 V p-p	into 1 MΩ: 1.8 mV to 55 V p-p into 50 Ω: 1.8 mV to 2.5 V p-p
1-Year Absolute Uncertainty, tcal ± 5 °C, 10 Hz to 10 kHz	± (3 % of p-p output +100 µV)	± (3 % of p-p output + 100µV)
Sequence	1-2-5 (10 mV, 20 mV, 50 mV)	1-2-5 (10 mV, 20 mV, 50 mV)
Typical DC Offset Range	0 to ± (≥40 % of p-p amplitude) [1]	0 to ± (≥40 % of p-p amplitude) [1]
Ramp Linearity [2]		better than 0.1 % 10 Hz to 10 kHz
Frequency		
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 ± 5 °C [3]	± (2.5 ppm + 5 µHz) [4]	± (2.5 ppm + 5 µHz) [4]

[1] The DC offset plus the wave signal must not exceed 30 V rms.
[2] Applies to the 10 % to 90 % of the triangle waveform 500 mV p-p to 10 V p-p.
[3] Uncertainty below 10 Hz is typical.
[4] With 10 MHz external reference selected, the uncertainty becomes that of the external clock plus 5 µHz.

1-12. Pulse Generator 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. Pulse Generator Specifications

Pulse Generator Characteristics	Positive pulse into 50 Ω
Rise Time	500 ps typical
Available Amplitudes (typical)	1.5 V, 600 mV, 150 mV, 60 mV, 15 mV
Pulse Width	
Range [1]	1 ns to 500 ns
Uncertainty	5 % ±200 ps
Pulse Period	
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 1 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	± 1 ppm
Pulse Skew with Trigger [3]	
Range [2]	+30 ns to -10 ns with 250 ps resolution
Uncertainty	± 500 ps
[1] May generate pulses below 1 ns but pulse width accuracy is not specified. [2] Assumes that trigger used in divide by 1 mode. Other divide modes are not specified. [3] Pulse skew measured from 30% of trigger signal amplitude to 30% of pulse amplitude range.	

1-13. Trigger Signal Specifications (Pulse Function)

Table 1-7. Trigger Signal Specifications (Pulse Function)

Time Marker Period	Division Ratio [1]	Amplitude into 50 Ω (p-p)	Typical Rise Time
20 ms to 150 ns	off/1/10/100	≥ 1 V	≤ 2 ns

1-14. Trigger Signal Specifications (Time Marker Function)

Table 1-8. 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

1-15. Trigger Signal Specifications (Edge Function)

Table 1-9. Trigger Signal Specifications (Edge Function)

Edge Signal Frequency	Division Ratio	Typical Amplitude into 50 Ω (p-p)	Typical Rise Time	Typical Lead Time
1 kHz to 10 MHz	off/1	≥ 1 V	≤ 2 ns	40 ns

1-16. Trigger Signal Specifications (Square Wave Voltage Function)

Table 1-10. Trigger Signal Specifications (Square Wave Voltage Function)

Edge Signal Frequency	Division Ratio	Typical Amplitude into 50 Ω (p-p)	Typical Rise Time	Typical Lead Time
10 Hz to 10 kHz	off/1	≥ 1 V	≤2 ns	1 µs

1-17. Trigger Signal Specifications

Table 1-11. TV Trigger Signal Specifications

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

1-18. Tunnel Diode Drive Capability

Table 1-12. 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

1-19. Oscilloscope Input Resistance Measurement Specifications

Table 1-13. Oscilloscope Input Resistance Measurement Specifications

Scope Input Selected	50 Ω	1 MΩ
Measurement Range	40 Ω to 60 Ω	500 kΩ to 1.5 MΩ
Uncertainty	0.1 %	0.1 %

1-20. Oscilloscope Input Capacitance Measurement 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 1-14. Oscilloscope Input Capacitance Measurement Specifications

Scope Input Selected	1 MΩ
Measurement Range	5 pF to 50 pF
Uncertainty	± (5 % of input + 0.5 pF) [1]
[1] Measurement made within 30 minutes of capacitance zero reference. Scope option must be selected for at least five minutes prior to any capacitance measurement or zero.	

1-21. 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 1-15. 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 1 s to 60 s

1-22. External Reference Input Specifications

The External Reference Input selection allows the user to provide their own high stability 10 MHz reference clock for the 5800A 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.

1-23. Auxiliary Input Specifications

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

Table 1-16. 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
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

Chapter 2
Theory of Operation

Title	Page

2-1. Introduction

The following discussion provides a brief overview of the following 5800A operating modes:

- Voltage
- Edge
- Leveled sine wave
- Time marker
- Wave generator
- Video
- Pulse generator
- Current
- Input impedance
- Overload
- 5 Channel Option
- GHz Option

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 5800A.

The components in the scope module are shown in Figure 2-2. The scope module consists of the Main board (which generates leveled sine, maker, and trigger), the A51 voltage board (which generates precision DC and AC low frequency square wave, video, overload measurement and impedance measurement), the A90 edge and attenuator board (which attenuates the signal by 0 to -48 dB), and the A, pulse board (which generates pulse generator signals).

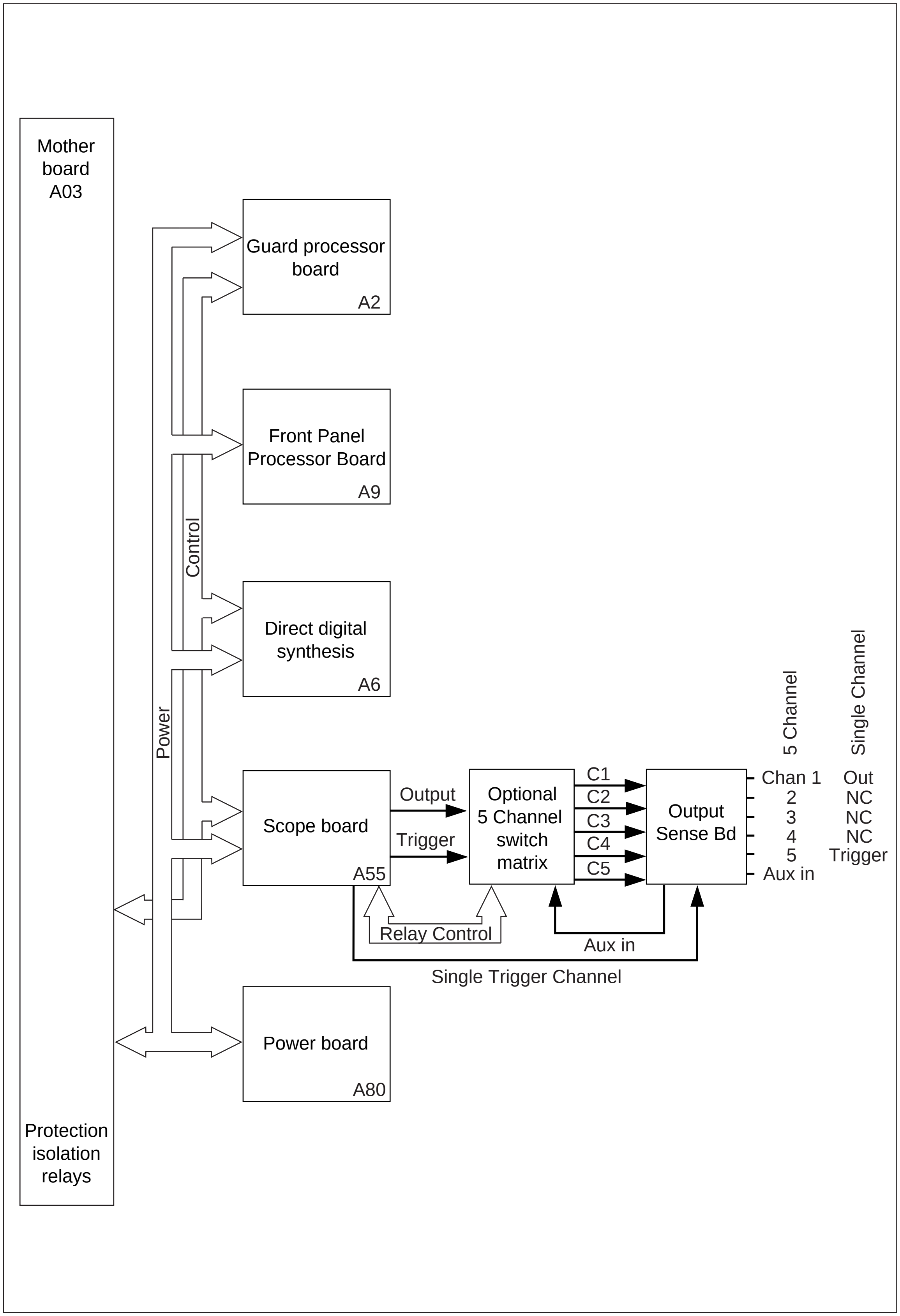

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Figure 2-1. Signal Diagram of Scope Module

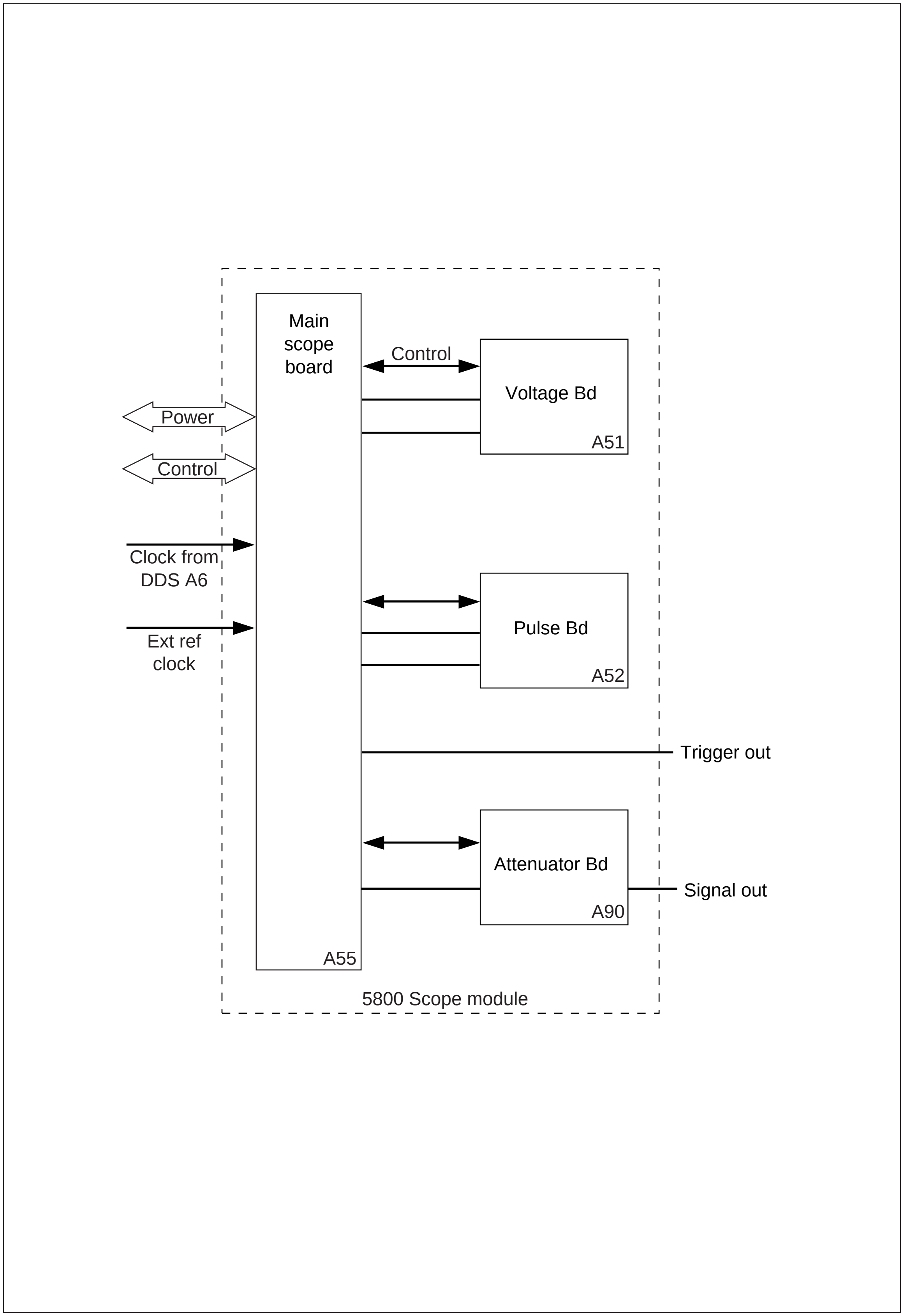

Figure 2-2. Block Diagram of Scope Module

2-2. Voltage Mode

All signals for the voltage function are generated from the A51 Voltage/Video board, a daughter card to the A55 board. A dc reference voltage is supplied to the A51 board from the A6 DDS board; all dc and ac oscilloscope output voltages are derived from this signal and generated on the A51 board. All frequency signals (clock) are generated on the A55. The output of the A51 board is passed to the A55 board and attenuator module and is then cabled to the output connectors on the front panel. The dc reference signal is used to generate both + and - dc and ac signals that are amplified or attenuated to provide the complete range of output signals.

2-3. Edge Mode

The edge clock originates on the A55 board and is used on the Edge Attenuator A90 to generate the edge signal. The A55 edge clock signal is also used to generate the external trigger signals. The edge signal is passed through the attenuator section of the A90 and then to the SCOPE connector on the front panel. If turned on, the trigger is connected to the Trig Out on the front panel.

2-4. Leveled Sine Wave Mode

All of the leveled sine wave signals (from 50 kHz to 600 MHz) are produced on the A55 board. The leveled sine wave signal is passed from the A55 board to the A90 attenuator assembly. The attenuator assembly provides range attenuation and also contains a power detector which maintains amplitude flatness across the frequency range. The signal is then passed to the SCOPE connector on the front panel.

2-5. Time Marker Mode

There are 3 primary “ranges” of time marker operation: 5 s to 20 ms, 10 ms to 2 µs, and 1 µs to 2 ns.

The 5 s to 20 ms markers are generated on the A6 DDS board and are passed to the A55 board. The 10 ms to 2 µs markers are derived from a square wave signal that is generated on the A55 board and passed through wave shaping and external trigger generation.

The 10 ns to 2 ns sine markers are generated from the leveled sine wave generator on the A55 board. 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 the A55 board, where the signal is shaped into the other marker waveforms. The marker signals are passed from the A55 board to the attenuator assembly and on to the SCOPE connector on the front panel.

The signal path is also split to drive the external trigger circuitry on the A55 board. If turned on, the trigger is connected to the Trig Out on the front panel. Filters on the A55 shape the signal into spike and 20% pulse. The marker signal passing through the A55 board is connected to the attenuator assembly. The signal is then passed to the SCOPE connector on the front panel.

2-6. Wave Generator Mode

All signals for the wavegen function are generated from the DDS A6 board and are passed to the A55 board. They are then sent to the A90 attenuator assembly, where range attenuation occurs. Wavegen signals are then sent to the SCOPE connector on the front panel.

2-7. Pulse Generator

Pulse Gen (Pulse Generator Modes) signals are derived from the A52. Min pulse period is 20 ms or 50 Hz.

2-8. Input Impedance Mode (Resistance)

The reference resistors for this mode are on the A51 board, while the DCV reference signal and measuring signals are on the A6 DDS board.

2-9. Input Impedance Mode (Capacitance)

Capacitance measurement circuits are contained on the A55, utilizing signals from the leveled sine wave source. If there are faults associated only with capacitance measurement, the A55 board most likely needs replacement or repair.

2-10. Overload Mode

The source voltage for the overload mode is generated on the A51 Voltage/Video board on the A55. The voltage is applied to the external 50 Ω load, and the circuit current is monitored by the A6 DDS board.

2-11. 5 Channel Option

This option expands the output to 5 channels and allows the trigger to be output on channel 1, channel 5 or not output at all.

2-12. GHz Option

This option extends the leveled sine frequency range to the GHz frequency range.

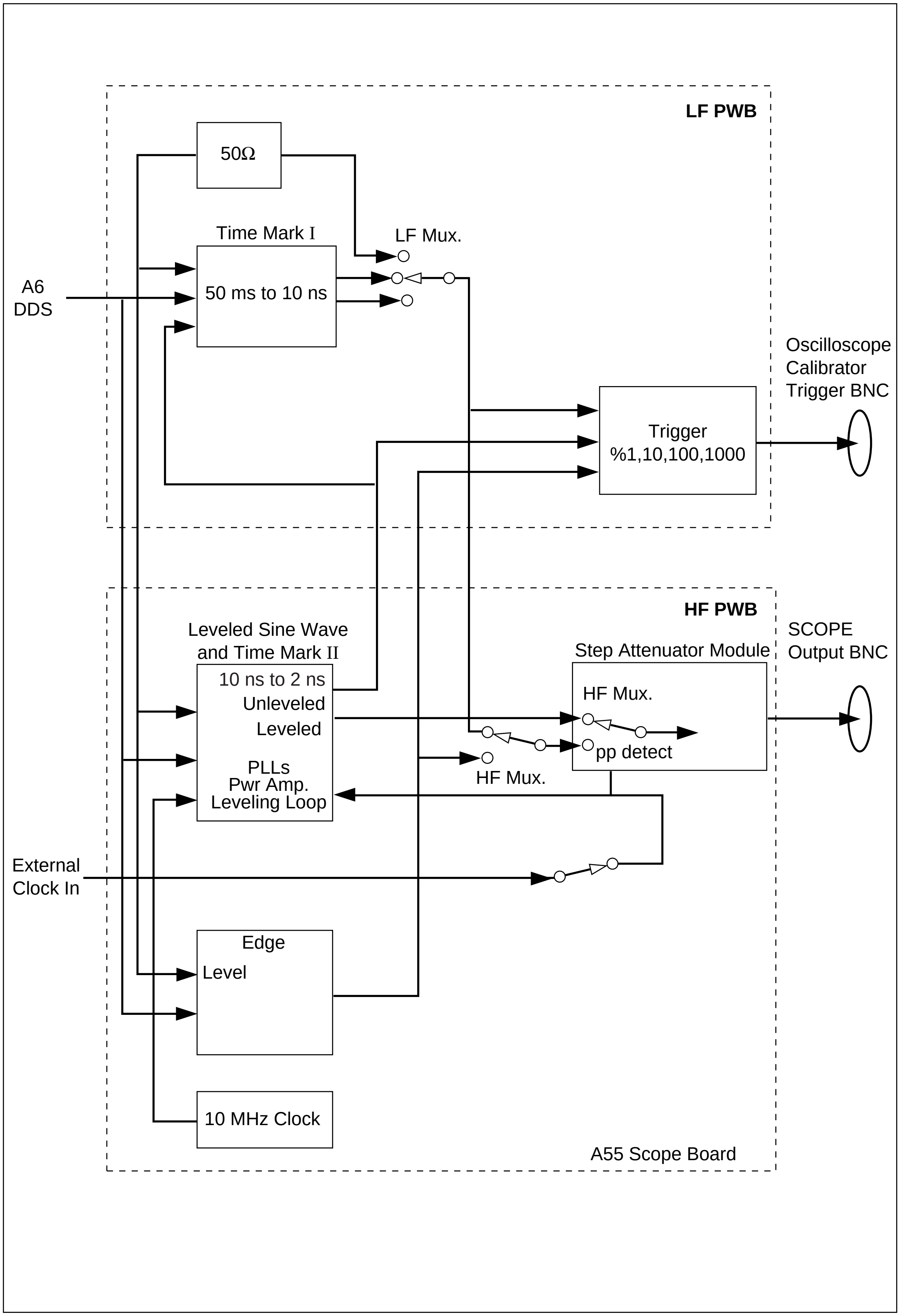

Figure 2-3. Signal Diagram of Scope Module

Chapter 3
Calibration and Verification

Title		Page

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

Instrument	Model	Minimum Use Specifications	
Wave Generator and Edge Amplitude Calibration, AC Voltage and TD Pulser Verification			
Digital Multimeter	HP 3458A	Voltage	1.8 mV to ±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 Ω ± 1% (used with Edge Amplitude Calibration and AC Voltage Verification)	
N to BNC Cable	(supplied with Scope Calibrator)		
Edge Rise Time and Aberrations Verification			
High-Frequency Digital Storage Oscilloscope	Tektronix 11801 with Tektronix SD-22/26 sampling head, or Tektronix TDS 820 with 8 GHz bandwidth	Frequency	12.5 GHz
		Resolution	4.5 mV to 2.75 V
Attenuator	Weinschel 9-10 (SMA) or Weinschel 18W-10 or equivalent	10 dB, 3.5 mm (m/f)	
Adapter		BNC(f) to 3.5 mm(m)	
N to BNC Cable	(supplied with Scope Calibrator)		
Leveled Sine Wave Amplitude Calibration and Verification			
AC Measurement Standard	Fluke 5790A	Range	5 mV p-p to 5.5 V p-p
		Frequency	50 kHz
Adapter	Pomona #1269	BNC(f) to Double Banana Plug	
Termination		Feedthrough 50 Ω ± 1%.	
Spectrum Analyzer	HP 85922 Only used for the GHZ Option Leveled Sine Harmonic Test		
N to BNC Cable	(supplied with Scope Calibrator)		
DC and AC Voltage Calibration and Verification, DC Voltage Verification			
Digital Multimeter	HP 3458A		
Adapter	Pomona #1269	BNC(f) to Double Banana Plug	
Termination		Feedthrough 50 Ω ± 1%.	
N to BNC Cable	(supplied with Scope Calibrator)		

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

Pulse Width Calibration and Verification		
High-Frequency Digital Storage Oscilloscope	Tektronix 11801 with Tektronix SD-22/26 sampling head or Tektronics TDS 820 scope with 8 GHz option.	
Attenuator		3 dB, 3.5 mm (m/f)
Adapter (2)		BNC(f) to 3.5 mm(m)
N to BNC Cable	(supplied with Scope Calibrator)	

Leveled Sine Wave Frequency Verification		
Frequency Counter	PM 6680 with option (PM 9621, PM 9624, or PM 9625) and (PM 9690 or PM 9691)	50 kHz to 600 MHz, <0.15 ppm uncertainty
Adapter	Pomona #3288	BNC(f) to Type N(m)
N to BNC Cable	(supplied with Scope Calibrator)	

Leveled Sine Wave Flatness (Low Frequency) Calibration and Verification			
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)		

Leveled Sine Wave Harmonics Verification		
Spectrum Analyzer	HP 8590A	
Adapter	Pomona #3288	BNC(f) to Type N(m)
N to BNC Cable	(supplied with Scope Calibrator)	

Pulse Period, Edge Frequency, AC Voltage Frequency Verification		
Frequency Counter	PM 6680 with option (PM 9690 or PM 9691)	20 ms to 150 ns, 10 Hz to 10 MHz: <0.15 ppm uncertainty
N to BNC Cable	(supplied with Scope Calibrator)	

Edge Duty Cycle		
Frequency Counter	PM 6680	
N to BNC Cable	(supplied with Scope Calibrator)	

Overload Functional Verification		
Termination		Feedthrough 50 Ω ± 1%.
N to BNC Cable	(supplied with Scope Calibrator)	

MeasZ Resistance, Capacitance Verification		
Resistors		40 Ω, 60 Ω, 600 kΩ and 1.5 MΩ nominal values
Capacitors		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)	

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

Leveled Sine Wave Flatness (High Frequency) Calibration and Verification			
Instrument	**Model**	**Minimum Use Specifications**	
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 (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)		
Leveled Sine Wave Frequency, Time Marker Verification			
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: <0.15 ppm uncertainty	
Adapter	Pomona #3288	BNC(f) to Type N(m)	
N to BNC Cable	(supplied with Scope Calibrator)		
Wave Generator Verification			
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

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.

3-4. Scope Calibrator Calibration Setup

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 (OPR STBY).

Much of the Scope Calibrator can be calibrated interactively from the front panel. Enable the Scope Calibrator and wait at least 5 minutes. Enter 5800A Cal mode by pressing the front panel **SETUP** key, **CAL** blue softkey, and **5800A 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 each equipment's operating manual 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.

3-5. 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.

3-6. 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.

3-7. 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.

Table 3-2. Voltage HP3458A Settings

Voltage 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.

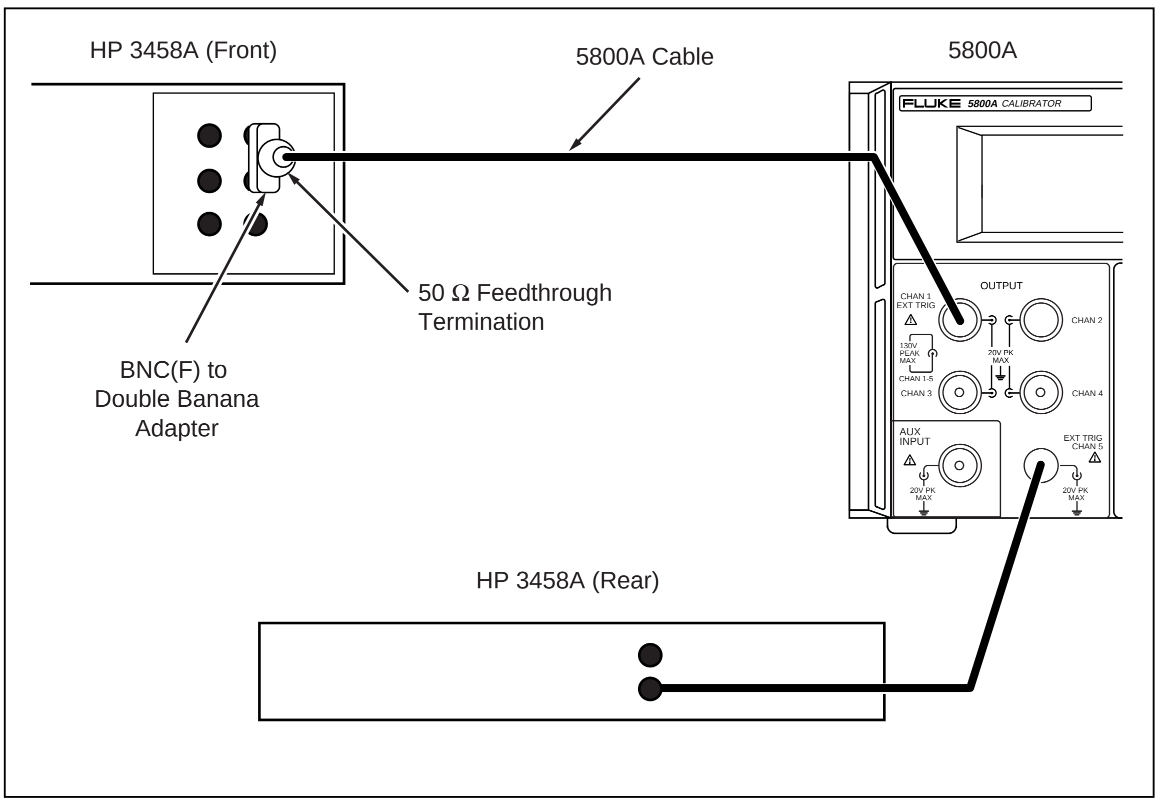

Figure 3-1. Setup for Scope Calibrator Voltage Square Wave Measurements

3-8. 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 3-3.

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

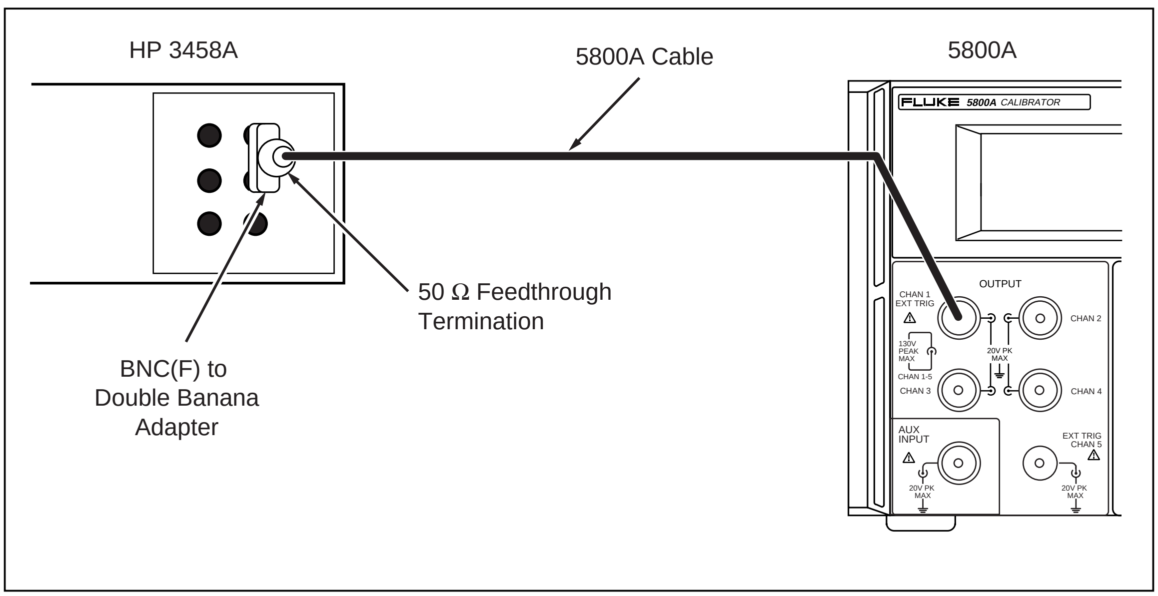

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Figure 3-2. Setup for Scope Calibrator Edge and Wave Gen Square Wave Measurements

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.

3-9. 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.

Set the Calibrator Mainframe in Scope Cal mode, DC Voltage section. 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 V DC ± 10 μV. 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, μ, 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.

3-10. 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.

3-11. 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.

3-12. 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 Ω 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 + Rload)/Rload), where Rload = actual feedthrough termination resistance.

3-13. Leveled Sine Wave Amplitude Calibration

This procedure uses the following equipment:

- HP 437A Power Meter
- 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.
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 [OPR STBY] to activate operating mode on the Calibrator Mainframe.
5. Allow the 5790A rms reading to stabilize. Multiply the 5790A reading by (0.5 * (50 + Rload) / Rload), where Rload = 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.

6. 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.

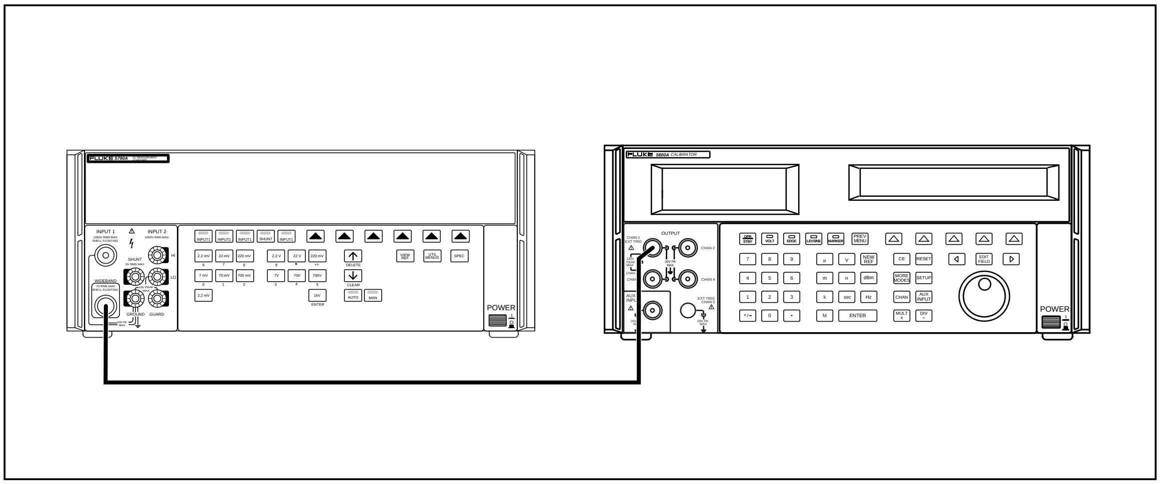

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Figure 3-3. Connecting the Calibrator Mainframe to the 5790A AC Measurement Standard

3-14. 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".

3-15. 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.

1. Press the **GO ON** blue softkey.
2. 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.

3-16. 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.

3-17. 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.
2. 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.

3. 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

4. Press the **GO ON** blue softkey.
5. 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.
6. 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.
7. 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.

8. 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.

3-18. MeasZ Calibration

The MeasZ function is calibrated using resistors and a capacitor 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 an 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 Ω, 60 Ω, 600 kΩ and 1.5 MΩ 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

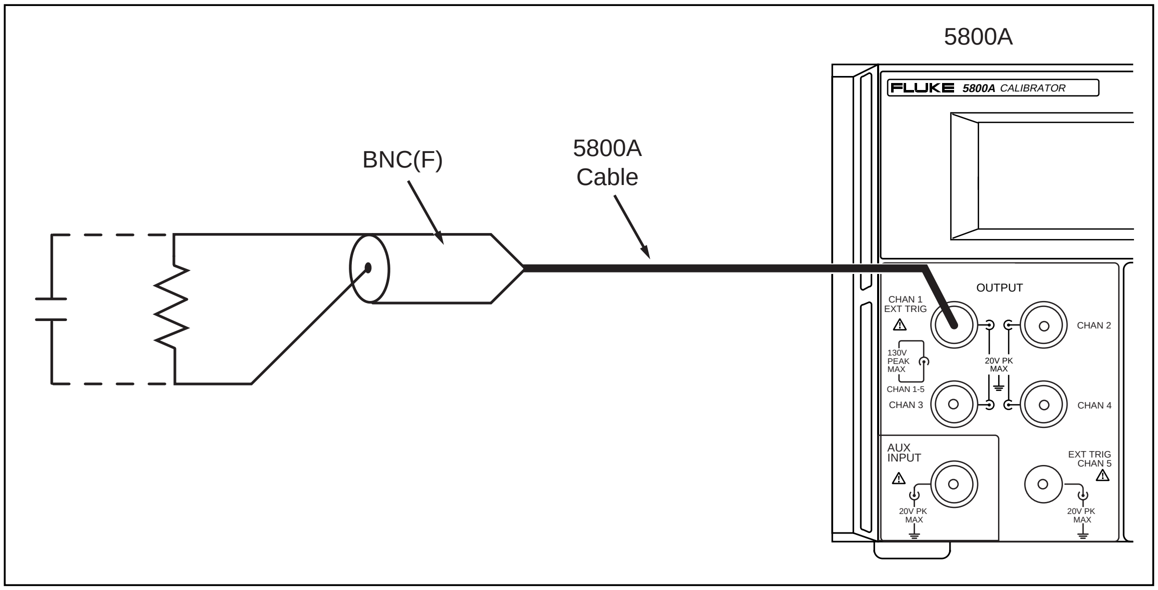

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Figure 3-4. Setup for MeasZ Calibration

Set the Calibrator Mainframe in Scope Cal mode at the prompt to connect a 40 Ω 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 Ω resistance.
2. Press the **GO ON** blue softkey.
3. Enter the actual 40 Ω resistance.
4. When prompted by the Calibrator Mainframe, disconnect the 40 Ω resistance and connect the 60 Ω resistance.
5. Press the **GO ON** blue softkey.
6. Enter the actual 60 Ω 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 Ω resistance and connect the 0.6 MΩ resistance to the end of the N to BNC cable.
8. Press the **GO ON** blue softkey.
9. Enter 0.6 MΩ resistance
10. When prompted by the Calibrator Mainframe, disconnect the 0.6 MΩ resistance and connect the 1.5 MΩ 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 MΩ 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.

3-19. Leveled Sine Wave Flatness Calibration (GHz Option)

Leveled Sine Wave Flatness Calibration is only applicable if the 5800A has the GHz Option installed. This calibration procedure uses the same equipment as in the 5800A Leveled Sine Wave Flatness (High Frequency) calibration procedure. See the GHz insert for details.

3-20. 5800A-5 Option

The 5800A-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 5800A is equipped with the 5-channel option, the Mainframe will indicate when to move the DMM to the next channel.

3-21. 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 and instruments 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 each equipment’s operating manual 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.
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.

3-22. DC Voltage Verification

This procedure uses the following equipment:

- Hewlett-Packard 3458A Digital Multimeter
- BNC(f) to Double Banana adapter
- 50 Ω 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.

3-23. Verification at 1 M Ohm

For the 1 MΩ 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 MΩ (The blue softkey under **Output @** toggles the impedance between 50Ω and 1 MΩ).

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 [OPR STBY] 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.

3-24. Verification at 50 Ohms

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

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

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 OPR/STBY 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. Multiply the readings by (0.5 * (50 + Rload) / Rload), where Rload = 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 (V dc)	**Measured Value (V dc)**	**Deviation (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 (V dc)	Measured Value (V dc)	Deviation (V dc)	1-Year Spec.
0.5			150 µV
-0.5			150 µV
1.35			362.5 µV
-1.35			362.5 µV
2.19			572 µV
-2.19			572 µV
2.2			572 µV
-2.2			572 µV
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 Ω)			16.5 mV

Table 3-6. DC Voltage Verification at 50 Ω

Calibrator Mainframe 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

3-25. AC Voltage Amplitude Verification

This procedure uses the following equipment:

- Hewlett-Packard 3458A Digital Multimeter
- BNC(f) to Double Banana adapter
- 50 Ω 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.

3-26. *Verification at 1 M Ohm*

For the 1 MΩ 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 MΩ. (The blue softkey under Output @ toggles the impedance between 50 Ω and 1 MΩ.)

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 MΩ Impedance Unless Noted)				
Nominal Value (V p-p)	**Frequency (Hz)**	**Measured Value (V p-p)**	**Deviation (V p-p)**	**1-year Spec. (V p-p)**
0.001	1000			5.5 µV
-0.001	1000			5.5 µV
0.025	1000			17.5 µV
-0.025	1000			17.5 µV
0.11	1000			60 µV
-0.11	1000			60 µV
0.5	1000			255 µV
-0.5	1000			255 µV
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

3-27. *Verification at 50 Ohms*

For the 50 Ω 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 50Ω 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 Ω. (The blue softkey under Output @ toggles the impedance between 50 Ω and 1 MΩ). 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

3-28. 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

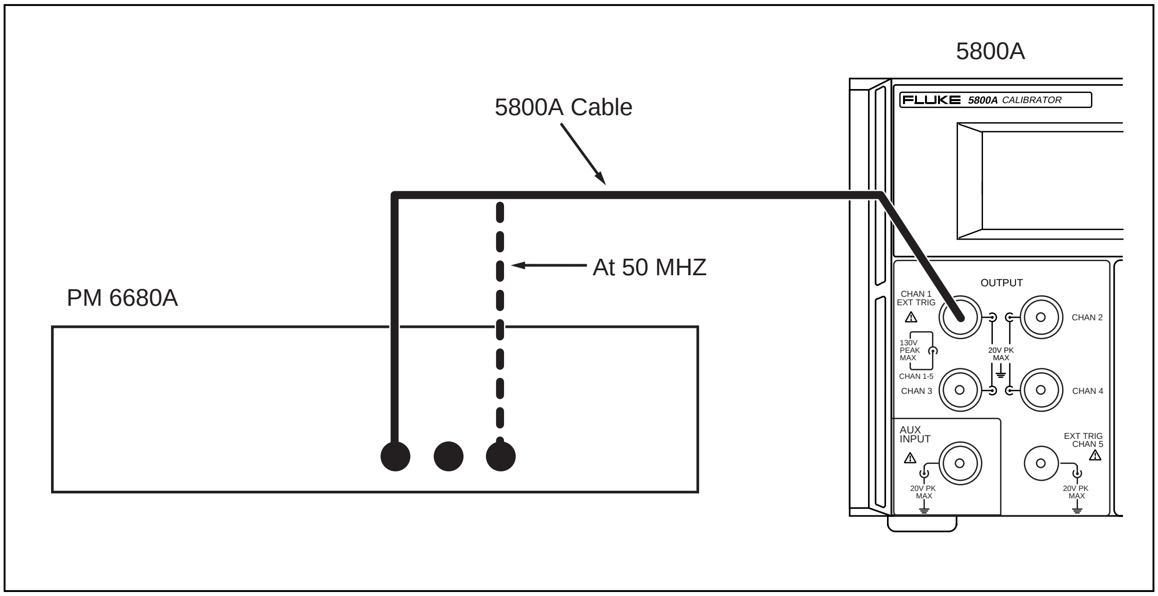

Figure 3-5. Setup for AC Voltage Frequency Verification

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, 1MΩ 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		$10\ E^{-6}$
100 Hz		$100\ E^{-6}$
1 kHz		$1\ E^{-3}$
10 kHz		$10\ E^{-3}$

3-29. 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 3-10.
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 + Rload)/Rload), where Rload = actual feedthrough termination resistance. Record each reading as indicated in Table 3-10.

Table 3-10. 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

3-30. 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 3-11.
4. Allow the PM 6680 reading to stabilize, then record the PM 6680 reading for each frequency listed in Table 3-11. Compare to the tolerance column of Table 3-11.

Table 3-11. Edge Frequency Verification

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

3-31. 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%.

3-32. 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.

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.

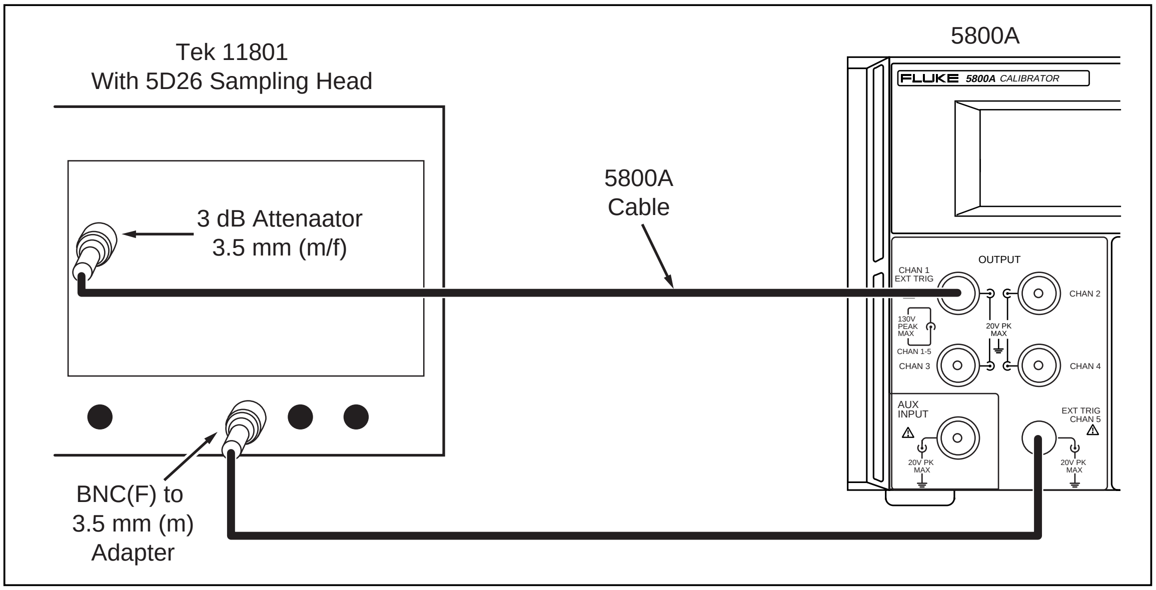

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Figure 3-6. Setup for Edge Rise Time Verification

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 3-12. 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 3-12.
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((Column A)^2 - (SD-22/26 rise time)^2).
4. The edge rise time measured should be less than the time indicated in Table 3-12.

Table 3-12. Edge Rise Time Verification

Calibrator Mainframe Output		DSO Vertical Axis	A	B	
Voltage	Frequency	(mV/div)	11801 Reading	Corrected Reading	Tolerance
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

3-33. Edge Aberrations

The following equipment is needed for this procedure:

- Tektronix 11801 oscilloscope with SD22/26 sampling head
- Output cable provided with the Scope Calibrator

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

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.

With these settings, each vertical line on the oscilloscope represents a 1% aberration. Determine that the Scope Calibrator falls within the typical specifications shown in Table 3-13.

Table 3-13. 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 - 15 ns	< 12 mV (1.2%)
> 15 ns	< 7 mV (0.7%)

3-34. 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 3-14, and compare against the listed tolerance.

Table 3-14. Tunnel Diode Pulser Verification

Nominal Value (V p-p)	Frequency (Hz)	Measured Value (V p-p)	Deviation (V p-p)	1-Year Spec. (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

3-35. Leveled Sine Wave Amplitude Verification

This procedure uses the following equipment:

- 5790A AC Measurement Standard
- BNC(f) to Double Banana Plug adapter
- 50 Ω 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 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 voltage listed in Table 3-15.

4. Allow the 5790A reading to stabilize, then record the 5790A's rms reading for each voltage listed in Table 3-15.
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 + Rload) / Rload), where Rload = the actual feedthrough termination resistance, to correct for the resistance error. Compare result to the tolerance column.

Table 3-15. 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

3-36. 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 Ω 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 3-16. 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 3-16. 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 3-16.

Table 3-16. Leveled Sine Wave Frequency Verification

Calibrator Mainframe Frequency	PM 6680 Settings		PM 6680 Reading	
(Output @ 5.5 V p-p)	**Channel**	**Filter**	**(Frequency)**	**Tolerance**
50 kHz	A	On		0.050 Hz
500 kHz	A	Off		0.500 Hz
5 MHz	A	Off		5.00 Hz
50 MHz	A	Off		50.00 Hz
500 MHz	C	Off		500 Hz

3-37. Leveled Sine Wave Harmonics Verification

This procedure uses the following equipment:

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

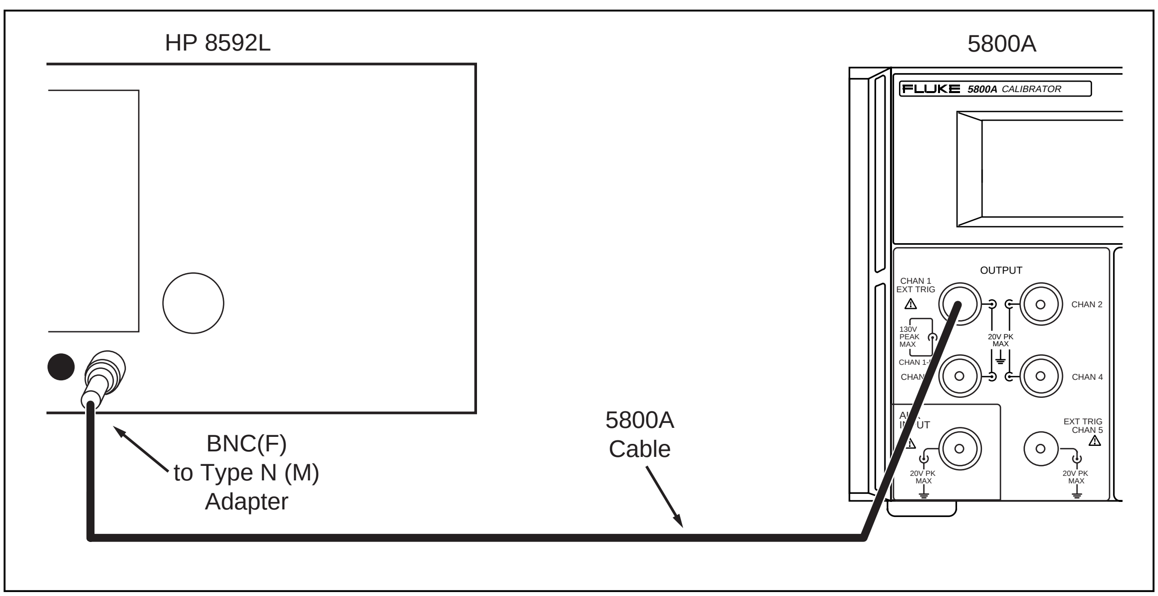

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Figure 3-7. Setup for Leveled Sine Wave Harmonics Verification

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 3-17. 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 3-17. 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 3-17.

Table 3-17. 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		-46 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

3-38. 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.

3-39. 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.

3-40. 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)

3-41. 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 3-18.

1. Program the Calibrator Mainframe for an output of 5.5 V @ 500 kHz. Press OPR/STBY 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 3-18.
3. Enter 50 kHz into the Calibrator Mainframe. Allow the 5790A reading to stabilize, then enter the 5790A reading in Column B of Table 3-18.
4. Enter the next frequency listed in Table 3-18. 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 3-18.
6. Repeat steps 4 and 5 for all of frequencies listed in Table 3-18. Continue until you have completed Columns A and B.
7. When you have completed Columns A and B, press OPR/STBY to remove the Calibrator Mainframe's output. Complete Table 3-18 by performing the calculations for column C. Compare Column C to the specifications listed in the final column.

Table 3-18. Low Frequency Flatness Verification at 5.5 V

Calibrator Mainframe Frequency	A	B 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:

A Enter 5790A Reading (mV) for the present frequency.

B Enter 5790A Reading (mV) for 50 kHz.

C Compute and enter the Calibrator Mainframe Flatness Deviation (%): 100 * ((Column A entry)-(Column B entry))/ (Column B entry)

3-42. High Frequency Verification

This procedure provides an example of testing high 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 3-19. For this voltage range, you will use the model HP 8482A power sensor.

1. Program the Calibrator Mainframe for an output of 5.5 V @ 30 MHz. Press OPR/STBY 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 3-19.

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 3-19.
4. Enter the next frequency listed in Table 3-19. 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 3-19.
6. Repeat steps 4 and 5 for all of frequencies listed in Table 3-19. Continue until you have completed Columns A and B.
7. When you have completed Columns A and B, press [OPR/STBY] to remove the Calibrator Mainframe's output. Complete Table 3-19 by performing the calculations for each column. Compare Column G to the specifications listed in the final column.

Table 3-19. High Frequency Flatness Verification at 5.5 V

Calibrator Mainframe Freq. (MHz)	A	B 10 MHz	C	D	E	F	G	Calibrator Mainframe Flatness Spec. (%)
30								±1.50
70								±1.50
120								±2.00
290								±2.00
360								±4.00
390								±4.00
400								±4.00
480								±4.00
570								±4.00
580								±4.00
590								±4.00
600								±4.00

Complete Columns A-G 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 * (Column A entry)
D	Apply power sensor correction factor for 10 MHz (W): CF * (Column B entry)
E	Compute and enter Error relative to 10 MHz (%): 100 * (sqrt(Column A entry) - sqrt(Column B entry)) / sqrt(Column B entry)
F	Enter the 10 MHz rms Error (%) for 5.5 V from Table 3-18, Column C.
G	Compute and enter the Calibrator Mainframe Flatness Deviation (%): (Column E entry) + (Column F entry)

3-43. *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 Ω impedance.

Set the Calibrator Mainframe to SCOPE mode, with the Marker menu on the display. Press OPR/STBY on the Calibrator Mainframe to activate the output. Then follow these steps to for each period listed in Table 3-20.

1. Program the Calibrator Mainframe to the output as listed in Table 3-20.
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 3-20. 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 kHz = 0.999993655 ms.

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

Table 3-20. Marker Generator Verification

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

3-44. Wave Generator Verification

This procedure uses the following equipment:

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

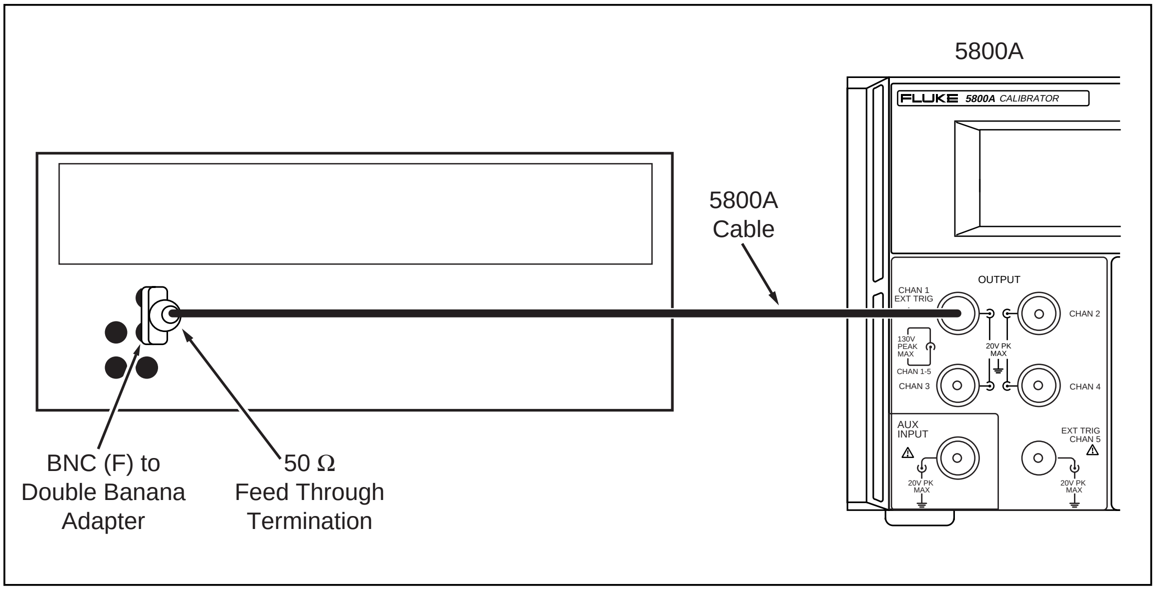

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Figure 3-8. Setup for Wave Generator Function

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.

3-45. Verification at 1 M Ohm

Set the Calibrator Mainframe impedance to 1 MΩ (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 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 3-21.
4. Allow the 5790A reading to stabilize, then record the 5790A rms reading for each wave type and voltage in Table 3-21.
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 3-21. Wave Generator Verification at 1 MΩ

Calibrator Mainframe Wave Type	Calibrator Mainframe output (@ 10 kHz)	5790A Reading (V rms)	Conversion Factor	5790A Reading x Conversion Factor (V p-p)	Tolerance (V p-p)
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

3-46. Verification at 50 Ohms

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 3-22.
4. Allow the 5790A reading to stabilize, then record the 5790A rms reading for each wave type and voltage in Table 3-22.
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 3-22. 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
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

3-47. 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, 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.

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. The Calibrator Mainframe should display the Edge menu. Press OPR/STBY on the Calibrator Mainframe to activate the output. Press the softkey under TRIG to select the TRIG/1 External Trigger output.

Set the DSO to these parameters:

Digital Storage Oscilloscope Setup

Main Time Base position (initial)	40 ns
Vertical scale	200 mV/div
Trigger	source = ext; level = 0.5 V; ext atten = x10; slope = +; mode = auto
Measurement Function	positive width

1. Program the Calibrator Mainframe to output the pulse width and period at 1 V as listed in Table 3-23.
2. Change the horizontal scale of the DSO to the value listed in the table. Adjust the main time base position and vertical offset until the pulse signal is centered on the display. Record the width measurement. Compare to the tolerance column of Table 3-23.

Table 3-23. Pulse Generator Verification: Pulse Width

Nominal Value (V p-p)	Pulse Width (s)	Period (s)	Measured Value (s)	Deviation (s)	1-Year Spec. (s)
0.25	4.0×10^{-9}	1.5×10^{-7}			7.0×10^{-10}
0.25	4.0×10^{-8}	1.5×10^{-7}			2.5×10^{-9}
0.25	4.1×10^{-8}	1.5×10^{-7}			2.6×10^{-9}
0.25	5.0×10^{-7}	1.25×10^{-6}			2.6×10^{-8}
1	4.0×10^{-9}	1.5×10^{-7}			7.0×10^{-10}
1	4.0×10^{-8}	1.5×10^{-7}			2.5×10^{-9}
1	4.1×10^{-8}	1.5×10^{-7}			2.6×10^{-9}
1	5.0×10^{-7}	1.25×10^{-7}			2.6×10^{-8}

3-48. Pulse Skew Calibration and Verification

The skew function was introduced in August 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 this procedure, skew is measured from 30% of the trigger signal amplitude to 30% of pulse range amplitude. As an example, the trigger output is > 1.0 V into 50 Ω, if the pulse amplitude range is 600 mV, the skew would be measured from 180 mV point on the pulse to 300 mV on the trigger.

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. See the Table 3-24 for suggested test values.

Table 3-24. Pulse Skew

Channel	Function	Measurement	Skew	Width	Period	Measured Value	Deviatio n	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

3-49. 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, 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 the pulse width and period (at 2.5 V) as listed in Table 3-25.
4. Allow the PM 6680 reading to stabilize, then record the PM 6680 reading for each period listed for the Calibrator Mainframe.

Table 3-25. Pulse Generator Verification: Period

Nominal Value (V p-p)	Pulse Width (s)	Period (s)	Measured Value (s)	Deviation (s)	1-Year Spec. (s)
1	4.0×10^{-8}	1.5×10^{-7}			1.5×10^{-13}
1	5.0×10^{-7}	0.01			1.0×10^{-8}
1	5.0×10^{-7}	0.02			2.0×10^{-8}

3-50. 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 MΩ, 1 MΩ, 60 Ω, 50 Ω, 40 Ω 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 KΩ nominal value can be achieved by connecting the 1.5 MΩ and 1 MΩ 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

3-51. 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 3-27.

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

3-52. Overload Function Verification

This procedure uses the following equipment:

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

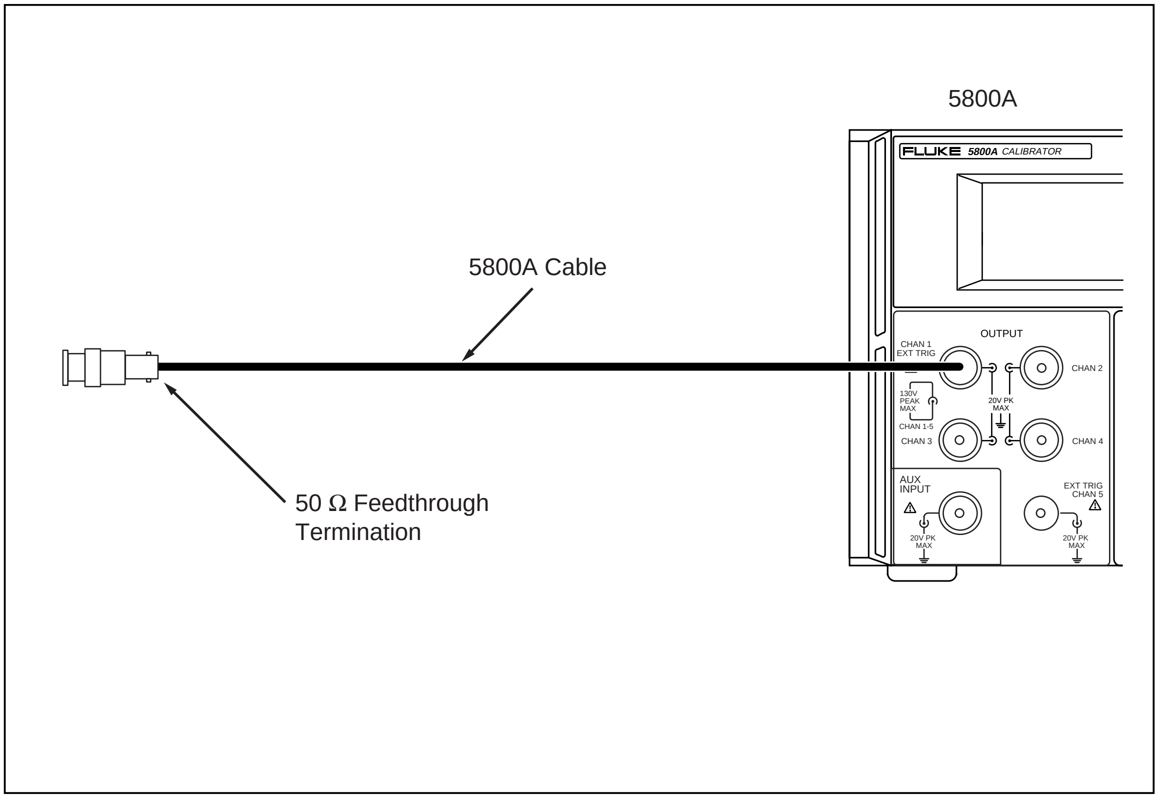

Figure 3-9. Setup for Overload Function Verification

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 Ω feedthrough termination before 60 seconds and verify that Calibrator Mainframe goes to **STBY**.
5. Reconnect the 50 Ω 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 OPR/STBY on the Calibrator Mainframe to activate the output and verify that the **OPR** display timer increments.
8. Remove the 50 Ω feedthrough termination before 60 seconds and verify that Calibrator Mainframe goes to **STBY**.

3-53. Verification Tables for Channels 2-5

The following Verification Tables 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.

3-54. Leveled Sine Flatness

Table 3-28. 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 3-29. 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 3-30. 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 3-31. 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

3-55. Pulse Width

Table 3-32. Pulse Width

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

3-56. Edge Rise Time Verification (All Channels)

Table 3-33. Edge Rise Time

Channel	Function	Measurement	Amplitude	Frequency	Measured Value	Deviation	Spec (s)
1	edge	rise time	0.025	1000000			3.00E-10
1	edge	rise time	0.25	1000000			3.00E-10
1	edge	rise time	1	1000000			3.00E-10
1	edge	rise time	2.5	1000000			3.00E-10
1	edge	rise time	2.5	10000000			3.50E-10

Table 3-34. 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 3-35. 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 3-36. 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 3-37. 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

3-57. Pulse Skew

Table 3-38. 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

3-58. Channel 2 DMM Input

Table 3-39. Levsine Amplitude

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

Table 3-40. DC Voltage 1MΩ

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 3-41. AC Voltage 1MΩ

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 3-42. Edge Amplitude

Channel	Function	Measurement	Amplitude	Frequency	Measured Value	Deviation	Spec (Vp-p)
2	edge	amplitude	2.5	100000			0.0502
2	edge	topline aberr. 15 ns	2.5	100000			0.0145

3-59. Channel 3 DMM Input

Table 3-43. Levsine Amplitude

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

Table 3-44. DC Voltage 1MΩ

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 3-45. AC Voltage 1MΩ

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 3-46. Edge Amplitude

Channel	Function	Measurement	Amplitude	Frequency	Measured Value	Deviation	Spec (Vp-p)
3	edge	amplitude	2.5	100000			0.0502
3	edge	topline aberr 15 ns	2.5	100000			0.0145

3-60. Channel 4 DMM Input

Table 3-47. Levsine Amplitude

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

Table 3-48. DC Voltage 1MΩ

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	130			0.032525
4	dcvh	-130			0.032525

Table 3-49. AC Voltage 1MΩ

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	130	1000			0.32504
4	acvh	amplitude	130	1000			0.065005
4	acvh	topline aberration	130	1000			0.6501
4	acvh	baseline aberration	130	1000			0.6501
4	acvh	offset	-130	1000			0.32504
4	acvh	amplitude	-130	1000			0.065005
4	acvh	topline aberration	-130	1000			0.6501
4	acvh	baseline aberration	-130	1000			0.6501

Table 3-50. Edge Amplitude

Channel	Function	Measurement	Amplitude	Frequency	Measured Value	Deviation	Spec (Vp-p)
4	edge	amplitude	2.5	100000			0.0502
4	edge	topline aberr. 15 ns	2.5	100000			0.0145

3-61. Channel 5 DMM Input

Table 3-51. Levsine Amplitude

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

Table 3-52. DC Voltage 1MΩ

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 3-53. AC Voltage 1MΩ

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 3-54. Edge Amplitude

Channel	Function	Measurement	Amplitude	Frequency	Measured Value	Deviation	Spec (Vp-p)
5	edge	amplitude	2.5	100000			0.0502
5	edge	topline aberration	2.5	100000			0.0145

3-62. Capacitance

Table 3-55. Capacitance (All Channels)

Channel	Function	Measurement	Value	Measured Value	Deviation	Cap (F)
1	measz	capacitance	1.00E-12			5.50E-13
1	measz	capacitance	1.30E-11			1.15E-12
1	measz	capacitance	4.00E-11			2.5E-12
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

3-63. Hardware Adjustments

Hardware adjustments must be made to the leveled sine and edge functions each time the 5800A 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.

3-64. 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 5800A
- Spectrum Analyzer (Hewlett-Packard 8590A)

3-65. 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.

3-66. 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 OPR/STBY 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.

3-67. 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 the diagram) 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.

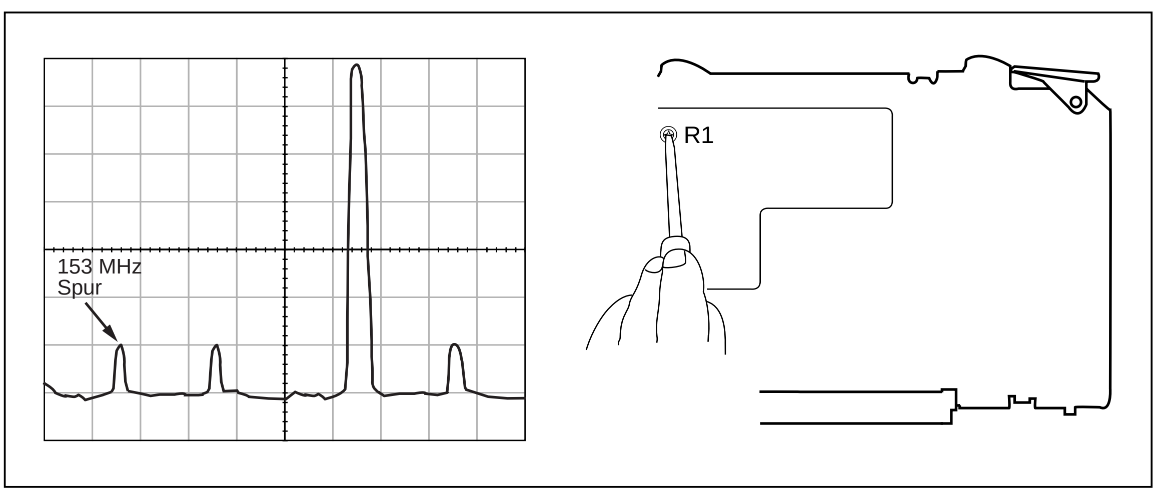

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Figure 3-10. Adjusting the Leveled Sine Wave Balance

3-68. *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

2. 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.
3. 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.

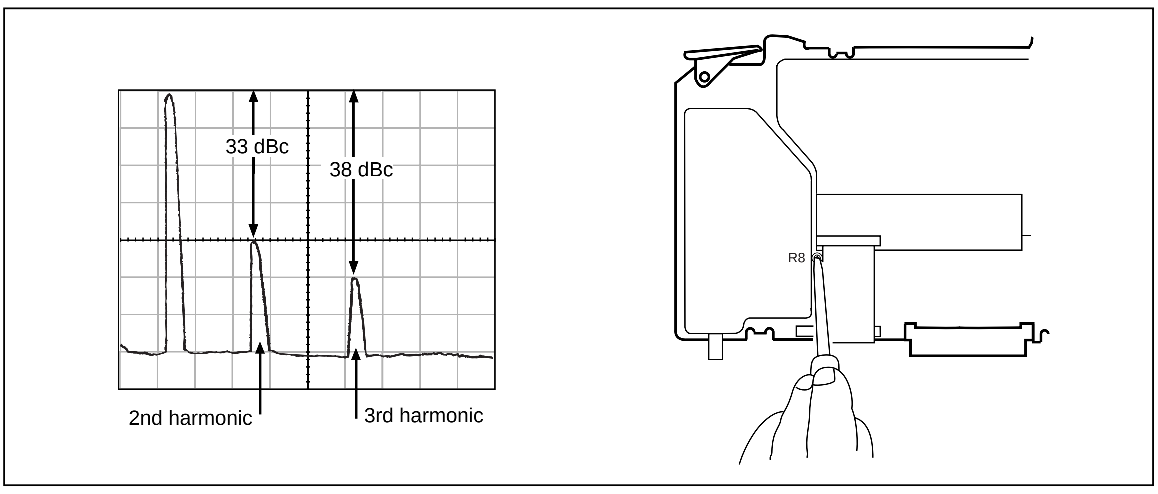

Figure 3-11. Adjusting the Leveled Sine Wave Harmonics

3-69. 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 5800A.

3-70. 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 5800A

Before you begin this procedure, verify that the 5800A is in the edge mode (the Edge menu is displayed), and program it to output 1 V p-p @ 1 MHz. Press [OPR/STBY] 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.

3-71. 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.

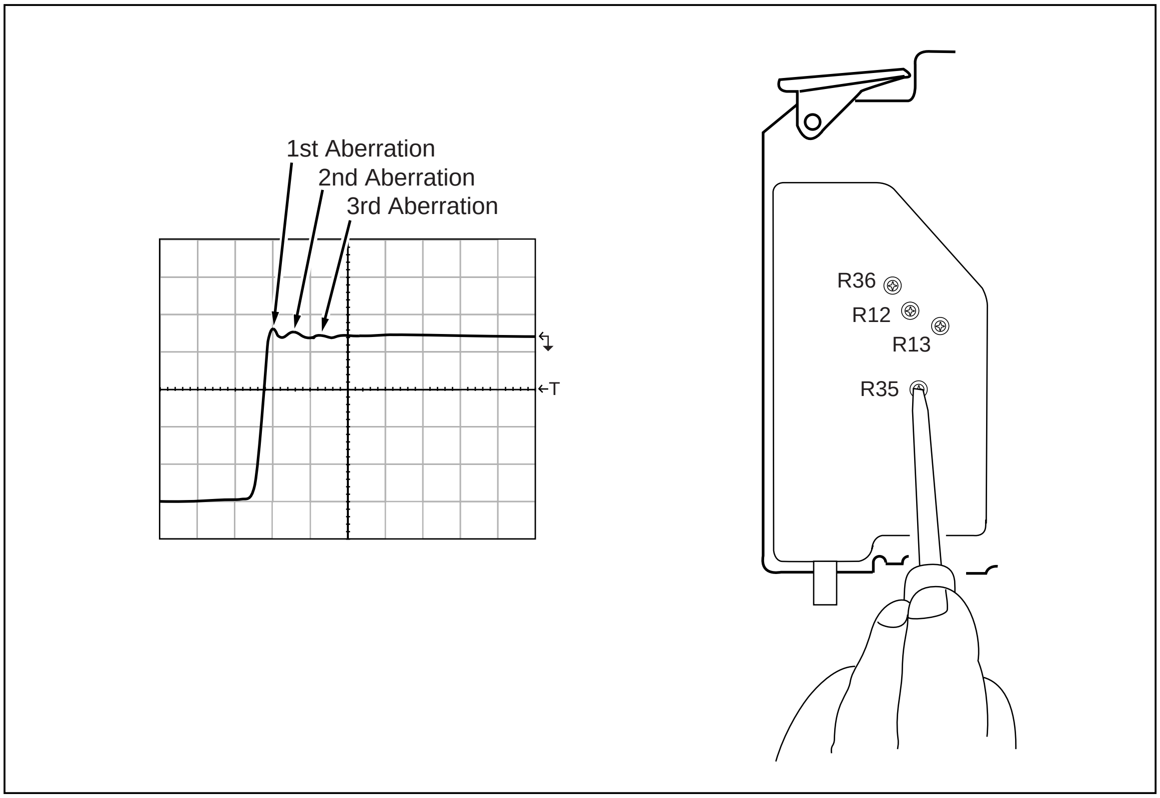

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Figure 3-12. Adjusting Edge Aberrations

Chapter 4
Maintenance

4-1. Introduction

This chapter explains how to perform routine maintenance to keep a normally operating 5800A 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

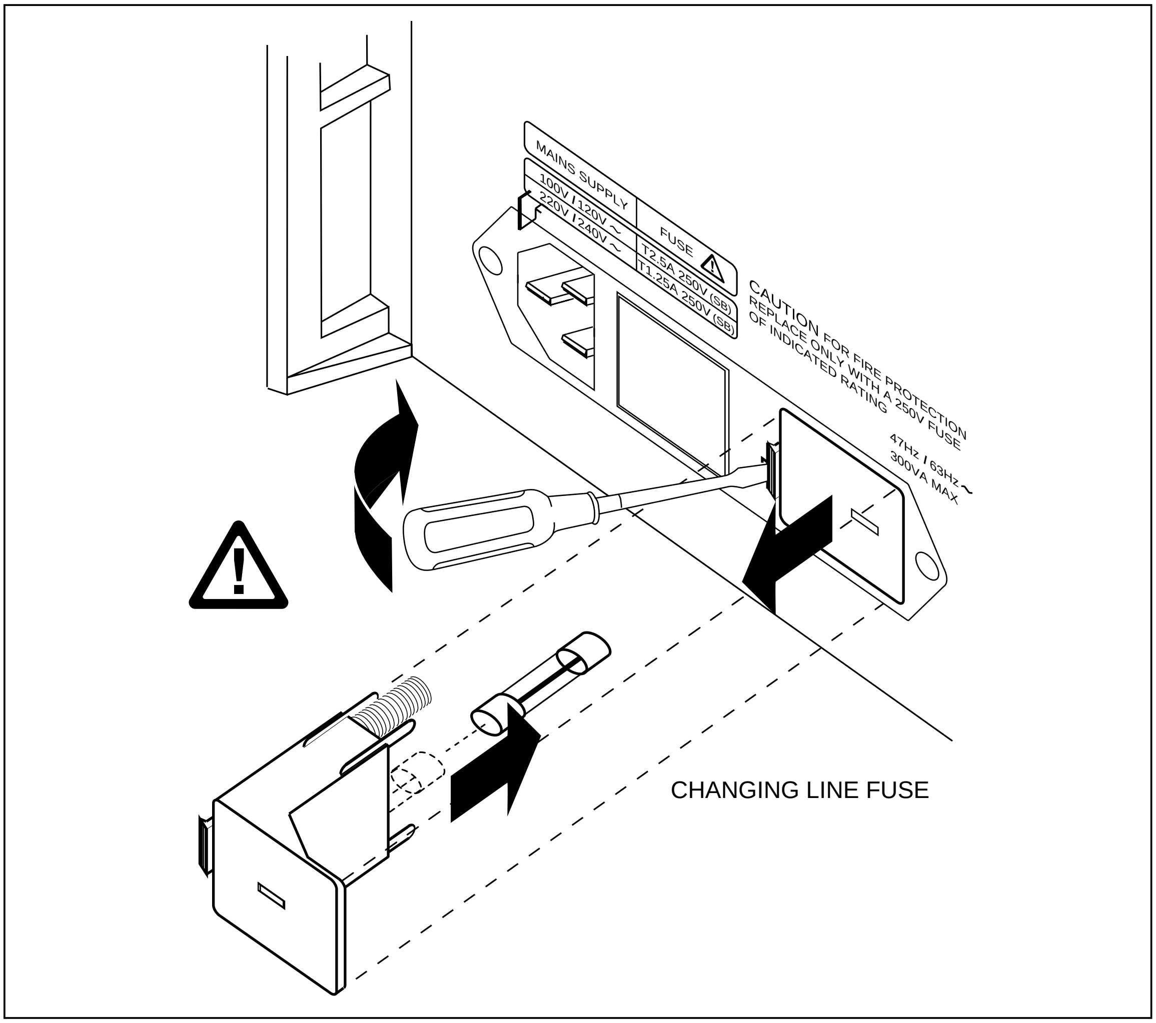

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Figure 4-1. Accessing the Fuse

4-3. Cleaning the Air Filter

⚠ Warning

To avoid risk of injury, never operate or power the 5800A 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.

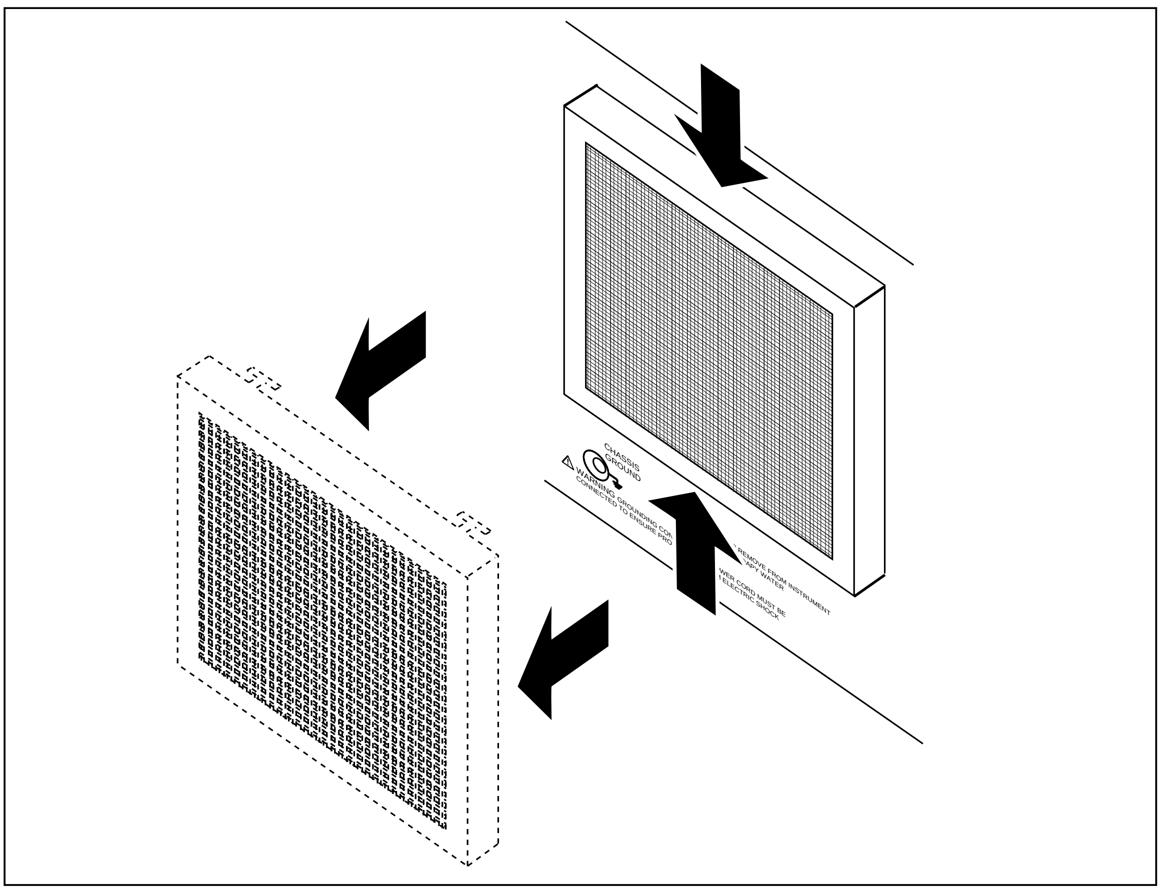

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Figure 4-2. Accessing the Air Filter

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 5800A Calibrator is 1 year beginning on the date received. The warranty is located at the front of this manual.

To contact Fluke, call:

USA and Canada: 1-888-99-FLUKE (1-888-993-5853)
Europe: +31 402-678-200
Japan: +81-3-3434-0181
Singapore: +65-738-5655
Anywhere in the world: +1-425-356-5500

For additional information about Fluke, its products, and services, visit Fluke's web site at:

www.fluke.com

Chapter 5
Options

Title	Page

5-1. Introduction

The following describes an additional option to the standard 5800A Calibrator.

5-2. 5800A-5 Option

The 5800A-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 5800A is equipped with the 5-channel option, the Mainframe will indicate when to move the DMM to the next channel.

5-3. Verification Tables

The following Verification Tables 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 5-1. 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 5-2. 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 5-3. 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 5-4. 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

Table 5-5. Pulse Width

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

Table 5-6. Edge Rise Time

Channel	Function	Measurement	Amplitude	Frequency	Measured Value	Deviation	Spec (s)
1	edge	rise time	0.025	1000000			3.00E-10
1	edge	rise time	0.25	1000000			3.00E-10
1	edge	rise time	1	1000000			3.00E-10
1	edge	rise time	2.5	1000000			3.00E-10
1	edge	rise time	2.5	10000000			3.50E-10

Table 5-7. 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 5-8. 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 5-9. 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 5-10. 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

5-4. Pulse Skew

Table 5-11. 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

5-5. Channel 2 DMM Input

Table 5-12. Levsine Amplitude

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

Table 5-13. DC Voltage 1 MΩ

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 5-14. AC Voltage 1 MΩ

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 5-15. Edge Amplitude

Channel	Function	Measurement	Amplitude	Frequency	Measured Value	Deviation	Spec (Vp-p)
2	edge	amplitude	2.5	100000			0.0502
2	edge	topline aberr. 15 ns	2.5	100000			0.0145

5-6. Channel 3 DMM Input

Table 5-16. Levsine Amplitude

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

Table 5-17. DC Voltage 1 MΩ

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 5-18. AC Voltage 1 MΩ

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 5-19. Edge Amplitude

Channel	Function	Measurement	Amplitude	Frequency	Measured Value	Deviation	Spec (Vp-p)
3	edge	amplitude	2.5	100000			0.0502
3	edge	topline aberr 15 ns	2.5	100000			0.0145

5-7. Channel 4 DMM Input

Table 5-20. Levsine Amplitude

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

Table 5-21. DC Voltage 1 MΩ

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	130			0.032525
4	dcvh	-130			0.032525

Table 5-22. AC Voltage 1 MΩ

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	130	1000			0.32504
4	acvh	amplitude	130	1000			0.065005
4	acvh	topline aberration	130	1000			0.6501
4	acvh	baseline aberration	130	1000			0.6501
4	acvh	offset	-130	1000			0.32504
4	acvh	amplitude	-130	1000			0.065005
4	acvh	topline aberration	-130	1000			0.6501
4	acvh	baseline aberration	-130	1000			0.6501

Table 5-23. Edge Amplitude

Channel	Function	Measurement	Amplitude	Frequency	Measured Value	Deviation	Spec (Vp-p)
4	edge	amplitude	2.5	100000			0.0502
4	edge	topline aberr. 15 ns	2.5	100000			0.0145

5-8. Channel 5 DMM Input

Table 5-24. Levsine Amplitude

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

Table 5-25. DC Voltage 1 MΩ

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 5-26. AC Voltage 1 MΩ

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 5-27. Edge Amplitude

Channel	Function	Measurement	Amplitude	Frequency	Measured Value	Deviation	Spec (Vp-p)
5	edge	amplitude	2.5	100000			0.0502
5	edge	topline aberration	2.5	100000			0.0145

5-9. Capacitance (All Channels)

Table 5-28. Capacitance (All Channels)

Channel	Function	Measurement	Value	Measured Value	Deviation	Cap (F)
1	measz	capacitance	1.00E-12			5.50E-13
1	measz	capacitance	1.30E-11			1.15E-12
1	measz	capacitance	4.00E-11			2.5E-12
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

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